



Assessing the Feasibility of Climate Change Mitigation Project Implementation in the Wandle Valley Regional Park

An Interdisciplinary Qualifying Project Submitted to the Faculty of Worcester Polytechnic Institute in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science

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Date: June 24th, 2009

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Abstract

This project, conducted for Groundwork London, a non-profit environmental agency, examined the feasibility of climate-proofing projects in four Wandle Valley Regional Park sites. To develop these projects we interviewed local council members, analyzed site-specific climate risks and resources using maps, direct observation, and borough council documents, and researched climate-mitigation technologies. Using this information we recommended three projects per site based on local interest, needs, and resources, including solar lighting, planting projects, river restoration, and plans for community access and education.

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Executive Summary

Groundwork London, a non-profit environmental agency, is currently developing a regional park along the nine mile long River Wandle. One of their many concerns in developing this park is climate change (C-Change) mitigating strategies. Climate change impacts specific to London include temperature changes, seasonal rainfall fluctuations, and the urban heat island effect, which stem from carbon emissions. Urban green spaces have the ability to reduce carbon emissions and the urban heat island effect through the natural cooling effect of open spaces and the carbon fixing capacities of plants. Groundwork hopes to take this concept a step further by introducing further climate proofing projects in their parks. Our team analyzed four specific sites: one urban green space in each of the four boroughs (Wandsworth, Merton Sutton, Croydon, and) along the River Wandle: King George's Park, Morden Hall Park, Dale Park, and Wandle Park. These analyses helped us to recommend a variety of projects that can help lessen the impact of climate change.

Objective one was to develop an understanding of the different boroughs, which we achieved through interviewing council members, researching different borough policies, and examining maps. We compiled a database of information on each borough with regard to its background and history, land ownership, climate change policy, open space policy, and political and community issues.

Objective two was to analyze the features, climate risks, and resources of specific open spaces. We selected four dissimilar parks, one from each borough, to illustrate the diversity of the Wandle Valley Regional Park (WVRP). We then analyzed each park using direct observation, historical data, and our background research. We created a chart for each park displaying its features, divided into environmental, regulatory and social, energy use, flood risk, and accessibility.

Objective three was to develop a list of climate change mitigation and environmental restoration strategies for our parks. To reach this objective, we utilized our research from objectives one and two, as well as our background research on climate change mitigation strategies to formulate a chart examining each of our six strategies which could be feasible in the WVRP. We then narrowed down our general chart to show how each strategy could be utilized by each of our specific parks.

Objective four was to determine community interest in our general climate change mitigation strategies in the parks. This was achieved through a survey we conducted at the Wandle Valley Festival in conjunction with Groundwork London and Natural London. Using the survey results, which we examined thoroughly in a categorized chart, we were able to refine our general list into specific projects to suggest to Groundwork for each park.

Our first deliverable was to summarize what the climate change mitigation capacities were for our strategies. We examined charts and utilized our background research to discern the costs, benefits, carbon offsetting, and future implications of each of our final strategies, which were alternative energy, planting, green education, accessibility, and biofuels. After this analysis, we were able to make our park-specific project suggestions.

For King George's Park in Wandsworth, our team suggested retrofitting approximately half of the 101 lampposts with solar paneled lighting, using signage and maps to improve accessibility in the park, and planting projects in specific areas.

For Morden Hall Park in Merton, our team suggested a continuation of the National Trust's 'Hub of the Park' project, which is directed towards rendering the park sustainable by fixing their hydroelectric water wheel and retrofitting 19th century buildings with modern green technology. We then identified a potential to implement a water storage and reuse system, using water from the marshland and side streams. Finally, we suggested converting to biodiesel use because the use of red diesel mowers in the park goes against its carbon-efficient goal.

For Dale Park in Sutton, our team suggested green education programs due to the highly residential surroundings of the park. Also, we suggested planting projects, such as ivy to cover the vandalism on the park's fences and to encourage local interest and access to the park. Finally, solar paneled lighting along the walkway within the park based on the interest in solar panels indicated by Sutton locals in our survey as well as to encourage citizen use by allaying safety concerns.

For Wandle Park in Croydon, our team suggested supporting the developing project to remove the culvert of the River Wandle based on the local citizen and council interest in the project as well as the restoration of the natural landscape, planting projects based on the citizen interest indicated in our survey, and green education programs based on the citizen interest and to increase community involvement in the park.

In suggesting these projects, we have given Groundwork and the local borough councils a framework for future analysis of each park, and climate change mitigation strategies. We have collected a lot of supporting information from direct observation, desktop research and survey work, interviews and the examination of maps. We then used this collected information to devise project descriptions (i.e. planting in King George's Park) based on a cross reference and analysis of the data mentioned. The results of our project will aid Groundwork in the future development of the Wandle Valley Regional Park.

Introduction

The reality of climate change is growing increasingly apparent. According to Jones and Alexander of the Hadley Centre for Climate Prediction and Research (2000), there has been “a significant increase in winter [rainfall totals] and winter half-year precipitation contrasting with a significant decrease in summer [rainfall totals] and summer half-year precipitation” in the last century in England and Wales (Alexander & Jones, 2000, p. 6). These increases in rainfall over the winter have increased flooding in London in flood catchment areas, close to rivers such as the Thames. This increase is due to temperature fluctuations from greenhouse gas containment and thinning of the ozone layer.

Strategies for mitigating and reversing climate change effects are rapidly developing. Green spaces are a useful tool for combating climate change in urban areas because vegetation can absorb excess rainfall that would otherwise cause flooding (Peng et. al) Green spaces also reduce the amount of fixed carbon which is in part responsible for the greenhouse effect since the vegetation uses carbon dioxide in respiration and produces oxygen. Also, the displacement of heat is regulated by this vegetation and reduces the Urban Heat Island effect, which is caused by materials with high thermal conductivity such as asphalt. Studies have determined that urban parks not only effectively collect storm water but also can reduce carbon in urban settings, making parks an important part of climate change mitigation strategy.

Groundwork London is a non-profit environmental agency spearheading the initiative to create a regional park along the River Wandle in southwest London. This regional park would not only mitigate climate change by inducing carbon reduction and rainwater runoff regulation but also provide the four boroughs along the river a useful resource and regional point of pride. At this stage, Groundwork London and its partners, including the National Trust, The Mayor of London, and The South London Partnership, are investigating the feasibility of implementing a park that stretches along the nine mile river.

Groundwork London has laid out a plan for connecting the boroughs of Wandsworth, Merton, Sutton, and Croydon by creating an identity for the Wandle Valley Regional Park. Groundwork has made progress to identify the problems associated with making their vision of the regional park into a reality. This is called the transitional phase plan, or an outline to achieve a continuous open space infrastructure along the River Wandle. Groundwork must address issues

such as regulations set in the London Spatial Plan, community reactions, and budget constraints that may take pose challenges in the implementation of the transitional phase plan.

Our team's project was to help Groundwork London develop a set of potential projects in four specific parks that can be used to mitigate climate change in the Wandle Valley and to create a framework for evaluating these potential projects in light of their ability involve community and support climate mitigation strategies. We first gained an understanding of the boroughs by research and interviews, and then analyzed the boroughs directly by visiting our four specific open spaces. Given this, we cross referenced the information and formed a preliminary list of climate change mitigation strategies that may be implemented in each park. Then, we gauged community interest by a survey given at the Wandle Festival, and then assessed the carbon offsetting potential of each project by research and analysis of alternative energy and planting, along with other indirect carbon offsetting projects (accessibility, green education). Given all these factors, we were able to confidently suggest which projects would be suitable for each specific open space.

Background Chapter

What is Climate Change?

Climate change is both a global issue being addressed by the world and a local issue fought by individuals in concerned areas. Climate change is driven by human forces, such as greenhouse gas emissions. Greenhouse gases come from a wide range of activities including carbon dioxide emissions from automobiles, fluorocarbons from refrigerators and air conditioners, and methane from the cultivation of livestock. The Pew Center of Global Climate Change (2007) suggests that greenhouse emissions are the leading cause of climate change. The report states that : "most of the observed increase in globally averaged temperatures since the mid-20th century is very likely (greater than 90% probability) due to the observed increase in anthropogenic greenhouse gas concentrations" (p. 4).

Climate Change in the UK

Climate change is currently being addressed in the United Kingdom. The United Kingdom Climate Impacts Programme (2007) has suggested based on longitudinal data gathered from the 1960s through the 1990s that "By 2040, average annual temperature for the UK is expected to rise by between 0.5 and 1°C, depending on region" (p. 1). They then predict "by 2100, average annual temperature for the UK is expected to rise by between 1 and 5°C, depending on region and emissions scenario" (The United Kingdom Climate Impacts Programme, 2007, p. 1). Though this temperature rise does not seem all that drastic to the average person, it would make a dynamic change with regard to rising sea levels and glaciers melting, which would be a recreation of conditions that preceded the last Ice Age. The UKCIP also suggests that "extreme sea levels are expected to be experienced more frequently; events could occur up to 20 times more frequently for some coastal locations and emissions scenarios" (p. 2). Given these predictions, several areas of climate change are currently being investigated to curb the damage being done to the environment.

Specific Climate Change Issues in London

London is specifically affected by climate change through increased rainfall and other precipitation, flooding, and the Urban Heat Island Effect, all of which will be explained in

greater detail below. A historically rainy city, London is easily susceptible to the effects of climate change, and is also located right on the Thames River, making flood risk an increasingly more prevalent issue. Also, the Urban Heat Island Effect is a concern due to the industrial nature of the city.

Rainfall

Rainfall in London has been moving along a specific trend in the past several decades. This trend suggests that the summer precipitation totals are dropping while the winter

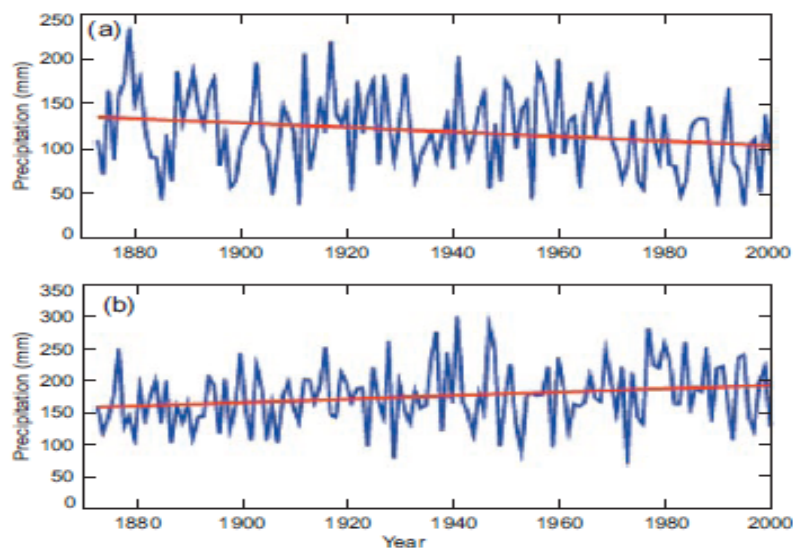


Figure B1: (a) summer precipitation with trend line in south-east England, and (b) winter precipitation with trend line in north-east England.

From: *Updated Precipitation Series for the U.K. and Discussion of Recent Extremes*

precipitation totals are rising. Alexander and Jones of the Hadley Centre for Climate Predictions and Research (2000) have shown that “the downward trend [in participation] is significant at the 95% significance level” (see Figure 1, Graph A) and “The upward trend is significant at the 95% significance level” (Figure 1, Graph B) (Alexander & Jones, 2000, p. 6). UKCIP (2007) concurs, suggesting that “winter precipitation is expected to become more frequent” (p. 2) and also “the number of days when buildings require cooling is expected to increase” (p.1). This situation creates a difficult cycle to overcome considering the rise in temperature will cause a need for more air.

Flooding

Segments of London have a high risk of flooding due to the River Thames and Wandle. British scholars Alexander and Jones (2000) have observed that since the 1960s, there has been a dramatic increase in number of days above the seasonal norm, and a greater variance in precipitation between seasons. Also, the water levels around the United Kingdom have been increasing in recent years, Jenkins, Perry, and Prior (2009) of the Hadley Center for Climate

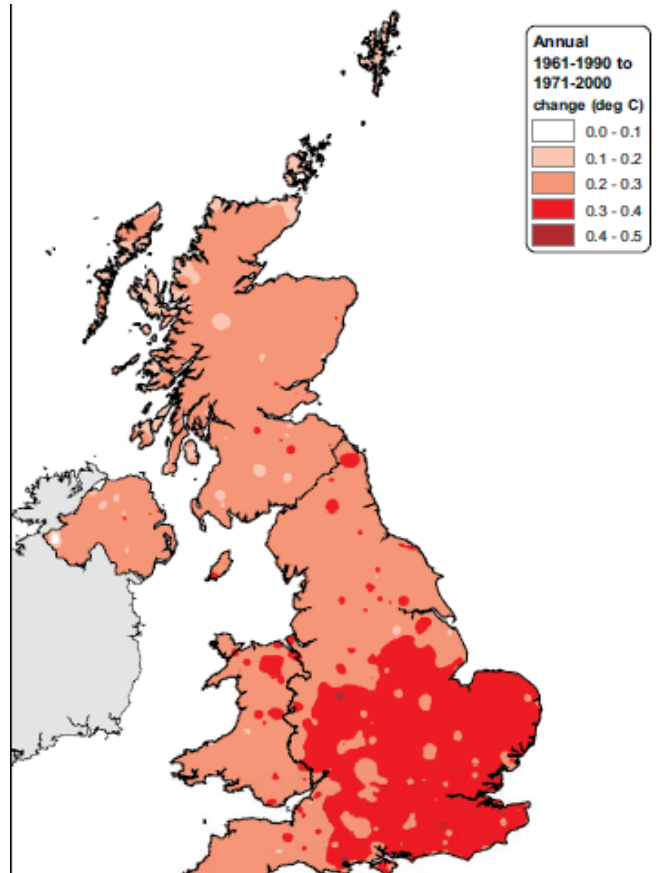


*Figure B2: The flood catchment areas and flood risk areas in the Wandle Valley
From; The Vision, Groundwork*

Prediction stated that “Global sea-level rise has accelerated between mid-19th century and mid-20th century, and is now about 3mm per year. It is likely that human activities have contributed between a quarter and a half of the rise in the last half of the 20th century,” (p. 4). Also, the sea level has been rising specific to the United Kingdom: “Sea level around the UK rose by about 1mm/yr in the 20th century” (Jenkins, Perry, & Prior, 2009, p. 4). While the Thames Barrier is functional to prevent flooding along the Thames River, much of the land along the River Wandle is considered a flood risk area, since no barrier currently exists there, as Figure 2 displays.

Temperature Fluctuations

Temperature in London has been increasing in the past several decades. Summers are growing hotter while the winters are becoming wetter and of milder temperature. This change can be clearly seen in the maps provided by the Hadley Center for Climate Prediction and Research's



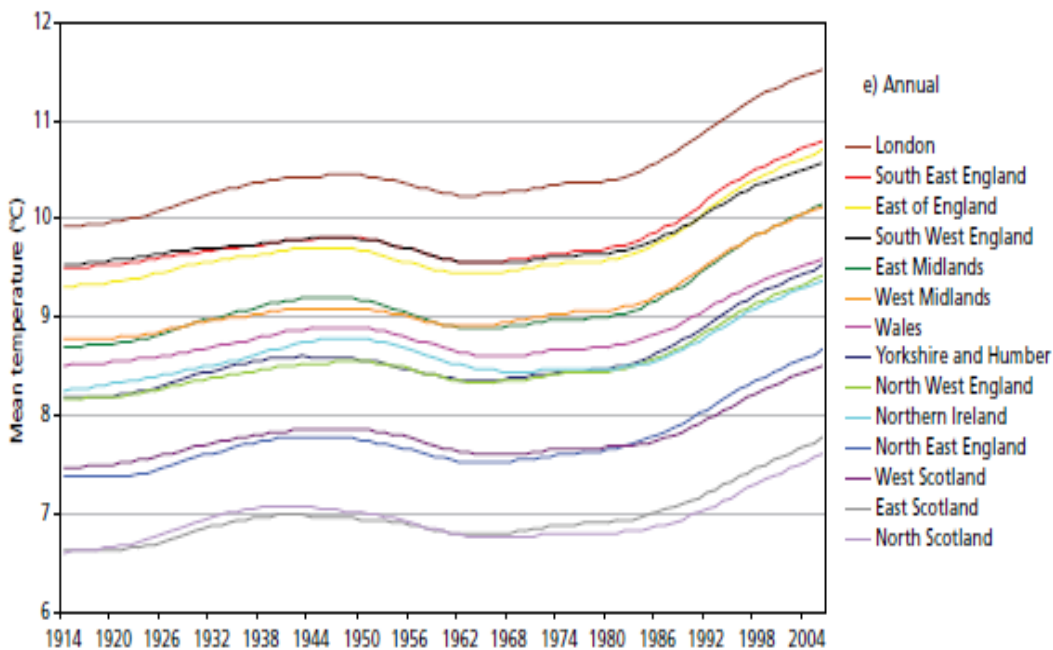
*Figure B3: Annual temperature change between 1961-1990 to 1971-2006.
From The climate of the UK and recent trends*

study, "The climate of the UK and recent trends". Figure 3 shows the change in temperatures from 1961 through 1990 compared against temperatures from 1971-2006. Due to the Urban Heat Island Effect, the southeast of England, which includes London, has a far greater raise in temperature than the more rural areas. This is due to the historical industry in London, and also the recent prevalence of construction in that region. The result of these industrial factors is that southeast England is a prime region for the Urban Heat Island Effect.

Urban Heat Island Effect

The Urban Heat Island Effect suggests that urban areas will have higher temperatures than surrounding rural areas. This variation is due to local emissions, heat radiated from buildings, and the utilization of land that does not allow the displacement of heat. In their article “Urban heat island effect analysis for San Juan, Puerto Rico”, Velazquez-Lozada, Gonzalez, and Winter (2005) present the following explanation of the urban heat island effect.

The urban [land cover and land use] modifies mass and energy exchanges between the surface and the low atmosphere reflected in low relative humidity and high temperatures observed in urban areas when compared to rural areas. These in turn produce a convective circulation over the urban areas, a phenomenon compared to the sea and land breezes, commonly known as heat islands (HI), where the ocean/land temperature difference creates a convective circulation. Using this analogy the urban/rural convective circulation is then called the urban heat island (UHI) effect. (p. 1732)



*Figure B4: Mean Temperatures of United Kingdom cities.
From “The Climate of the UK and recent trends”*

Figure B4 shows that the temperatures in London tend to be annually higher than other areas. These environmental issues need to be addressed to make a more environmentally sound and sustainable London. Our project in conjunction with Groundwork London seeks to use green spaces in order to mitigate this range of effects.

Urban Parks as a Climate Mitigation Strategy

One strategy which is becoming more and more popular worldwide is the use of urban parks to mitigate the effects of climate change. Parks provide greenery, which reduces carbon emissions, provide drainage opportunities for a space within a flood risk area, and also reduce pollution. Parks are also an important community fixture and are aesthetically pleasing.

European Union's GRaBS Initiative

The GRaBS initiative, introduced earlier, is a climate change mitigation plan introduced by the EU to decrease carbon emissions and greenhouse gases by implementing green and blue spaces. The plan states: "Green infrastructure including gardens, parks, productive landscapes, green corridors, green roofs and walls and blue infrastructure such as water bodies, rivers, streams, floodplains and sustainable drainage systems, play a vital role in creating climate resilient development" (GRaBS, 2009, p. 4).

There are four main objectives to the GRaBS initiative. The first is to get the attention of vital European spatial planners to help with the daunting task of planning green and blue infrastructures all throughout Europe. The second is to help countries adapt to the new strategies implemented by the GRaBS initiative, such as urban greenery, which will require cooperation among all key parties involved (planners, stake-holders, communities). The third is to create a "risk and vulnerability assessment tool" (GRaBS, 2009, p. 4) that is cost effective and user friendly. This will aid strategic planning in the target country, and will likely be a feasibility study of some sort. The fourth and final objective is to involve local governments, city officials, and regular people with GRaBS, as it will be much easier if the community is involved to implement the climate change techniques mentioned above.

CITYgreen Model

An example of a GRaBS type project is the CITYgreen model utilized in Nanjing, China. CITYgreen incorporated many of the initiatives upon which GRaBS relies to reduce carbon emissions and mitigate other elements of climate change. The relevance of the CITYgreen model is the emphasis on the use of urban parks to accomplish these goals.

The CITYgreen model is a past study done on the effectiveness of green spaces and runoff reduction. Even though this study was done in Nanjing, China, the results and information obtained is very close to what we would expect from our initiative. The study first calculates the

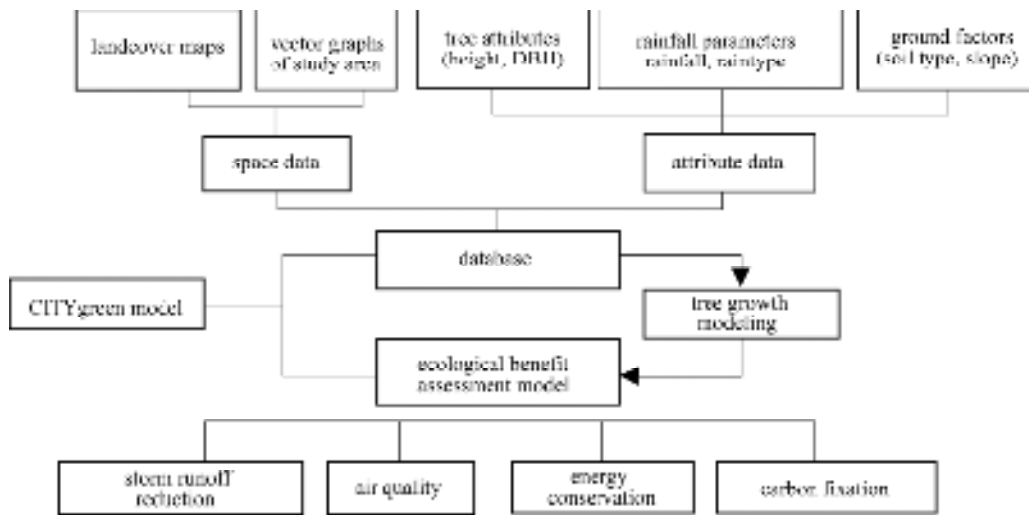


Figure B5: Flowchart for the CITYgreen project

From: CITYgreen Project (Peng et. Al)

area in terms of space data, meaning detailed map and on site analysis. Next, open space attribute data is analyzed, meaning the tree characters, rainfall types and ground factors such as soil types. After the site itself is thoroughly analyzed, the factors concerning the space itself and its key attributes are cross referenced with what type of tree growth scheme should be put into place, meaning whether small shrubs or large forests should be implemented. The benefit to the environment surrounding the open space and the open space itself is considered, meaning the storm runoff reduction, air quality, energy conservation and carbon sequestration are all calculated and referenced against each other. This is shown in a flowchart diagram in Figure B5.

The results of the study look promising and are displayed by Figure B6. Obviously the green spaces showed the most reduction in runoff and greenhouse gasses as compared to industrial spaces. This article will be extremely helpful in writing the methodology section, and

shows how valuable green and blue spaces are to carbon reduction. The CITYGreen model is also a good example of urban parks for flood prevention and climate change mitigation.

Table 2 Ecological benefits of green space within different land use types in the main city of Nanjing

land use types	number of plots	total area/hm ²	carbon storage capacity/t·hm ⁻²	annual carbon sequestration rate/t·hm ⁻² ·year ⁻¹	runoff reduction volume/m ³ ·hm ⁻²
green land	49	128.17	58.61	0.46	185.79
public facility	160	318.70	38.35	0.30	156.23
residential	213	342.82	23.58	0.19	138.35
road and square	11	185.98	23.06	0.18	135.13
industrial	20	387.84	17.88	0.14	124.05
municipal utility	4	3.64	9.08	0.07	108.25
total or average	457	1367.15	28.58	0.22	142.00
main city		24200	30.20	0.24	144.82

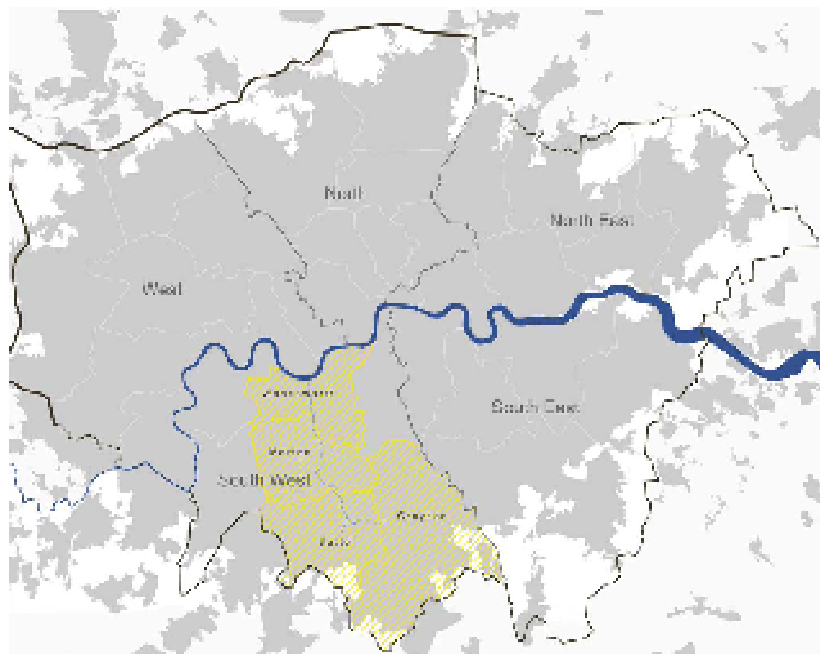
Note: the values of ecological benefits of the main city are calculated with the land use structure and the ecological benefit values of each land use type.

*Figure B6: Benefits of green space in urban settings
From: CITYgreen Project (Peng et. Al)*

The Wandle Valley Regional Park Plan

The Vision and Plan

Groundwork London, a non-profit organization, is working in conjunction with the Greater London Authority and other environmentally focused organizations to carry out the Mayor of London’s London Plan, which is a spatial development strategy to connect green



*Figure B7: The Wandle Valley Region (highlighted in yellow)
From: <http://www.groundwork.org.uk/>*

spaces. The Wandle Valley Regional Park will be an 8000 acre park adjacent to the River Wandle and winding through the Sutton, Merton, Croydon, and Wandsworth boroughs. The geography of the Wandle Valley is illustrated in Figure B7.

Groundwork London's vision of the regional park focuses on "a rich and thriving biodiversity, offering recreational, landscape, heritage, cultural and resource management benefits in which local people and businesses can take pride and ownership" (Groundwork, 2009, p. 2). Groundwork London's goal is to create a park that aids the environment and the economy, defends against climate change, and connects several boroughs both physically and culturally.

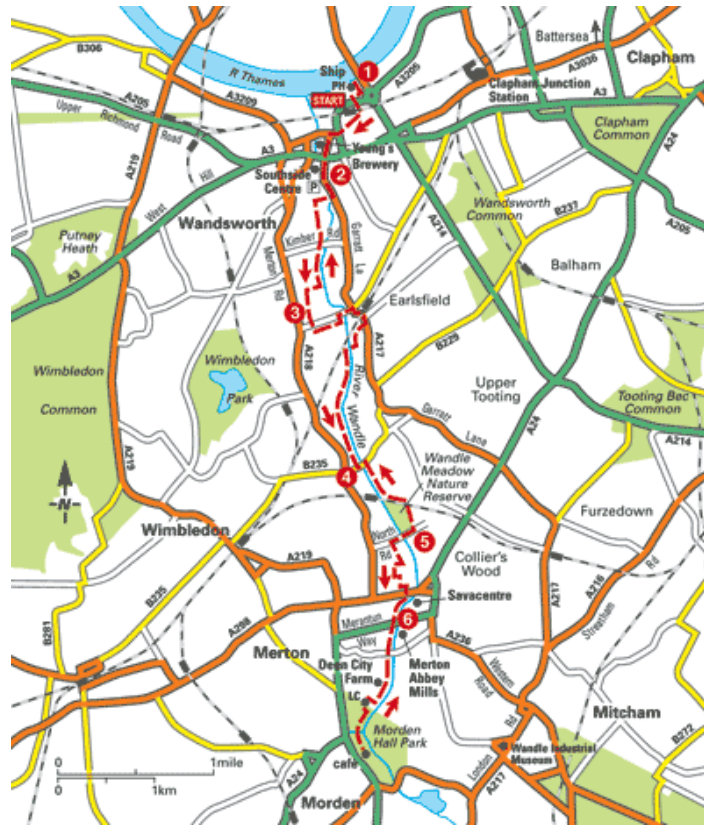
Groundwork London has been planting trees and other forms of vegetation given that this greenery can "offset higher temperatures, filter out pollution, increase evaporative cooling and are permeable...reducing the risk of flooding" (Groundwork, 2009, p. 27). Sustainable Urban Drainage Systems, or SUDS, is an option to use for capturing and controlling runoff. SUDS may also be used as means for flood water storage. The Wandle Valley Regional Park will also help with the reducing carbon dioxide emissions by encouraging "increased use of public transport and promote healthy and low-impact alternatives such as walking and cycling" (Groundwork, 2009, p. 27). Building this park will help the economy in London seeing as it creates jobs and this park should ultimately attract numerous visitors, which support the city's tourism trade.

To connect the different boroughs, Groundwork London is looking into expanding the cross trails into more areas in the Wandle Valley, making the valley easier to access. This will add to the already existing cycling paths through the Wandle Valley and the central road, Route 22, which goes from the north end of the Wandle Valley to the south end.

The Transitional Phase Plan

The Wandle Valley Regional Park will not be created from scratch. The Wandle Valley trail displayed in Figure B8 is an existing trail that follows the River Wandle. Groundwork London hopes to enhance these existing trails and parks, to make them more eco-friendly and resistant to climate change. Currently, Groundwork London and its partners are looking at a transitional phase of "a period of up to two years" because they have to "consolidate the existing partnership, agree boundaries and governance structures for the Regional Park," (Groundwork, 2009, p. 39). This will be achieved by issuing an Implementation Framework, which will "combine strategic

objectives with a spatial plan showing opportunities for interventions and a prioritized action plan for delivering crosscutting, strategic and local projects” (Groundwork, 2009, p. 40). In



*Figure B8: Wandle Valley Trail
From; The Vision, Groundwork*

addition, Groundwork London is in contact with residents and park goers in the surrounding boroughs to sell the very idea of the park. This way, it is hoped, the citizens feel as though they are a part of the design process and thus become open and welcoming to the new park being installed.

Methodology

Introduction

To create our final deliverable, a bank of specific projects tailored to the needs of our four specific boroughs, our team needed to research the needs, wants, and assets first. In what follows we outline our main research objectives and the methods we used to gather the necessary information to create our final deliverable.

Objective One: Develop an understanding of the different boroughs

Our first objective was to develop an understanding of the four boroughs in the Wandle Valley: Wandsworth, Merton, Sutton and Croydon. It was critical for us to learn relevant background information regarding each borough's specific geography, land ownership, climate change policy, open space policy, and community issues to identify appropriate project. In order to complete this objective, we conducted interviews with council members from the available boroughs to discuss community issues, local policies, and existing environmental and sustainability projects. We utilized Groundwork's database of maps to investigate the geography of the parks as well as their connection to the river. Also, our team research the open space policies, councils' climate change documents, and local land agreements to ascertain specific policies within the boroughs as well as borough priorities about the parks and environment. After compiling all this information about each borough were able to use the relevant information to begin the selection of our specific parks and to provide a stable base from which we were able to build our final deliverable.

Objective Two: Analyze the features, climate risks, and resources of specific open spaces

Our second objective was to analyze four specific open spaces (one from each borough along the Wandle). We chose the four specific parks based on our background research, the results from our first objective, and recommendations from Groundwork personnel. Our team decided to pick out very diverse parks, varying in size, assets, and local surrounding. King George's Park, in Wandsworth, is a long expanse of fairly structured and very well maintained

open space. King George's Park is the only park in the Wandle Valley in the borough of Wandsworth, and is unique in its limited accessibility of the River Wandle. Morden Hall Park, in Merton, is the biggest of the four parks, maintains a more natural environment setting and includes many environmentally sound techniques and technologies. Morden Hall Park is also one of the best maintained parks in the Wandle Valley and has a very close proximity to Groundwork, as the Morden Hall Cottage office is within the park. Dale Park, in Sutton, is a small, poorly maintained park in a strictly residential area with limited accessibility other than to local citizens. The unique setting of Dale Park in conjunction with the limited space and facilities would enable us to look at sustainability and climate change in a unique setting when compared with the other parks. Wandle Park in Croydon based on the fact the River Wandle is culverted there. This issue has generated quite a bit of community interest that drew our team towards further investigation.

To analyze the relevant features of the selected parks, we developed charts for observations. We broke down the issues within the park to be environmental, regulatory, social, energy usage, and accessibility. In the environmental analyses, we noted the geography, current plant life, land usage within the park, and flood risk. In the regulatory segment, we noted the current land ownership, building and structures in place, and the surrounding use of land outside of the green spaces. In the social section, we noted current citizen usage, environmental and sustainability projects currently planned or underway, and social clubs and groups that take place in the park. For energy use, we discuss the electrical needs, heating needs of structures, maintenance vehicles, and maintenance frequency. The completed chart is Appendix E1. To complete this chart, our team relied on on-site observational visits, research of borough environmental policy documents, and our background knowledge of climate change issues and prevention measures. The completed charts were then used as grounds and justification for decisions made in our third objective.

Objective Three: Develop a list of possible climate change mitigation and environmental restoration strategies.

After compiling the results from objectives one and two, our team identified relevant strategies from our background that fit the sites to the particular resources, risks, and interests that emerged in the interviews and observations and archival research for climate change

mitigation and environmental restoration. These strategies were developed based on the needs of the Wandle Valley Regional Park as a whole, as well as the borough's climate change mitigation strategies set forth in the policy documents and borough specific needs expressed by council members in the interviews. This allowed us to sort out any ineffective or impossible strategies based on the specific open spaces. Appendix E2 is a chart of general projects as well as their specific needs that we generated to determine the feasibility of implementation based on our specific analyses of the spaces described in objective two. After compiling this list of strategies, it was still instrumental to find out what the local communities would think of our strategies because in order to implement any of our eventual projects, we rely on community involvement.

Objective 4: Gauge Community Interest in Climate Mitigation Strategies in the Parks

In order to gauge the community interest in potential climate change strategies, we used two methods. Our first method was our interviews with council members. In these interviews, council members discussed projects with us that are being considered or are underway based on the interests of their constituents. The second method was to distribute a survey to park-goers at the Wandle Valley Festival, which took place in our specific parks over the course of two days. The survey was done in conjunction with a National England survey on the local opinion on natural features in the Wandle Valley.

Most of the questions pertained directly to our project. The question "What natural features you want to see revitalized in the Wandle Valley?" which was followed by a space to write in answers, though it was a Natural England question, allowed us to see what priorities the citizens had set about park improvements. The question "Would you be willing to volunteer to help with these projects?" where an individual could check yes or no enabled us to see how many citizens were actively willing to aid in environmental projects. The question "Which borough do you currently live in?", where the individuals could check one of the four Wandle Valley boroughs or "other", enabled us to sort our responses and analyze the results on the local level. We also included a series of potential projects, which we determined from our list of potential strategies, and asked the people surveyed to select the three they would be most interested in being implemented into the Wandle Valley Regional Park. The survey form is attached as Appendix RD 1.

Our team worked with Groundwork's assistant community manager and marketing director to develop and distribute this survey. This survey was conducted on June 6th and June 7th, 2009. The surveys were distributed to individuals who attended the festival from different boroughs, which gave us evenly distributed total responses between boroughs.

Conclusion

In addressing these four objectives, we identified the necessary information to develop our final deliverable: a bank of specific projects tailored to each borough's needs, resources and potential risks. In the following sections our team will present our findings and results pertaining to these objectives.

Results

Objective 1: Develop an understanding of the different boroughs

London Borough of Wandsworth

Introduction

Wandsworth is the largest inner borough in London, stretching from Vauxhall to Richmond Park west to east. The borough itself is very rich in open spaces, as 25% of land is open spaces and there are 227 open spaces in total. Wandsworth town, which is the section of the borough tied to the Wandle River, stretches from the Wandle Delta, where it flows into the Thames, to the southern tip of King George's Park, which is our area of interest. This is shown in Figure R1.

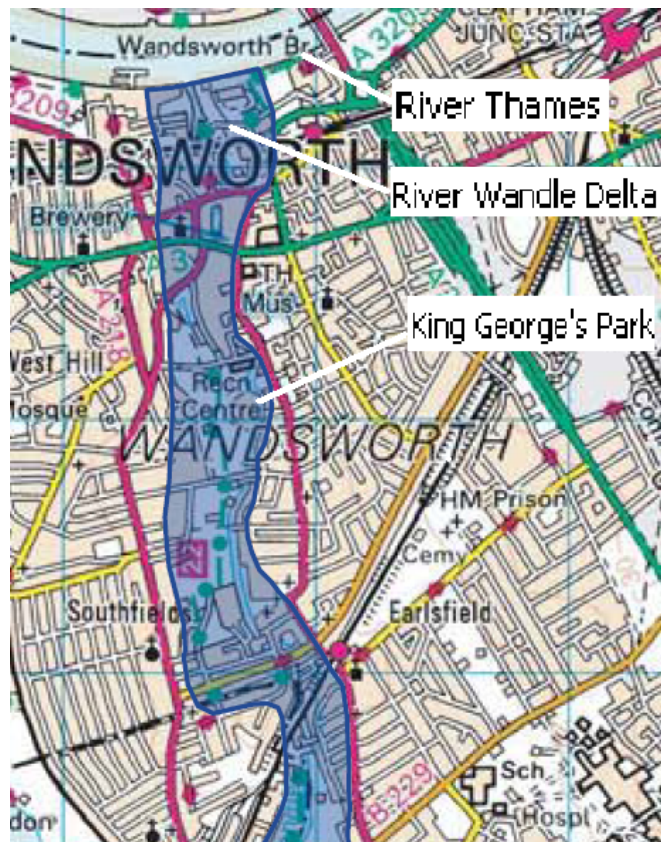


Figure R1: Wandle Delta map
From: Groundwork Map Archives

Wandsworth contains 2.42 kilometers of the Wandle Trail, and one park is in the Wandle Valley, which is King George’s Park. The River Thames is in very close proximity to the park, at 1.15 kilometers. The Thames tidal levels, however are not considered a flooding issue as one may think: “The Environment Agency has confirmed that the extreme tidal levels in Central London do not increase with climate change due to increased use of the Thames Barrier” (Wandsworth, Merton, Sutton & Croydon Councils, 2007, page 3AC).

Land Ownership

In order to understand land ownership and how it affects open space policy, we examined Wandsworth Council’s Open Space Study from 2007. The Figure R2, which was found in Appendix A of the study, displays all land ownership, whether it is public or privately owned land. The figure illustrates that most of the open land is publicly owned (area marked in teal or blue), but there are large open spaces that are owned by private companies (marked in lavender).

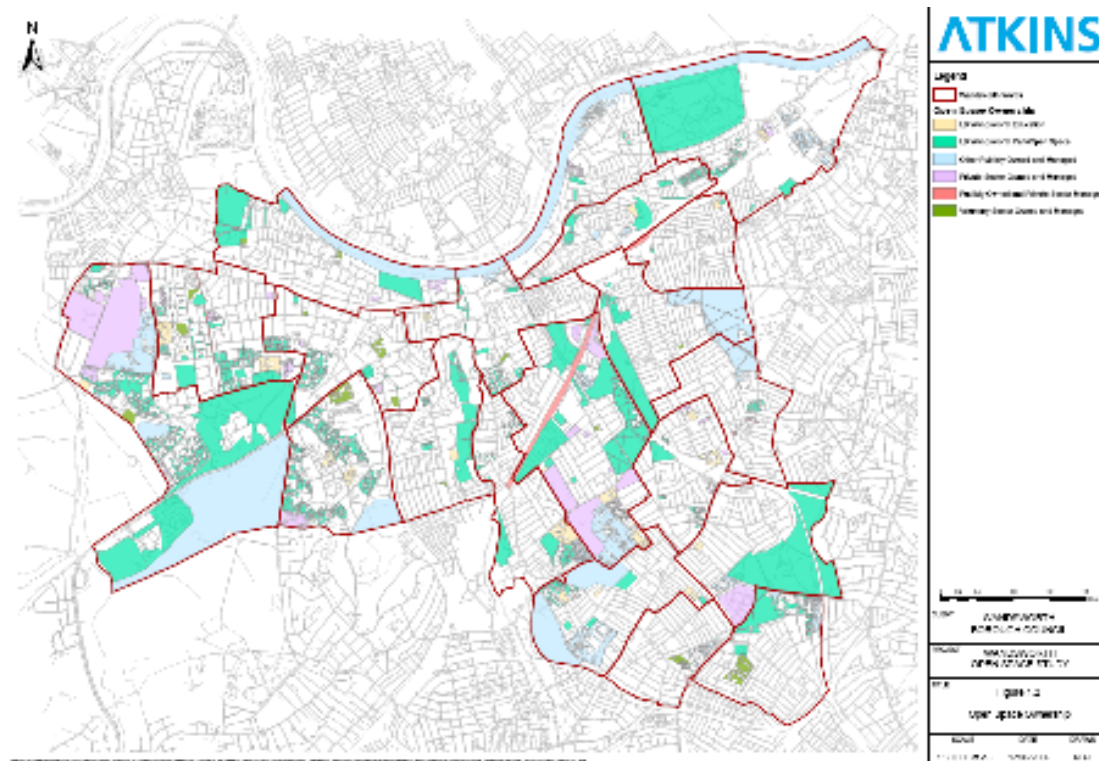


Figure R2: Wandsworth open space ownership
 From: Wandsworth Open Space Study

The publicly owned spaces have unrestricted public access, or access to any citizen for the majority of the time. The other spaces have restrictions on public access which close the spaces off to some. For example, privately owned spaces can be set to restrictions put forth by the owner, or some public facilities like school yards can be restricted from public use as the council sees fit. This figure also shows that there are areas that are severely deficient in open spaces, with some wards not containing an easily accessible open space, and some wards not containing open space with unrestricted access at all. Figure R1 can be viewed in full size in Appendix RA1.

Climate Change Policy

In order to understand environmental and climate change policy, we examined the Environmental Action Plan document. The Environmental Action Plan is a general outline put forth by Wandsworth Borough Council in an attempt to set goals for action on climate change. The plan addresses six objectives which include improving energy efficiency in both domestic and council premises, reducing CO2 emissions, relying more on alternative energy and ensuring efficiency in heating and energy usage. The overall plan is to increase energy efficiency and provide affordable heating services to all of Wandsworth (Wandsworth EAP, 2007, p. 6) . In an interview with Head of Economic Regeneration, Mike Brook, he highlighted that the council is interested in green economy, or usage of alternative energy and less reliance on carbon based fuel sources. It is also stated in this document that Wandsworth is setting the goal to purchase 55% of council energy from renewable sources. This interest in alternative energy looks promising since it ties in with the development of a sustainable Wandle Valley Regional Park.

Open Space Policy

In the Council's policy for land use, one of the key factors for acquiring land is accessibility and transportation in the area. "Developments likely to generate numbers of visitors should be located in areas well served by public transportation." (Wandsworth CIP, 2006, p. 4). Open space accessibility is an issue for the beginning of the Wandle Trail (River Wandle delta) which means people would likely have difficulty following the trail down to King George's Park.

Unfortunately, Wandsworth Council does not have much else in the way of open space policy. The main issues and objectives all tie into sustainability or sustainable transport.

From our interview with Mike Brook and Mandy King (Wandsworth Borough Council Environment Policy officer), the council is interested in using open space policy to their benefit. The council is interested in sustainable energy, and using local energy systems rather than relying on large power companies. This highlights alternative energy usage, and possibly making open spaces a hub for alternative energy implication. This would address the sustainability issues stressed in the Council Implementation Plan and fuse it with the green economy that was raised by Mike Brook.

Transportation and accessibility play a large role in climate change mitigation with respect to urban parks. If a park is easy to get to in an urban setting, people will gravitate towards it and not use electricity by staying in their homes. If there is adequate public transportation near the park and clear walkways people utilizing the park would not have to use cars, which also add to the problem of climate change and the building of greenhouse gasses in the atmosphere. Wandsworth council recognizes the need for better accessibility to parks, which directly affects climate change.

Political and Community Issues

The most insightful perspective on issues in Wandsworth came from our interview with Jennifer Ullman, a Wandsworth and Borough Council consultant, and former Parks Manager. The main issues she raised were the diversity of neighborhoods, and King George's Park. The north end of the park, the district of Wandsworth Town, is a positively developing area with a younger population and improving economy. However, the south end of the park, the district of Southfields, is a more slowly developing area with slightly greater levels of poverty, crime and violence. King George's Park is the area's biggest and most widely used park, as well as the link between Wandsworth Town and Southfields, which means it should be accessible and useful for all of Wandsworth's residents and visitors.

The Wandsworth Local Strategic Partnership is a community bridge between the borough council and the citizens of Wandsworth. Due to sustainability issues, the WLSP has formed a plan named the Sustainable Community Strategy, known better to Wandsworth residents as Our Wandsworth 2018. The plan has a broad scope, and is focused very generally on rendering

Wandsworth 'sustainable' with regard to multiple strategies. One of these aspects is the environment and mitigating climate change, which is addressed by a survey given to Wandsworth citizens and shows that a key problem to be addressed is the need for greater emphasis on energy savings in homes (Wandsworth SCP, 2007). This may point to community interest in energy saving and alternative energy implication in urban parks such as King George's Park.

London Borough of Merton

Introduction

The longest stretch of the Wandle Valley is located in Merton, and it is very important to the Regional Park, containing 8.07 km of the Wandle Trail. Merton contains more open spaces (177) than any other borough in London, including nine parks along the River Wandle (MOSS Summary). Where the average London borough is 10% open spaces, Merton contains 18% open spaces, which shows how important natural areas are to the borough (Merton MOSS, 2007). Also, Merton already has 67 public parks which are used heavily by the population.

Land Ownership

In the 177 open spaces in Merton, there is diversity with regard to ownership and maintenance. The Council identifies this issue in the Merton Open Space Strategy (2005) stating, "An important issue to consider when defining open spaces is ownership and the level of public access. While open spaces are either publicly or privately owned, private ownership does not necessarily indicate decreased public access" (p. 3). One example is Morden Hall Park, which is owned by a charitable organization, the National Trust, but has unrestricted public access. However, some open spaces, such as council owned school yards, have restricted or limited access. This means ownership is mostly on a case by case basis due to informal agreements made for each open space. Classification of open spaces can be viewed in Figure R3 and full sized in Appendix RA2.

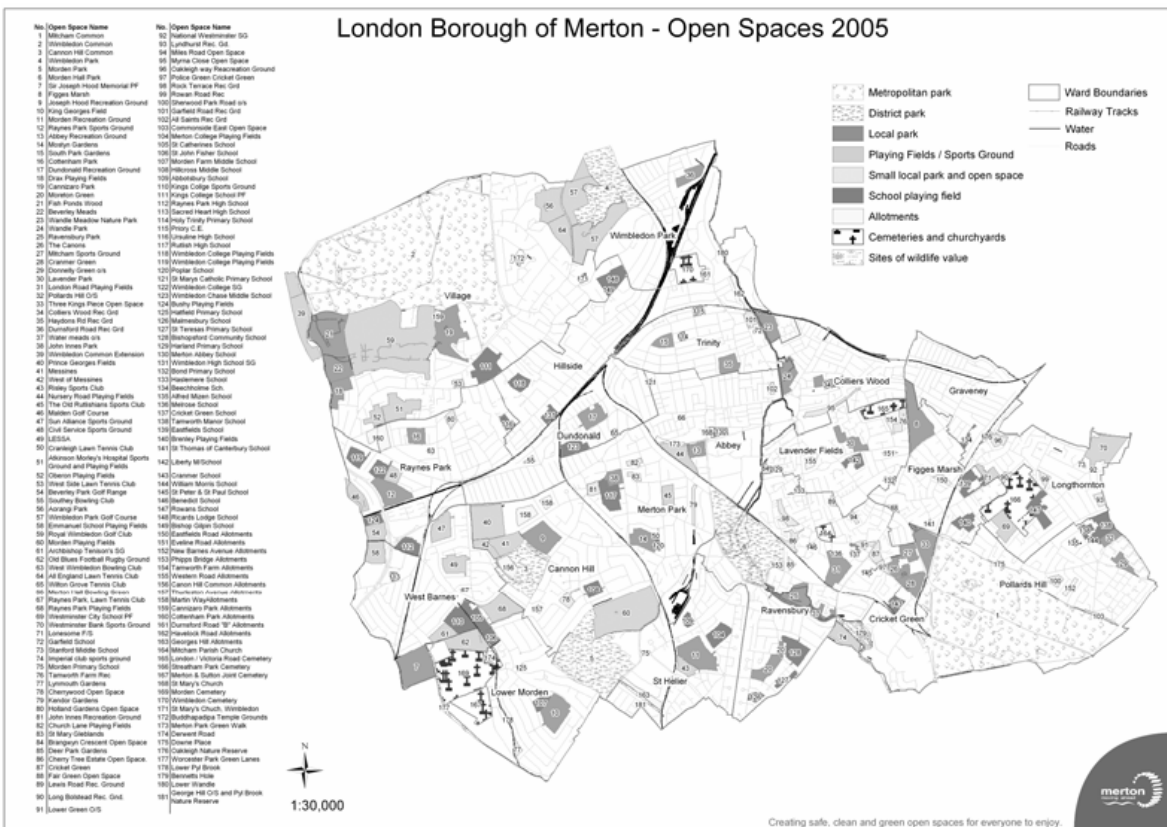


Figure R3: Merton open space ownership
From: Merton Open Space Study

Climate Change Policy

The Merton Rule is a policy that requires all non residential buildings over 11,000 square feet in area to generate 10% of their energy usage from alternative sources. Merton was the first borough to approve such a law, and as of January 2008 the Merton Rule has been applied over 100 times in local boroughs since being adopted in 2003. Influence is also spreading to other boroughs, as over 80 additional boroughs in the UK have adopted the policy since 2003, with 70 more to adopt in the near future. Some examples of qualified sources include wind, solar, biomass heating, ground sourced heating or cooling and solar hot water systems. This policy is also expanding rapidly and in some cases is being applied to residential buildings as well. This rule is very applicable to Groundwork’s initiatives since alternative energy is a main theme of climate change mitigation.

The Borough of Merton Climate Change Strategy is a straight forward plan targeted at the main problems regarding impending climate change. The main themes include energy, planning and development, waste, transport, water, biodiversity, environmental education, fair

trade and city knowledge. The main goal of the plan is to reduce carbon emissions by 15% by 2015 (Merton CCS, 2007, p. 5).

With respect to energy, Merton aims to have localized power sources for a more sustainable approach to providing Merton with electricity. This is referred to as a District Heat and Power network, or the DHP (Merton CCS, 2007, p. 16). This is a long term goal but is still attainable in the future. For the immediate future, Merton aims to use low wattage street lamps to decrease power consumption or possibly other forms of renewable energy such as solar panel street lamps.

Waste is also a pertinent issue. The new waste section of the strategy suggests pyrolysis, or combustion of waste as a means of disposal. Of course one drawback would be the need to treat the effluent gas byproducts produced by combustion of this waste; since those fumes are harmful to the environment and are not fit to enter the atmosphere. This would make it more difficult to design and provide funding for; but nonetheless pyrolysis is still being considered in the long term. Increased composting and recycling of waste has also been proposed. To further cut down on waste, Merton would like to rid the borough of plastic bags and only use reusable or paper bags, as the majority of plastic bags are not biodegradable.

Water and flooding seems to be one of the most important problems to Merton, as Merton is in the flood plain of the River Wandle. Merton looks to improve drainage by implementing porous hard surfaces to decrease flash flooding and naturally drain water runoff. This means porous asphalt would be used instead of regular non-porous. This would allow flood water to naturally flow through the material and into groundwater or sewer systems. This material is naturally more expensive but would pay off since Merton is in the flood plain for the River Wandle. Merton also looks to improve water usage by installing water meters to ensure efficient use on council properties and by recycling grey water.

Open Space Policy

The Merton Open Space Strategy is a plan to create an open space infrastructure similar to what Groundwork is looking to achieve. Merton aims to have a sustainable open space infrastructure which is beneficial not only to the environment, but to the community as a park and a hub for heritage and diversity that may be enjoyed by all community members (Merton OSS, 2005, p. 6). Some challenges include integrating open spaces with the urban setting,

increasing park accessibility, improving safety and security, and of course sustainability. MOSS also addresses problems with community involvement, partnerships and possible funding opportunities. The main problems tie directly to interest in open space sustainability from the community and local sponsors and getting them to have a sense of involvement in said open spaces.

Merton has addressed a lot of open space policy that relates to climate change mitigation. Accessibility, as addressed by Wandsworth, has a direct effect on how often the park is used and how one gets there. Merton also stresses community involvement for sustainability. Community involvement is necessary not only with respect to whether or not the space is used but also in regard to how it is kept. If the community cares, the park will stay in good condition and will continue to attract visitors. Also, the greenery will stay healthy, not only beautifying the park but keeping the potential element of plants as carbon removal agents.

With regard to adding biodiversity in open spaces, MOSS says that Merton will increase plantings to improve the habitat for wildlife. Merton also takes the Wandle Valley Regional Park to be the main focus of increasing biodiversity (Merton CCS, 2005, p. 2). Since the parks in Merton in the Wandle Valley are so large, it is logical to base that as the main means of increasing biodiversity in the area due to its large natural habitat.

Political and Community Issues

The main community issues include accessibility, uneven distribution of open spaces and open spaces such as private gardens not being accessible to the public (Merton OSS, 2002, p. 6). Also, 76% of Merton residents indicated that they utilized one of the many parks in a 2003 survey (Merton OSS, 2005, p. 35). The population is also growing rapidly and is projected to increase by 10,000 more citizens by 2011 (Merton OSS, 2005, p. 35). Political issues are very similar to that of Wandsworth, but are less severe. Ownership once again causes an issue. In this case many open spaces that could be used as public access playgrounds and playing pitches for football or rugby are instead private access school yards. The borough of Merton is in the process of making these open spaces accessible to the public. This is less of an issue of private ownership but accessibility and changing the agreements discussed in the land ownership section for Merton.

London Borough of Sutton

Introduction

The borough of Sutton has a good portion of the Wandle Valley Regional Park, with 7.12 km of the Wandle Trail. Sutton is a small borough, and in most places is devoid of public open spaces. The Council's local area agreement and other planning strategies have shown what the borough is supporting for climate change mitigation. As the map (Appendix RA4) shows, the public open spaces in Sutton are few and far between, which demonstrates a severe need to make improvements upon the small selection in existence.

Land Ownership

Sutton has a diverse range of open spaces from large open green areas known as the "green belt" in the southern part of the borough to the smaller civic spaces in the urban areas. Unfortunately, most open spaces in Sutton are owned by utility companies and sports clubs, limiting public use. This is shown in Figure R4 and in full size and detail in Appendix RA3,

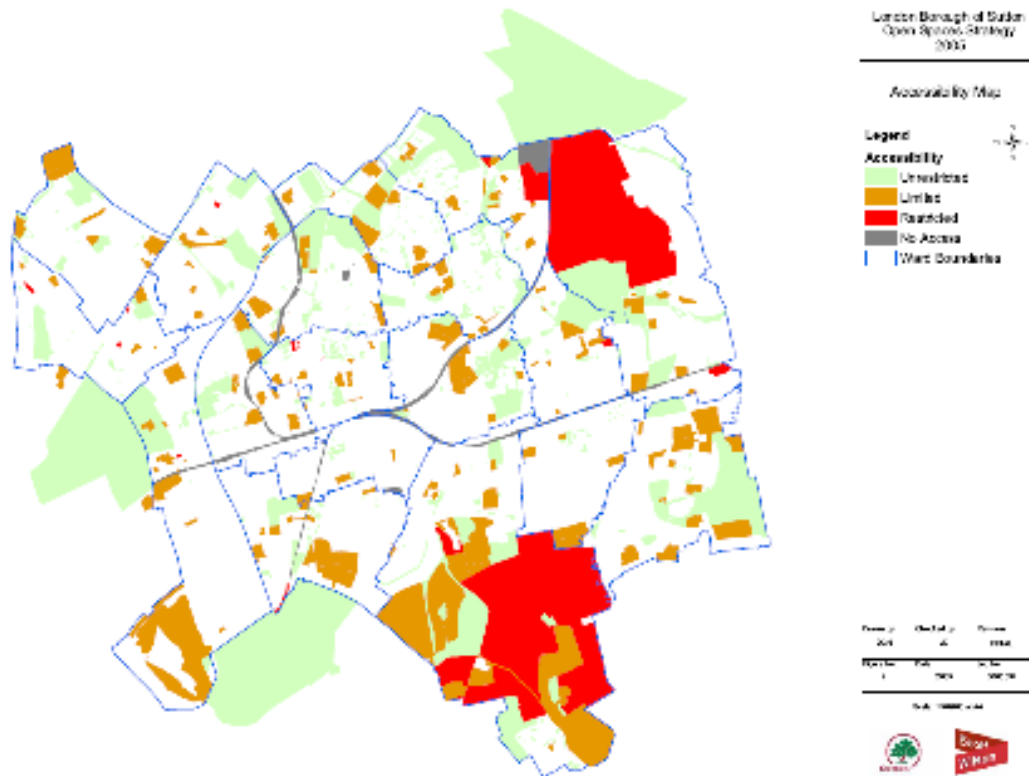


Figure R4: Sutton open space ownership
From: Sutton Open Space Study

where most restricted access (displayed in red) is concentrated in two areas. Accessible and limited accessibility areas are shown in green and orange, respectively, and are spread out throughout the borough. The large red spaces are large privately owned farms. The orange spaces are private for the most part with limited accessibility such as sports clubs. The green spaces are unrestricted public access. It can also be seen that open spaces are concentrated in some areas and not existing in others.

Climate Change Policy

From our research, Sutton has little in the way of a climate change mitigation plan. The council's website shows that the Sutton Council has recognized that climate change is a problem and illustrates that if nothing is done, the results could be dire. Despite this, no action plan has been put together unlike the plans from Wandsworth, Merton and Croydon that they have on their websites. There is nothing on the website ("London Borough of Sutton", 2009) with respect to a climate change plan, merely documentation similar to our background chapter. This raises the question of how much Sutton prioritizes climate change, which they may see as a less pressing issue than accessibility to their open spaces and open space quality as shown in their Open Space Study performed in 2005.

On the other hand, Sutton does take several green initiatives, one example being the Hackbridge project. The Council lays out an ambitious plan for the development of a sustainable suburban area which produces no carbon emissions, reuses as much as possible (gray water, recycling) and produces no waste. This certainly shows that Sutton is concerned with climate change, yet they did not put out a document stating their climate change goals which would have been helpful in writing this section. We were also unable to get an interview with Sutton Borough Council.

Open Space Policy

Sutton has numerous open spaces throughout the borough. However, these are not evenly distributed across the area of the boroughs and many open spaces are privately owned. Others are spread across urban areas and have limited accessibility. In the Open Space Policy laid out by Sutton Council, the regulation of 2.88 hectares of open space per 1000 citizens is the first objective set forth ("London Borough of Sutton", 2009). The policy also plans to form methods

for improving the quality of most open spaces in Sutton, in addition to improving accessibility, biodiversity and play facilities for children. Overall, the theme of sustainability is stressed, as the borough does not want its investments wasted in the near future.

Some issues with Suttons open spaces are accessibility, quality and distribution. Accessibility is a common theme and is stressed by all boroughs as an open space strategy. Increasing the number of open spaces would be effective in getting people to use them but also for better convenience and accessibility. The pressing issue, however, is quality. If there is vandalism, the park then becomes unappealing and becomes a hangout and sanctuary for unruly behavior. Safety is also an issue due to these factors. Community issues like these would take a significant number of resources to fix, but the overall goal is intact; making each open space accessible and convenient to use for all citizens associated with it. The idea for climate change mitigation connection is that if an open space is utilized instead of an indoor environment theoretically less carbon is emitted.

The Sutton Open Space Study was performed in 2005 to assess the quality and distribution of open spaces in Sutton. Across the entire borough 678 open spaces were identified with 450 having unrestricted public access. The restricted access ones unfortunately had the most space per 1000 residents at six hectares/1000. Most of these are privately owned by farms, however, and would be difficult to make publicly accessible. Some areas within the borough were severely deficient such as Wallington and Sutton South which have 0.14-0.15 hectares of open space/1000 citizens. In total, two-thirds of Sutton falls below the borough regulated 2.88 hectares/1000, with much of it being of poor quality (Sutton OSS, 2005, p. 12).

Specific to the Wandle Valley region in Sutton, it is mentioned in the Open Space document that South London, specifically the Wandle Valley, is deficient in access. This, however, is currently being addressed by Groundwork and other initiatives in that area. It is also said that in the Wandle Valley region of Sutton, there is a small number of sites, much severance of the river trail, poor accessibility and too dense of a population to truly reap the benefits desired of an open space in an urban area. It is also stressed that the area is deficient in diverse wildlife. This study highlights the same problems Groundwork has outlined in the Vision, which illuminates the ties between the Council, Groundwork, and the Wandle Valley Plan.

Political and Community Issues

As demonstrated, Sutton appears to prioritize open spaces over climate change mitigation. This prioritization may point to the fact that Sutton intends to use urban parks as a mode of climate change mitigation. In a policy aimed directly at open space provisions, the Sutton Council claims that:

Policy OE19 – Open Space Deficiencies

In areas of open space deficiency the council will resist the loss of public open space and urban green space and will:

- 1. Require new public open space to be provided in appropriate development proposals;*
- 2. Seek to secure private and public investment in existing local recreation and leisure facilities;*
- 3. Improve public access to existing open spaces (including urban green space);*
- 4. Encourage; through agreement with owners, the community use for private recreational facilities;*
- 5. Seek to provide additional open space.*

This illustrates that the council is very dedicated to using open spaces for climate change mitigation and beautification and benefit of the borough. We were, however, unable to get an interview with any council member, as requests for interviews were unable to be met.

According to a survey from the Sutton Open Space Strategy, main barriers expressed by the inhabitants of the borough include the spaces not being kept clean, as in littering and animal curbing, and feeling unsafe around the youth population. From the same survey, a mere 43% of the open spaces and parks were considered to be above average. The Sutton Council Open Space Strategy (2005) suggests Sutton open spaces are in need of improvement before the community will start to become involved and actively use these spaces (p. 12).

London Borough of Croydon

Introduction

The borough of Croydon is very rich in open spaces. In total, the borough contains 330 open spaces and parks over 1750 hectares of land (croydon.gov.uk). Parks are also essential to Croydon since most of the borough is either industrial or residential. With respect to the Wandle Valley in particular, two parks are a part of the system; Wandle Park and Waddon Ponds (Appendix RB4). Though a small area of land, this is where the River Wandle starts, thus what

goes into the river there will be carried through the other boroughs and into the River Thames. This stretch in Croydon contains 3.52 km of the River Trail.

Land Ownership

Croydon has many open spaces; however, the open spaces within Croydon have largely private access. This is shown in Figure R5 and in full detail in Appendix RA3, where private access is outlined in red, limited access in orange and public access in green. There is a lot of private ownership, causing issues with accessibility and use. Density of open spaces is also shown on the map. It is clear that some areas have many open spaces in the immediate vicinity, such as the south and the east. However north, west, and central Croydon are severely lacking in open spaces with unrestricted public access.

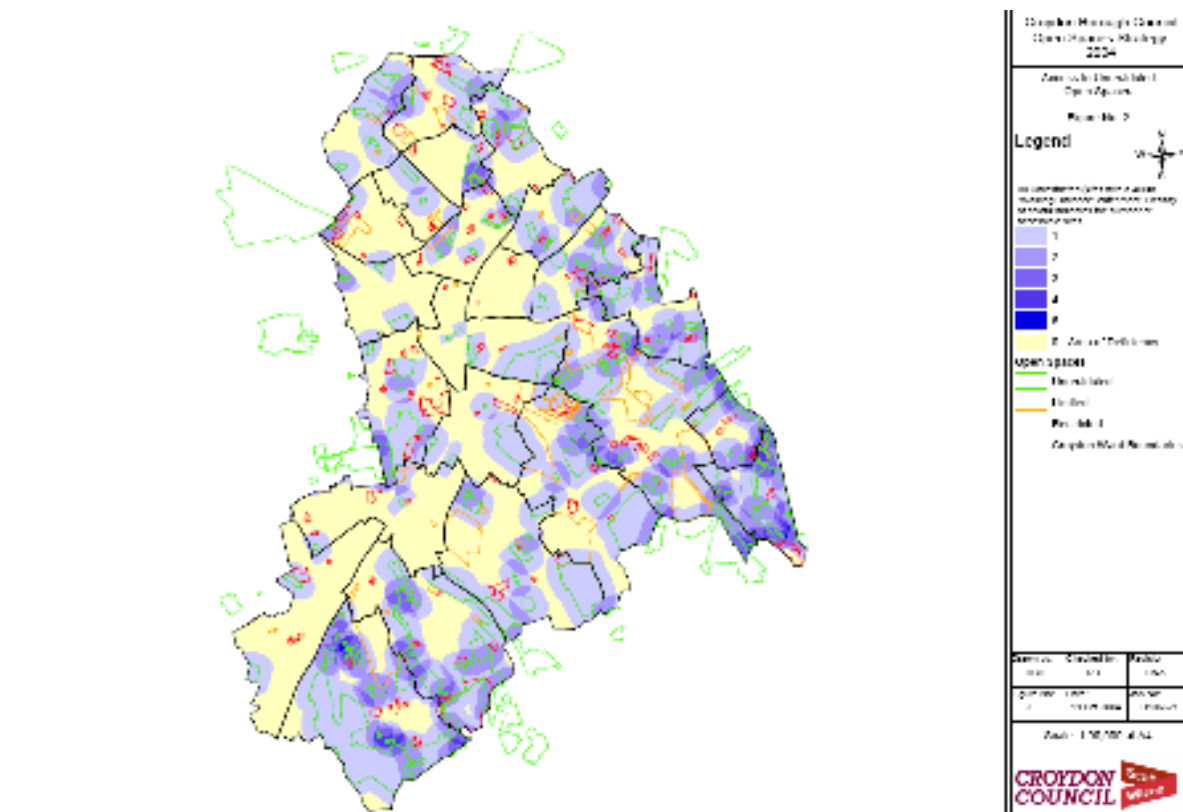


Figure R5: Croydon open space ownership
From: Croydon Open Space Policy

Climate Change Policy

Croydon, a largely industrial borough, has identified a unique responsibility in its impact on the environment and has recognized this obligation with the Environmental Procurement Policy. This states that Croydon will "use our [Croydon's] investments and purchasing power to promote environmental sustainability" (EPP, 2007, p5). To reiterate Croydon will promote environmental sustainability by choosing products and contracting that considers the environment. Since 2007, the new green mentality has saved approximately 12,153 tons of material from going into landfills, "prevented 113.2 tons of CO₂ and 1.7 tons of other air pollutants from entering the atmosphere," and saved 1,840,447 liters of water (EPP). This shows that Croydon has taken significant steps towards climate change mitigation and will likely be a valuable partner to Groundwork.

One of the main issues in Croydon is wasted energy and water. Through a partnership with British Gas, the Croydon Council has enabled a home installation scheme designed to save energy and heating costs. British Gas Company will install wall and loft insulation for £250. In exchange, the homeowner will receive a £100 tax credit. In addition to this, the energy savings per year will amount to up to £200, quickly paying off. Citizens need not even be a British Gas customer, as they will insulate any home with any energy provider (keepcroydonwarm.org.uk).

Croydon has also expressed interest in having unified energy and heating. This means that all of the energy and heating would be from one source in Croydon, eliminating unnecessary greenhouse gas emissions that would have been produced by many plants operating at once and eliminating competitive pricing (croydon.gov.uk). This would also give Croydon the opportunity to integrate alternative energy themes into unified heating.

The Croydon council has also worked out a deal with Sun Rise, a company that specializes in photovoltaic (solar) water heating, which would provide a solar water heating system for every resident of Croydon. The local government would also cover the cost of installation with an interest free loan which would be payable over time.

Open Space Policy

Croydon contains 330 open spaces and has an extensive strategy of how to best utilize them for the benefit of the borough which is outlined in their objectives. In the Croydon Open Space Strategy, a plan is outlined to maintain and enhance an open space network, much like the

one Groundwork hopes to form in the Wandle Valley. Their objectives include improving access to and quality of the open spaces, conserving the natural habitat, involving the community and using borough open spaces (COSP, 2005).

According to the Borough Council's Open Space Strategy, the strategies for increasing open space usage are increasing unrestricted open space access to 4.30 hectares of open space per 1000 people, the most ambitious of any borough. They also plan to increase access by improving walkways and cycling trails. To improve the quality of the open space the Council will improve signage and improve sports pitches and possibly renovate some buildings. The most interesting part of the action plan, however is community involvement plans, which talks of increasing activities in the open spaces to stimulate involvement. Furthermore, the Council plans to involve a lifelong learning program stating they would like to "Increase opportunities for lifelong learning (the understanding of conservation and care of open spaces, heritage and historical use of sites, wildlife and planting), also identify links with schools to specific open spaces," (COSP, 2005). This shows definite interest in green education programs combining school programs with open spaces and green education.

Political and Community Issues

The borough of Croydon prioritizes environmental sustainability very highly. In January 2003 the Croydon Council formed the Environmental Partnership comprised mainly of the Environmental and Sustainability Team (EaST). The main objective of this team is to provide cleaner streets and open spaces and environmental sustainability and transport, with a focus on the latter. Key issues include climate change mitigation, waste reduction, water conservation, improving the environment and providing sustainable transport (croydon.gov.uk).

In a 2002 survey, 40% of local citizens who responded claimed that they would pay extra taxes in order to ensure the parks would be properly kept (Open Space Policy). In the same survey, 76% of citizens stated that they use Croydon parks on a regular basis, with 24% of them using Croydon parks daily (Open Space Policy). These parks are commonly used and therefore must be sustainable. In general, the community would like to see better accessibility and maintenance of open spaces.

Objective 2: Analyze the features, climate risks, and resources of open spaces

From our research and interviews we were able to gather insight on prevalent issues and policy relating to the borough. We were then able to define the issues of our selected open spaces with the scope of input from the boroughs and current policy. One park from each borough of the Wandle Valley was selected: King George's Park in Wandsworth, Morden Hall Park in Merton, Dale Park in Sutton, and Wandle Park in Croydon. Each park varies and has different issues and barriers. This will provide Groundwork with diversity and make it easy to implement the ideas presented in other parks and open spaces.

Several factors were examined in each park. First we looked at geographical factors such as size, plant life and current structures in place to understand how the park was set up. If the park is not well planted, that could be a potential project for climate change mitigation. Also, the structures in place may take a lot of energy and be candidates for alternative energy integration.

Next we examined regulatory aspects; ownership, buildings and structures in the park and land use in and around the park. This helps to identify who is in charge of building, what the buildings are, and the parks context with respect to the surrounding area. Social themes such as citizen involvement and pre-existing projects were also considered to gauge community interest and get a feel for the problems existing in the area. These factors identify how the park is used by the community and whether or not it would be significant to implicate the projects we deem appropriate. Energy usage was also an important aspect. We examined the use of electricity, heat and fuel type used in different maintenance vehicles such as lawnmowers. This allows us to see just how much energy is being consumed in daily use for the park and whether or not it is feasible to implement alternative energy to make the park self sufficient.

Flood risk was also considered by a cross referencing of direct observation, maps indicating areas where flooding is possible, and historical information with respect to flooding. We observed the river bank and how deep it was, and considered the likelihood of flooding given the conditions (such as whether or not natural drainage such as a marshland existed). We then examined historical data and flood risk maps from the Environmental Agency, referencing our current assumptions with proof.

Accessibility from the surrounding neighborhood and navigation within the park was the last factor considered. This was determined by direct observation, our attempts to find the park, navigate through it, and find the river. Maps were also referenced in an effort to guide us as were

transport information gathered from direct observation (tram stops, bust stops and tube stations). Accessibility is essential to parks, since people need to be able to get to them to utilize them. If people visit parks, they are less likely to be inside using electricity. It will also make them more aware to current problems regarding the environment.

King George's Park

Environmental

King George's Park is 55 acres and is located at the northernmost section of the Wandle Valley Park. The open space study appendix of Wandsworth Council describes King George's Park as "A large and fragmented park containing a number of diverse facilities. Much of the park runs alongside the River Wandle, and the northern end is located in Wandsworth Town Centre" (Open Space Study Appendix A).

Plant life in King George's Park is diverse, including cherry trees, poplars, ornamental gardens containing roses, pergolas and other decorative flowers; and open grass. The volume of tree planting is not very great, as some areas are devoted to being specific for park activities such as playgrounds and football pitches. This was determined by the fly over map and confirmed by our observation. A large map with detailed labeling can be found in Appendix RB1.

Regulatory and Social

King George's Park is owned by the council and has unrestricted public access when the park is operating. The structures currently in place are a tennis court, two playgrounds, football pitches, a bowling green, a cricket field, a riverside walkway, and a cycle route. There is also a day care center and two sport houses for the tennis courts and the bowling green. The surrounding area is mixed where the north end, Wandsworth Town is urban and is heavily populated with businesses and transportation, where on the south end of Southfields, the area is very residential with less businesses and transportation.

Community involvement in King George's Park is very high, as the park is used for field trips and as an educational hub, hosting such events as the Wandle Festival that Groundwork took part in as well. In our five visits to the park, we observed that the playgrounds were always being utilized and the park was busy and filled with people. There are not, however, existing projects affiliated with King George's Park currently that were obviously related to our efforts in climate change mitigation that we were able to discover.

Energy Use

Energy use was difficult to determine at King George's Park due to the diffusion of responsibility for energy usage. Different factions of Wandsworth Council have control over various aspects of energy usage. For example, Children's Services Department is in charge of electrical expenses in the play areas, the Highway Department covers electrical services on the main walkways to power lampposts, and so on (Ms. Selby Interview).

In addition, cost of energy is lumped into one sum, and it is challenging to find the individual costs of a particular fixture or building, such as energy to power one lamppost or heat one building (Ms. Selby Interview). We were unable to get a lump sum, however, as it would have had to be pieced together.

Through thorough analysis of King George's Park, our team has discovered which elements of the park require electricity. Within the pond there is a large fountain which requires electricity to pump water through the nozzle. Structures within the two playgrounds and the tennis and bowling green buildings require electricity for lighting.

Along the river path, there are 102 lamp posts so the path can be lit at night. While some appeared to have a light-sensor on the top, we noticed five lights that remained on despite it being a bright afternoon.

The Park Maintenance staff also provided information about maintenance of the park. Lawn mowers run on diesel fuel, and the trucks they use run on gasoline. These trucks are used to transport the mowers to and from King George's Park, as they are shared between other parks in Wandsworth. The areas which are mowed the most are the picnic areas and the grass around the pond, which are mowed once a week. This is only two areas of the park and is not much in the way of maintenance.

Flood Risk

As shown by a fly over map of the park (Appendix RB1), the river runs much lower than the ground level of the park, making it much less of a flood risk. However, according to the flood zone map provided by the London Environmental agency in Figure R5, Wandsworth and King George's Park in particular is in flood risk 3, or a likelihood of one flood every 100 years, (a flood risk 2 would be one flood per 1000 years). The last recorded incident of flooding was in 1928 (Wandsworth LEA Document, 2008). As shown in Figure R6, most of King George's Park is in the flood plain, and is in the flood depth, meaning that a flood could happen in extreme

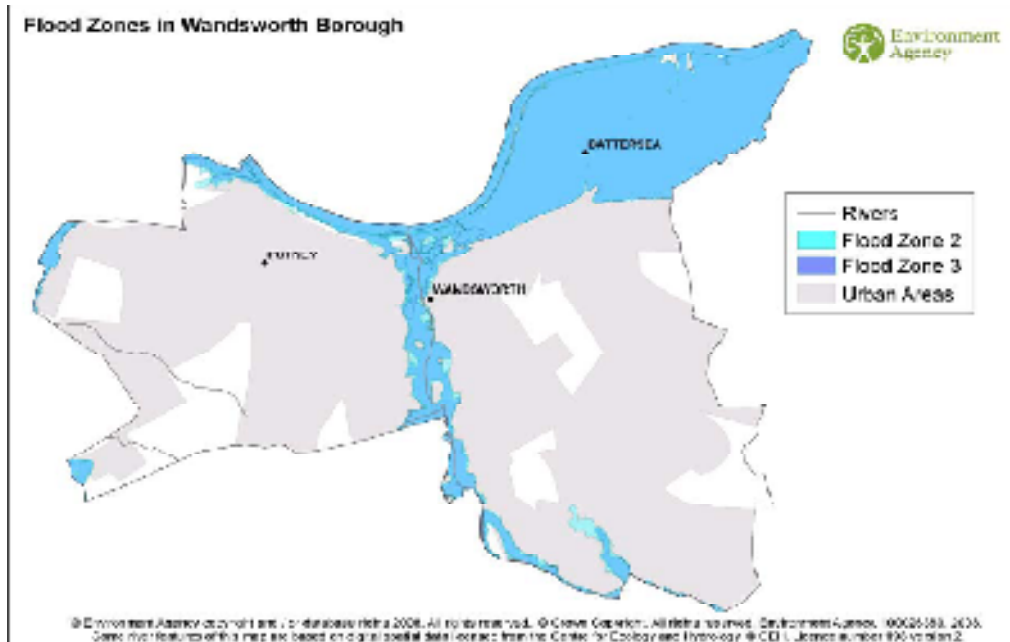


Figure R5: Flood Zones in Wandsworth, From: Wandsworth EAP Profile
From: EAP Wandsworth Biodiversity Profile

circumstances. However, most of the park itself is outside the flood hazard zone except for a small portion outlined in yellow in the figure, meaning a low hazard zone. This means that flood risk is minimal in King George’s Park. (SFRA, 2006)

Table A 21 Site Ref: 31 Site Name: Southern end Southside Shopping Centre (Wandsworth Parkside), Mapleton road, SW18		
<p>Note: Flood depth & hazard information taken from Draft River Wandle model outputs, June 2008. Outputs are currently undergoing final review and may be subject to future changes. Consult Environment Agency for latest information. © Crown copyright. All rights reserved. LG Wandsworth 100019270, 2008</p>		
<p>Proposed Use: Mixed use including residential and A3/A4 uses.</p> <p>Draft River Wandle flood outlines show the site does not lie within the floodplain therefore no restrictions in relation to vulnerability classifications on specific floors.</p>	<p>Draft River Wandle flood outlines show the site does not lie within the floodplain hence there is no associated flood depth.</p> <p>Obtain River Wandle modelled flood levels and compare with surrounding topography to confirm flood extents are correct.</p> <p>Minimum finished floor levels should be set at 1 in 100 year with climate change levels plus 300mm freeboard.</p>	<p>Draft River Wandle flood outlines show the site does not lie within the floodplain hence there is no associated flood hazard.</p> <p>Draft River Wandle model outputs show dry access and egress is available to Neville Gill Close and Garratt Lane via Mapleton Close.</p>
<p>Summary: Site specific FRA to confirm flood extents by comparing modelled flood levels with topography. Minimum finished floor levels set at 1 in 100 year with climate change flood level plus 300mm freeboard.</p>		

Figure R6: Flood Risk Assessment,
From: Strategic Flood Risk Assessment

Accessibility

The accessibility of King George's Park is moderately strong, with several streets and bus stops nearby. The Wandsworth Town and Southfields tube stops are within a ten minute walk, and the 39, 44, 156 and 270 busses all stop within a short walk of the park. The signage indicating the location of the park is limited and many aspects of the park such as the river and football pitches are difficult to locate. In addition, not many locals were aware of its presence when we tried to navigate our way to the park. Through the park there are signs, but they are somewhat difficult to follow when trying to find the intended landmark. The river in King George's Park is somewhat hidden and on the edge of the eastern boundary. There are also few signs indicating how to find the river, with only two signs at junctions. In our direct observation, we found it very difficult to locate the river.

Morden Hall Park

Environmental

Morden Hall Park consists of 125 acres of meadows, wetlands, forested area, open space, and developed area. Plant life is equally diverse containing trees such as oak beech, ash, birch, willow, and alder. There are also decorative gardens and willows in the marshland.

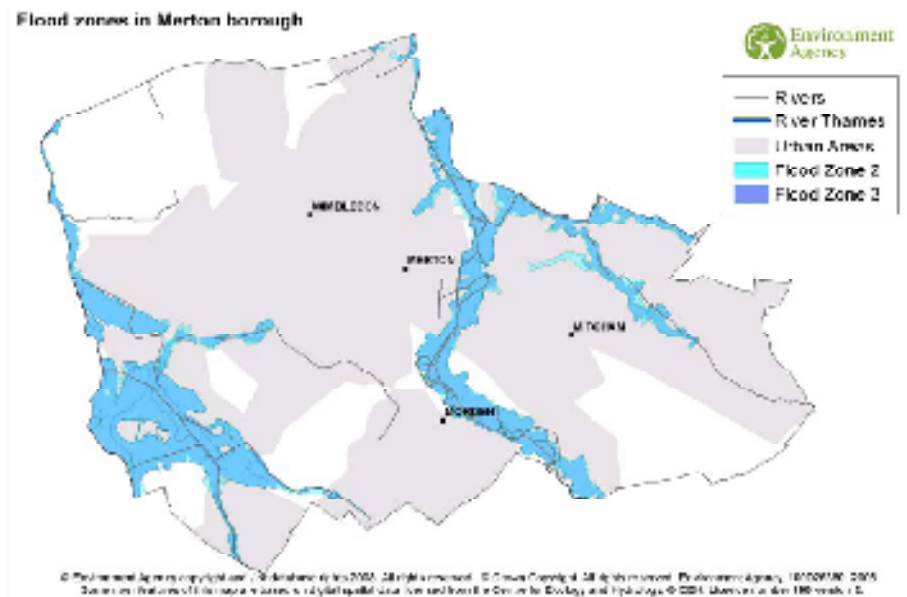
Regulatory and Social

Morden Hall Park is owned by The National Trust, an environmental organization funded by the British government. The National Trust is the main proprietor, and thus controls the maintenance and usage of the park. Access is the same as if it were owned by the council, as there is public access available within the park's hours of operation. Current buildings and structures are the Snuff Mill, six skill workshops and one National Trust workshop, a café, stables, and the Morden Hall Cottage offices. The surrounding area is heavily residential with commercial areas near the Morden tube station.

The social involvement in Morden Hall Park is excellent. As we walk to Morden Cottage nearly every day we observed that many schools have field trips there and people from the surrounding area constantly populate the trails. There is an existing project, the Hub of the Park (HOP) project headed by the National Trust looking to make the park self sustainable. This project is explored in depth in the deliverables section regarding Morden Hall Park.

Flood Risk

The River Wandle runs through the entire park and is very easy to locate. At one point the river flows very strongly, which may be a possible site for hydroelectric energy implementation. In fact, a water wheel exists at this point and is currently being looked at by the National Trust as a restoration project. In other parts, the river the flow is relatively stagnant, and most of the north end of the park is purely marshland. This means the flood risk is decreased because of the marshes and their natural drainage and catchment capability. However, the natural drainage capacity may flow over the marshes and flood into the rest of the park. Morden Hall Park is a Flood Risk 3, meaning one flood per 100 years. This is shown in Figure R7, as the park is where it is labeled Morden. As a low risk, the last recorded incidence of flooding occurred in 1968 in Beverly Brook. The river in relation to the park can be seen in Appendix RB2.



*Figure R7: Merton Flood Risk
From: Merton EAP profile*

Energy Usage

Maureen Patel of the National Trust was able to give us a thorough outline of the energy use and energy sources used at Morden Hall Park. The National Trust does a yearly energy audit which enables them to have more specific information about their park’s individual energy usage. Heating comes from several sources in the structures within Morden Hall Park. All the buildings at Morden Hall Park utilize loft insulation. The Riverside Café uses a heat source pump for heating. The National Trust shop uses sun pipes which have reduced the energy used.

The baseline electricity usage for the building that contains the Café and Shop uses 65947 kW annually according to Patel. This electricity is used by the lighting and appliances in the building. The workshops (six craft workshops and one Trust workshop) use 30936 kW annually with 9453 kW high rate electricity and 5378 kW low rate electricity (high rate corresponds to hours between 900-1900, and low rate corresponds to all other times that electricity is used). The Snuff mill uses electricity for lighting and the heating, using 500 units annually of high rate electricity and 700 units annually low rate electricity. For park maintenance, a tractor, riding mower and compacter are used. These vehicles use red diesel and require about 25 litres of fuel per week.

There is limited use of gas as well. The Café uses gas for cooking and uses approximately 2553 units annually. While the Snuff Mill runs mainly on solar panels to provide the energy for heating, there is back up gas heating that requires about 1500 units annually.

Accessibility

The accessibility of Morden Hall Park is very strong: there are parking areas, a tram stop along the park's edge (Phipps Bridge Tram Stop) a designated parking area near the entrance to the park, and several bus stops nearby (80, 93, 118, 154, 157, 163, 164, 201, 293, 413, 470, K5).



Figure R8: Morden Hall Park signage

The cycling route also leads directly to the park. Practically every mode of transport is accessible to Morden Hall Park.

Accessibility through the park is also excellent, with proper signage at every possible junction and whenever the path changes. This is shown in Figure R8. Furthermore, the river is very visible and in multiple parts of the park there are footbridges crossing the river that one must cross to continue on the trail, as the river flows directly through the park.

Dale Park

Environmental

Dale Park is the smallest space we have selected, only approximately 3.5 acres in size. The plant life is not very diverse, with some mature trees, unkempt open grass and some brush and tall grass surrounding the river. There are no other features aside from a playground and three lamp posts that are no longer in working condition.

Regulatory and Social

The park is currently owned by the Borough of Sutton Council and provides public access as long as the park is open to the public. There is only one structure in place, a small playground with old, damaged equipment shown in Figure R9. The surrounding land is a very residential middle class area, and the park is almost hidden in the middle of a community.



Figure R9: Dale Park playground

Energy Usage

Though no one from the council could speak to us on the issue, our team estimates Dale Park in Sutton has few energy needs. There are no structures in place. Within the park there are

three light posts, but according to locals they are not used. Also, the grass in the park is left fairly long and is probably not mowed more than once every one to two months by the borough council parks department which uses the same mowers as King George's Park.

Flood Risk

The river in Dale Park is hardly accessible with much obstruction. Through direct observation, the path to the river is through the landscape which is not ideal for walking on. Dale Park is also a moderate flood risk at flood risk 3 as well as shown by Figure R10. The river in relation to the park can be seen in Appendix RB3.

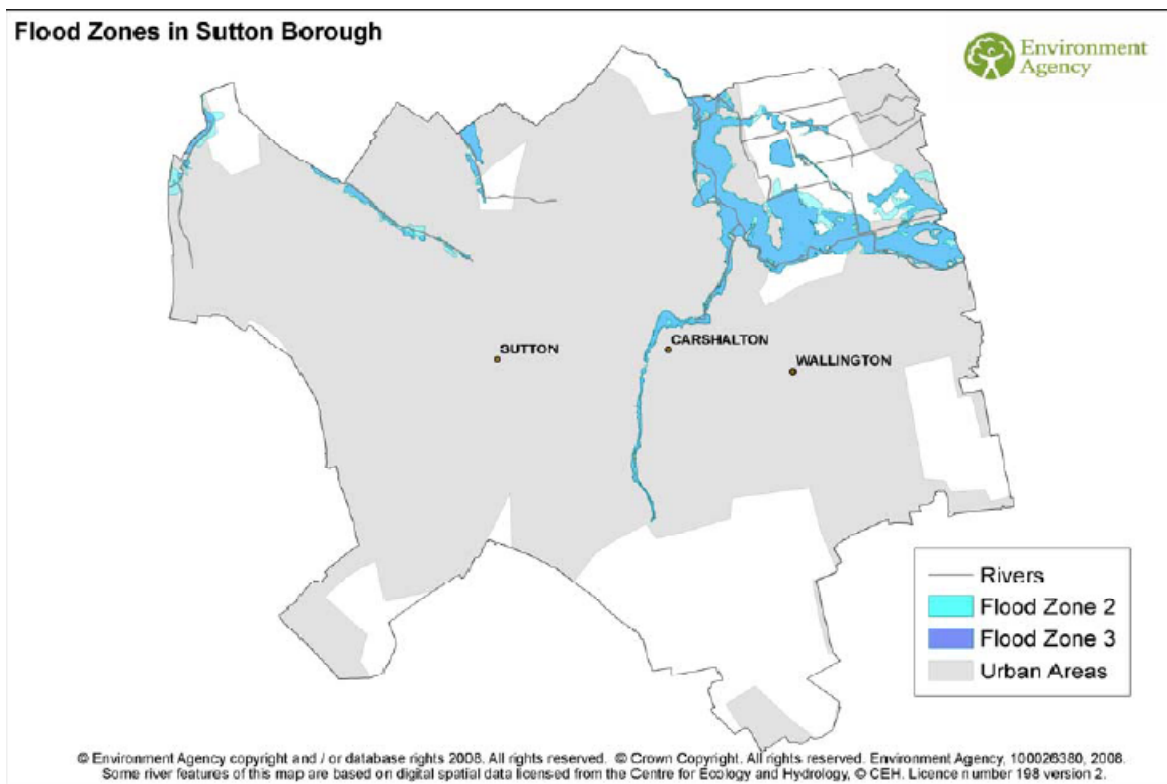


Figure R10: Merton Flood Risk, From Sutton EAP Profile

Accessibility

The accessibility to Dale Park is limited due to being centered in a residential area with only street access nearby. There are few bus stops within walking distance and no tube or tram



Figure R11: Dale Park river path

stops in the immediate vicinity. Accessibility through the park is adequate, as most of the park is visible upon entering. Access to the river is poor; however, as one must walk through forest like terrain in order to see the river. The path is much obstructed and not entirely noticeable as leading to the river. This is shown in Figure R11.

Wandle Park

Environmental

Wandle Park in Croydon is about 21 acres in size and is the source of the Wandle River. The plant life is not very diverse, with several mature trees around the outer ring of the park and much open grass. Current structures in the Wandle Park are a children's playground, a skate park, football pitches, cricket field, toilets, and a Rangers station.

Regulatory and Social

The Borough Council of Croydon owns Wandle Park and provides public access during the time that the park is open. The only structures in place that would be classified as buildings are a gazebo, unused bath house and the Rangers station. There is also a playground and a skate park. Some structures (Rangers station, playground and skate park) are depicted in Figure R12.



Figure R12: Wandle Park structures

Surrounding land usage is industrial and urban on the north end and residential on the south end. There is an existing top up which Friends of the Wandle is heading in an effort to restore the park. This is talked about in depth later in the chapter.

Energy Usage

No one from Croydon Council was able to talk answer our specific questions, but due to the council ownership one could expect similar contracting issues to what was described in Wandsworth. Energy use in Wandle Park is restricted to the Ranger Station and maintenance as there is no external lighting or facilities in use. While the Ranger station is not large, it has many energy needs. While there was lighting which we expected, the Ranger Station also includes several heaters, a bathroom, showers, and an electric boiler. A ranger allowed us to look through the ranger station which seemed to be in disrepair inside and out.

Maintenance requires a variety of vehicles. Within the park, they use a diesel tractor, a John Deere riding mower that runs on diesel, a spinner that runs on petrol, a blower that runs on petrol, and a sweeper that runs on diesel. Due to the maintenance contract, all these maintenance vehicles are transported to and from Wandle Park by truck. Standard mowing is done once or twice a month according to the Ranger on duty, but not all these vehicles are employed every time.

Flood Risk

The river does not flow through the park, but rather under the park. The source for the river comes from underground, eventually coming to the surface in Sutton. The river in Wandle Park was cemented over when the park was built to incorporate more green space (www.croydon.gov.uk). This means that Wandle Park is not in the flood plain for the River Wandle, and thus would not flood due to rainfall raising the river levels. One scenario would be if there was very heavy rain which was enough to build a heavy flow and cause increasing pressure in the culvert underground. This would break the culvert and effectively turn the park into a marshland.

Accessibility

Accessibility to the park is good, with a tram stop directly outside the park, and a parking lot directly outside as well. The park is structured in a circular fashion such that everything can be accessed by following the outer trail. The playground and skate park are also easy to see upon entering the park.

Future vision

The Croydon Council controls the park in conjunction with the Friends of the Wandle Organization. They have outlined multiple projects they would like to see completed on their



Figure R13: Wandle Park redevelopment

website (wandlepark.com) including restoration of the River Wandle, skate park improvements, planting and addition of football pitches. This is displayed Figure R13 which is the depiction from the website. A detailed aerial view of the park can be seen in Appendix RB4.

Objective 3: Develop a list of possible climate change mitigation and environmental restoration strategies.

To deliver a solid, feasible report to Groundwork, we must create a plausible list of potential strategies for climate change. In order to do so, we have formulated a list of multiple basic ideas based on our background research, on site analysis of our specific open spaces, and interviews with borough council members and other Groundwork personnel. We have created a chart to examine the feasibility of each potential strategy, which has research questions and answers based on interviews and site research, in order to find out if the project can be implemented.

Our original ideas were broad: ‘improving access’, ‘planting’, ‘water storage’, ‘solar panels’, ‘hydroelectric’ and ‘green education’. We then analyzed each of our general strategies by borough, using a set of thirteen research questions addressing topics such as cost, political issues, existing efforts in place, and where in each park this strategy could be used.

Planting

Does direct observation indicate this problem?
 Is the council concerned with this?
 Would this be expensive?
 How could the community get involved?
 Is this outlined in borough climate change mitigation strategy?
 Is this outlined in borough open space strategy?
 Will this cause political issues?
 Would this be difficult considering topography?
 Where specifically in the park is this an issue?
 Is land ownership an issue?
 What other explicit evidence is there in support of this project?
 Is there an existing top up?
 What can be done?

Does direct observation indicate this problem?
 Is the council concerned with this?
 Would this be expensive?
 How could the community get involved?
 Is this outlined in borough climate change mitigation strategy?
 Is this outlined in borough open space strategy?
 Will this cause political issues?
 Would this be difficult considering topography?
 Where specifically in the park is this an issue?
 Is land ownership an issue?
 What other explicit evidence is there in support of this project?
 Is there an existing top up?
 What can be done?

How does this tie into climate change mitigation?

Wandsworth

Could use more planting
 Yes, planted Battersea in 1998
 Not especially
 Volunteer time or money
 Yes, EAP 10.6
 No
 No, just adding plants
 Yes, there are few spots for planting
 Second northern quadrant is very open
 No, the park is council owned
 Overhead maps
 No
 Planting of trees and gardens

Sutton

Yes, park is very open
 Yes, outlined in SOSS
 Not especially
 Volunteer time or money
 N/A
 Yes, SOSS Objective 1, Task 13
 No, just adding plants
 No, there are many places to plant
 Anywhere in the park
 No, the park is council owned
 Overhead maps
 No
 Planting of trees and gardens

Plants naturally scrub the air of carbon dioxide, leaving oxygen as a by product.

Merton

No, park is heavily planted

Croydon

Yes, could use planting
 Yes, outlined in COSS
 Not especially
 Volunteer time or money
 No
 Yes, several places
 No, just adding plants
 No, there are many spots for planting
 Around the border, maybe some gardens
 No, park is council owned
 Overhead maps
 Yes, Friends of the Wandle
 Planting of trees and gardens

Gardens would not only beautify but decrease atmospheric carbon dioxide.

Figure R14: Strategy Chart by Borough

The fourteenth and final question regards the tie in between the strategic idea and climate change. Though one may not consider something such as improving access to a park as a climate change mitigation strategy, it is very important in that if the park is more accessible, it will draw more people, thus increasing open space usage, walking, and cycling. Also, it decreases the amount of time spent indoors using unnecessary power. Additional strategy charts can be viewed in Appendix RE.

Objective 4: Gauge Community Interest in Climate Change Mitigation Strategies

The results of our survey (Appendix RD2) gave us very specific and telling information. We accrued 130 responses to the survey, with a fairly even distribution among the four boroughs (37 from Wandsworth, 33 from Merton, 30 from Sutton, 16 from Croydon, and 14 from ‘other’). In total, 37% of responses indicated that wildlife (both plants and animals) was the area that people wanted to see most improved. This was in line with our expectations, because it is the most tangible aspect of the park. The most popular project ideas were improving accessibility (68%) and planting projects (61%). This was also a predicted result, as accessibility is a challenging and prevalent problem along the whole of the Wandle Valley Regional Park, and planting is a project that most people would enjoy participating in. The most encouraging number however was the 30% of people who indicated that they would be willing to volunteer to work on one or more of these projects. Our survey results, divided by borough, can be seen in figure R15.

Borough	Total	Willing Volunteers		
	Number of Surveys Recorded			
Wandsworth	37	12		
Merton	33	11		
Sutton	30	6		
Croydon	16	8		
Other	14	2		
Total	130	39		
Borough	Areas For Improvement Recommended			
	Accessibility	Cleanup of River/ Banks	Wildlife	Park Improvement
Wandsworth	11	13	10	7
Merton	16	5	30	25
Sutton	5	6	5	3
Croydon	2	5	1	3
Other	2	3	2	2
Total	36	32	48	40
Borough	Project Supported			
	Improving Access	Planting Projects	Green Education in Play Areas	Water Storage (Floods)
Wandsworth	38	24	19	16
Merton	21	17	13	9
Sutton	14	14	14	12
Croydon	12	12	7	9
Other	6	12	5	7
Total	91	79	58	53
Borough	Green Roofs		Solar Panels/ Solar Powered Lighting	
Wandsworth	11		12	
Merton	9		9	
Sutton	11		18	
Croydon	4		5	
Other	3		6	
Total	38		50	

Figure R15: Survey Results by Borough

Wandsworth

In Wandsworth, there was a Wandle Festival event at King George's Park, so we were able to target people who use our specific park. The results from Wandsworth showed that the most supported strategy that we suggested was improving accessibility (97%). This is consistent with our findings because in Wandsworth at the Wandle Delta, the trail and the river are very difficult to find. Also, 68% of people from Wandsworth polled indicated planting projects as an idea they would support. We had also earmarked this as a potential project for King George's Park because there is ample unused open space in the second northern quadrant (see map) and it will not upset any of the park's biodiversity. On top of that, we recognized a strong commitment from the people of Wandsworth as 32% of people polled were interested in volunteering to help with improvement projects.

Merton

In Merton, we polled 33 people at the Festival event in Morden Hall Park, and again received some telling results. 91% of Merton park-goers polled supported wildlife and biodiversity improvement as a concern of theirs. This makes sense based on the fact that Morden Hall Park is a very large and not heavily developed natural space. People expect to come to the park and see biodiversity such as kingfishers, water voles, fish species, etc. 63% of people polled also indicated that they would be most willing to support accessibility projects. This makes sense as well because in Merton, the Wandle Trail passes over and across main streets in multiple places along the trail. In Merton, a very encouraging 33% of people said that they would be willing to volunteer their help on projects, and many left contact information where they could be notified of any new developments.

Sutton

We were able to poll 30 people from the borough of Sutton at Beddington Park and those who had visited the festival in other boroughs. In Sutton, the most supported strategy was alternative energy and the use of solar panels, which garnered 60% interest. The other responses were evenly distributed, with three other strategy ideas (access, clean up, and green education) at 47%. This indicates a desire for renewable energy that is detailed heavily in the Sutton Council's

Open Space Strategy. Sutton did not have as high a turnout for volunteers as the other boroughs, with only 20% indicating an interest in participating.

Croydon

Croydon, in keeping consistent with our expectations, showed 75% of people polled were interested in planting projects in their park. However, 75% also indicated a desire to improve accessibility which was somewhat surprising to us. When we researched further into the possible reasons for this, we noticed that Wandle Park and Waddon Ponds (the other Wandle Park in Croydon) are almost like oases in a heavily urban area. This means that even though there is fairly good access to the parks, there is still a difficulty in reaching them at the local level. Also, we saw an interest (31%) in cleanup projects, which was encouraging but not overwhelming in an area that is sometimes overgrown and usually has garbage on the ground. However, Croydon had the highest percentage of volunteer interest, with 50% of park goers showing support.

Other

Though the results from outside our four boroughs do not factor into our results as heavily, it is still important to note that 86% of people from other boroughs indicated a need for planting projects in the Wandle Valley Parks. This is useful because it displays the initial reaction of people from out of town and shows us what people who are visitors to the Wandle Valley see as a need for improvement.

Deliverables

In this section, we will first introduce some general climate change mitigation strategies, then list our park-specific project suggestions. Before introducing our project suggestions, it is imperative to understand the carbon offsetting capacity and climate change implications of some of our strategies. We developed these deliverables based on our background research, and the results of our methodology.

Planting

In order to determine the carbon offsetting capacity of planting projects, it was necessary to consider what would be planted. The most effective agent to remove carbon would be a large plant which required a lot of carbon dioxide for cellular respiration and growth. Trees seem to fit, since they are large, take a considerable amount of time to grow and can live for a long period of time, making trees a solid investment in climate change mitigation.

It was also essential to consider which kinds of trees to plant. Obviously, trees that would naturally thrive in the southwest region of London were necessary. The trees chosen were of various nature, namely growth rate and wood type; meaning hardwood or softwood or conifer. Given these two factors to consider, the tree species chosen were alder, beech, birch, cedar, elm, ginkgo, maple, oak, spruce and sycamore. All of these species are widespread, as confirmed by the biodiversity profile for London.

Once the species were identified, our team was able to inject the information into a methodology for determining the carbon offsetting capacity on a basis of wood type and growth rate. These factors varied for different species, and species were chosen for their variance. Our team then hypothetically assumed different ages for each varying from 10-40 years of age to determine carbon offsetting capacity over time.

The tree type could possibly be hardwood or conifer, or softwood. This was the first factor in determining carbon offsetting capacity. Then the growth rate needed to be considered, which was classified as either slow, medium or fast. Next the age of the tree was considered which was hypothetically set to a number before 10-40 years. One constant was the number of trees planted, which was our control at 20 trees planted at a time. Once the above factors were identified the next step was to use a table provided in the methodology which can be seen in Appendix D1. This provided the survival factor, which was dependant on tree age and growth rate.

Multiplying the constant number of trees planted by the survival factor after the given amount of time provided the number of trees likely to survive. Lastly, the annual sequestration rate needed to be determined, which is also derived from the table in Appendix D1. This rate is dependent on wood type, growth rate and tree age. Multiplying the number of surviving trees by the annual sequestration rate gave the annual rate of carbon removal in pounds. This is shown in Figure D1.

Name	Tree Type	Growth Type	Tree Age	Number of Age 0 Trees	Survival Factor	Trees Surviving	Annual Removal Rate (kg/tree)	Carbon Sequestered (kg)
Alder	Hard-wood	Fast	10	20	0.589	11.78	8.77	103.4
Beech	H	Slow	10	20	0.568	11.36	2.50	28.4
Birch	H	Medium	10	20	0.576	11.52	5.09	58.6
Cedar	Con-ifer	M	20	20	0.462	9.24	7.59	70.1
Elm	H	F	20	20	0.472	9.44	18.6	175.9
Ginkgo	H	S	20	20	0.448	8.96	4.91	44.0
Maple	H	M	30	20	0.373	7.46	16.7	124.8
Oak	H	F	30	20	0.383	7.66	30.0	229.5
Spruce	C	M	40	20	0.302	6.04	18.9	114.0
Sycamore	H	F	40	20	0.293	5.86	42.4	248.2

Figure D1: Carbon sequestration table

From: Data/
<ftp://ftp.eia.doe.gov/pub/oiaf/1605/cdrom/pdf/sequencester.pdf>

After calculations, it was evident that the most effective tree for carbon removal would be a hardwood with fast growth factors. Even from a tree that had only been around for ten years, the amount of carbon removed was significantly higher than any other tree. This number only increased with time as well and almost doubled over the course of thirty years. This is likely due to the large carbon dioxide demands for a quickly growing tree. In terms of projects, this would be a cheap and effective way of removing carbon from the atmosphere, where time is the only inhibiting factor.

Alternative Energy

Before we make final project suggestions, it is essential to look into the carbon offsetting capacity of each strategy. Some strategies we have examined, such as improving accessibility, do not have direct climate change mitigation results. However, each one has an effect on climate change mitigation and this section will explain the different benefits of each project

One strategy with easily visible carbon offsetting is alternative energy implementation. Using the RECaBS calculator (recabs.iea-retd.org), a comparison can be made between natural gas or coal burning and hydroelectric or photovalic cell energy. The results are shown in Figure D2. There is also a trend path

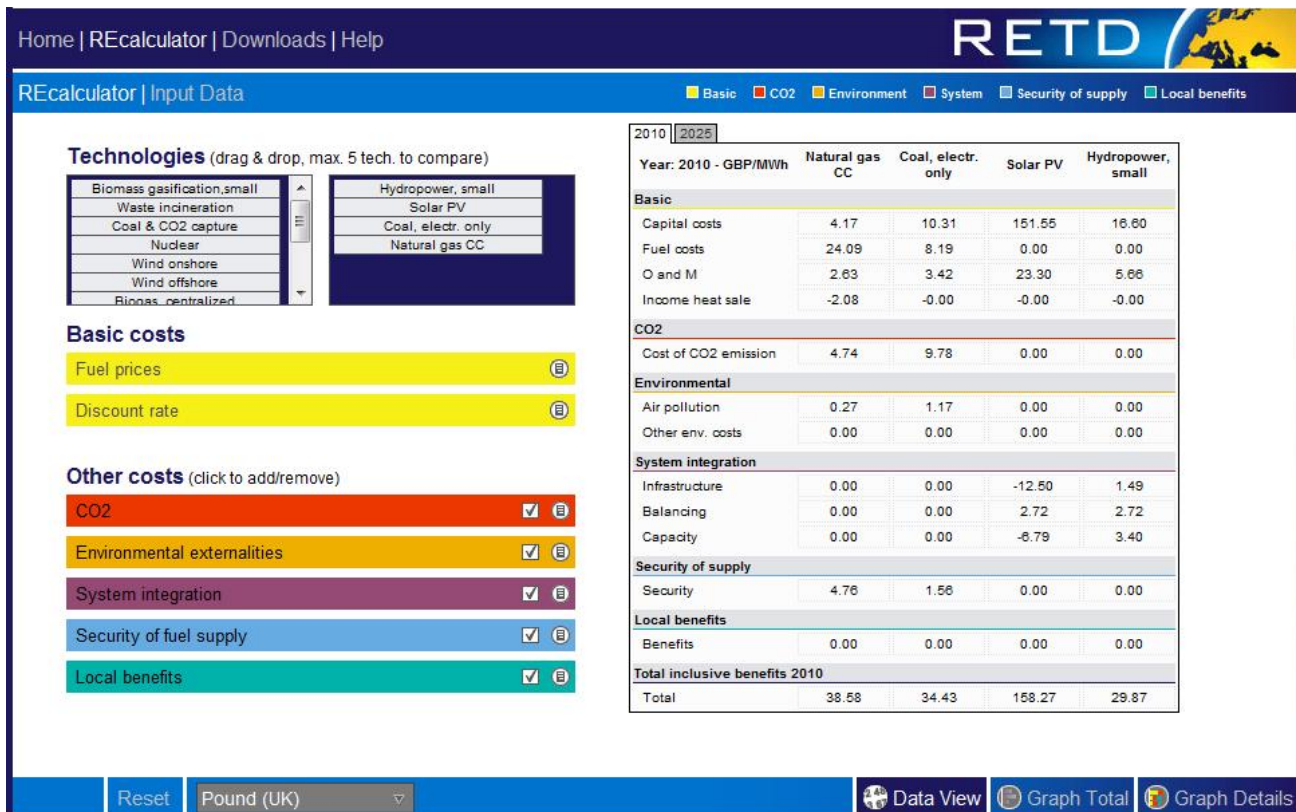


Figure D2: Fuel Cost Calculator
From: recabs.iea-retd.org

that can be seen, which allows for projections into 2025. Overall it shows that the prices for solar panels will continue to decrease, and will eventually help to pay off the high startup costs associated with photovalic energy.

The main benefit of using alternative energy is the decrease in CO2 emission and lack of

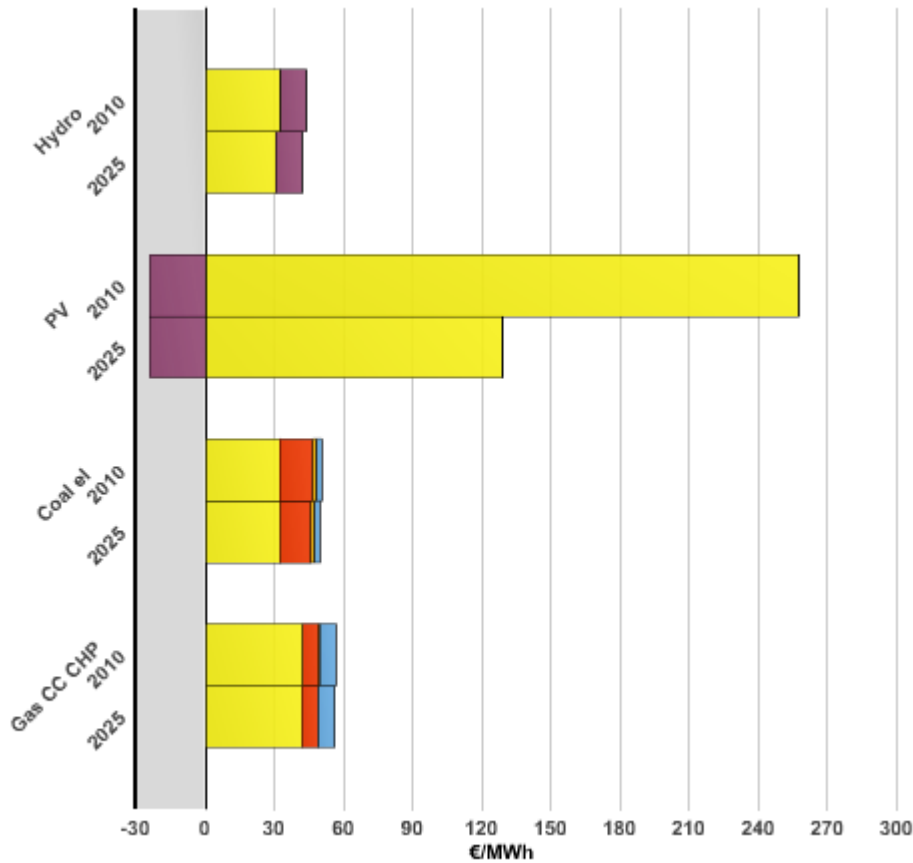


Figure D3: Fuel Cost Comparison Chart
From: recabs.iea-rettd.org

pollution released into the atmosphere. In exchange for this, the reliability and consistency of such an energy source is brought into question. For example, solar energy has high startup costs and requires strong sunlight to harvest an ideal amount of energy which would be suitable for storage. Hydroelectric energy is also shown to be a good medium between solar panels and traditional energy means such as carbon based fuel combustion. Natural gas is also a good alternative, as it releases much less greenhouse gasses. This is shown in Figure D3 all in one simple chart, with yellow representing basic costs, red representing cost of CO₂ emissions, purple representing system integration costs, and blue representing security of supply costs.

For the Wandle Valley Regional Park, it would be useful to implement alternative energy as a way to improve self sustainability and as a means of energy storage. For example, installing solar powered lamp posts would eliminate the need for electricity in many parks, as they are the only fixture in most parks consuming energy. If the river flows strongly in a passage of the river, a water wheel would be useful to produce energy. In our research, it was useful to look at how much energy was used to power a lamppost or heat a park building, but was seen as negligible in the big picture. The theme of alternative energy is more for self sustainability and less for energy generation.

Other Projects

Strategies such as accessibility improvement do not directly reduce carbon levels, but they may do so in a few indirect ways. Improved accessibility, which includes signage, public transportation, and cycle and walking routes, results in more people utilizing the park, which means less people will be at home using energy. Also, if the cycle path is more accessible, more people will want to ride bicycles, which reduces vehicular carbon emissions. If people start coming to parks on a regular basis, they will become more involved with park based activities, such as green education programs.

Project Suggestions

King George's Park

Project 1: Retrofitting Existing Lampposts With Solar Panels

King George's Park has 101 light posts on the main walkway. The electric lighting is a large consumer of energy; energy which comes from local power companies, which use carbon based fuels, which produce a plethora of undesired by-products after combustion- where solar does not.

The borough council has stressed in their Environmental Action Plan that they aim to improve energy efficiency, reduce carbon dioxide emissions and increase usage of alternative energy. The council would surely approve such a project if it is within budget constraints and saves on energy costs.

The current lights have sensors which turn them off while the sun is out, but not all of them work properly and five lights, we observed, remained on during the day; a clear waste of energy. If solar paneled lighting were installed the money that would have been used for paying for power could be invested elsewhere once the startup cost of paying for the battery and panel is offset.

From our survey results, 32% of the people polled in Wandsworth indicated they would like to see solar paneled lighting implemented as a project, which suggests a good amount of community support.

Implications for carbon offsetting with solar energy are straightforward; if energy is not used from power companies, but rather a renewable source, no pollutants are released into the atmosphere. In addition, the energy is free after the investment of solar panels pay off. Not only would this project mitigate climate change, it would also make the park self sustainable and not need energy from an outside source for the most part.

Project 2: Improving Accessibility in the Park Using Signage and Public Maps

Accessibility within King George's Park is a definite issue, as it is very difficult to navigate within the park. The Wandsworth Spatial Policy, accessibility is stressed in order to increase usage. If accessibility to the park is adequate, more people will visit. Likewise, if accessibility to park features improve the park will be more appealing.

Our direct observation revealed several accessibility issues within the park, the most pressing being the river. The river is very difficult to locate, and on our first site visit there were no maps or signs to direct us to it. Signage needs to improve greatly, mainly because the river is a very important component of the park's identity in the Wandle Valley. In addition to this, some playgrounds are only accessible on one side, and are locked on the other.

Community interest is very highly vested in accessibility, with 97% of people from Wandsworth surveyed identified accessibility as an issue. In addition, 30% specifically wrote in that accessibility was a problem when asked what needed improvement.

Improved accessibility has an indirect effect on climate change, where if people know where the park is and how to navigate through it they will visit the park more often and use less energy in their homes. They may also get involved with the many green education programs that take place in King George's Park. It is our recommendation to increase signage along the

walkways within the park and ensure that all parts of the park are easy to locate by placing maps at the entrances and at path junctions within the park. A good example of a very accessible park is Morden Hall Park, which is extremely easy to navigate.

Project 3: Planting

King George's Park is planted heavily in some areas, and not in others. This is likely due to the fact that they wanted to maximize open space by planting around the outside edge of the park and only in certain sectors to leave room for features such as football pitches, bowling lawn, and picnic areas.

The climate change policy does not directly imply that planting is necessary, but it does stress reducing carbon dioxide emissions. While most of the Environmental Action Plan stresses energy efficiency and reducing carbon dioxide emissions, a planting project would be a good supplement to the preventative measures already in place. Mike Brook and Mandy King, from Wandsworth council, emphasized planting as a beautifying measure and a valid carbon offsetting strategy.

From our direct observation, planting is scarce in many areas. From the overhead map (Appendix RB1) it is very obvious that planting is lacking in many areas. A planting project would not only make the park more appealing from a visual standpoint, but also act to mitigate climate change.

Community interest in planting in King George's Park is very strong with 65% of people surveyed selecting planting as a project. This is a strong result considering nearly all the people surveyed from Wandsworth were there for the Wandle Festival, and thus have a vested interest in King George's Park.

Planting has a very direct effect on climate change mitigation. The act of cellular respiration naturally converts carbon dioxide to oxygen. For the purposes of King George's Park, we recommend planting fast growing hardwood trees in the unpopulated green spaces such as the space in between the tennis courts and first set of football pitches or the area just south of the last set of football pitches. Decorative gardens may also be put into these spaces to add decorative effect.

Morden Hall Park

Project 1: HOP Top Up

In Morden Hall Park, the National Trust is already working toward sustainability of the park. The Hub of the Park (HOP) initiative is a five year plan which began in November 2008 and will continue until May 2013. The buildings in Morden Hall Park are from the nineteenth century, so the goal of the HOP project is to retrofit the old construction to be sustainable and energy efficient, as well as to demonstrate the different methods taken to accomplish this goal. The focus is on a diverse array of projects such as new insulation, hydroelectric power, solar power, and ceramic stoves. Not only will the HOP project create an energy efficient compound in Morden Hall Park, but the finished sustainability centre will serve as an educational tool for visitors, construction companies looking to improve their carbon footprint, and school groups on visits. The HOP will be a working demonstration of sustainable strategies, and still maintain the heritage of the original building.

Our team has met with the National Trust and multiple members of Groundwork regarding the HOP project, and has seen how effective the different elements will be. We already know that councils and other organizations are on board with the project, because it is already underway and has secured over 630,000 pounds in funding from Europe. Also, we have identified Morden Hall Park as the best park we have studied with regard to accessibility, efficiency based on area, and maintenance. The HOP project is exactly what we would have suggested- a model for energy efficiency which will reduce the carbon footprint of the park's structures, but also serve as a green education centre for school groups and other visitors.

The most tangible aspect of the HOP project is the water wheel on the Wandle. The water wheel is not in working condition right now, but is a focus of the National Trust as an energy generation tool and also as a working exhibit to show others how energy can be created by natural means. This type of project is our team's ideal scenario because it is not only a reduction of the National Trust's carbon emissions, but it will also teach others green energy methods and draw visitors to the park. The multifaceted results of the HOP project, and specifically the water wheel, are effective at spreading knowledge of energy efficiency and carbon reduction awareness.

Project 2: Water Storage

While the HOP project outline briefly mentions water harvesting, our team identified a few detailed ways in which the water in Morden Hall Park could be more efficiently utilized. Morden Hall Park has a large section of marshland which serves as a natural flood drainage system. However, based on the examples we have seen in our background research, we came to the conclusion that the water in some of the side streams and marshes could be used to reduce excess water use. Similar to the concept of 'grey water', our team found that setting up unobtrusive collection containers in selected locations along a few of the side streams would give the park a source of water for planting projects and other projects such as demonstrations on hydroelectric power in the HOP center. This has been researched by the Center for Appropriate Technology at Humboldt State University, and has been a success in their private gardens (<http://www.humboldt.edu/~ccat/waterconservation/marsh/stacySP2002/greywater.html>).

Project 3: Biodiesel Usage

The only element of Morden Hall Park we pinpointed as being inefficient carbon-wise was the use of diesel mowers for its upkeep. These mowers use 25 litres of diesel fuel each week, which is not a dangerously bad level, but still is an area which we feel can be made more efficient. We believe that it is possible to use more efficient fuels, such as biodiesel, to power the mowers and other maintenance equipment. The chart in figure D4 illustrates the difference in emissions of multiple chemicals between diesel fuel and biodiesel.

Table 3. Emissions (gr/kg) of biodiesel and diesel.

	Biodiesel			Diesel			% Increase
	Production	Combustion	Total	Production	Combustion	Total	
CO	0.92	3.18	4.10	0.40	6.98	7.38	80%
CH ₄	0.98	0	0.97	1.18	0	1.18	22%
NO _x	2.22	25.75	27.97	1.21	27.91	29.12	4%
N ₂ O	0.01	0	0.01	0.04	0	0.04	264%
PM ₁₀	0.10	0.13	0.23	0.02	0.47	0.49	113%
PM _{unsp.}	0.49	0	0.49	0.76	0	0.76	55%
SO _x	4.20	0	4.20	4.39	1	5.39	28%
CO ₂	-2,155	2,827	672	495	3,186	3,681	448%

Source: Sheeman, 1998

Figure D4: Biodiesel vs. Diesel Emissions Chart

From: <http://ressources.ciheam.org/om/pdf/a48/00800032.pdf>

The increase in emissions, especially of carbon dioxide, is dramatic. CO₂ alone is decreased by 448% when using biodiesel, which is a significant contribution when extrapolated to cover 25 litres per week. In addition, there is potential in Morden Hall Park to grow and produce biofuel plants such as sweet grass and other oil producing plant life. Though growing plants and producing biodiesel are not the same, we feel that it would be symbolic of how much Morden Hall Park is invested in sustainability. Also, as exhibited by Oliver Parsons-Baker in the human statue project in Trafalgar Square, feces can be a very natural source of energy. Though it is a reach, there is potential to create an even more sustainable Morden Hall Park.

Dale Park

Project 1: Creating a Green Education Center in the North End of the Park

Dale Park, the smallest park we have analyzed, has excellent potential as a green education center. The park is in a highly residential area, so it would be easily marketable to the surrounding community. Potential Dale Park green education programs could be a solar power or hydroelectric small scale model, intended to show people how different alternative energy methods can work. In the northern section of the park, there is an open area that could play host to a solar panel information center, with a working model. From that area, there could be a path down to the river, where there could be a simple water wheel powering a small circuit. If these two areas could be set up as exhibits, it could serve a stop for families who are interested in teaching their children or others about renewable energy. Many parents enjoy teaching children themselves, and this mini-renewables section of Dale Park would be an easily accessible opportunity to do so.

Project 2: Solar Panelled Lighting on Three Non-Functioning Park Lamps

The path running through the middle of Dale Park is currently lined by three lampposts, none of which are in functioning condition. Since the park is used so often by local people as a ‘cut through’, we have pinpointed lighting in the park as an area of interest. To keep this aspect of our analysis related to climate change mitigation, we recommend implementing solar powered lighting to render the park sustainable. We could not get definitive responses on the cost of implementing a solar system similar to Figure D5, for Dale Park, so it will require further

research. The only information we could find was that it would involve a substantial initial investment but would have a payback period of an average of less than nine years (<http://www.builditsolar.com/Projects/Lighting/lighting.htm>). This is a worthwhile investment, because not only does it solve the lighting problem, but it also reinforces the image of the park as self sustainable.



Figure D5: Example Solar Lighting System
From: <http://lasvegassolarsupply.com/>

Project 3: Planting Along Fences

Dale Park is not the best maintained park, and the park's fences and playground are heavily vandalized. There is also a lot of room along the fences where planting could be done. We recommend planting of an ivy-type plant on the fence itself, and a row of small (3-4 foot tall) trees or bushes in front on the fence. This would accomplish three goals: covering the existing vandalism (fence planting), preventing future vandalism (planting in front of the fence creates a

natural perimeter), and reducing carbon emissions (planting). This is a low-cost way to improve the park's appearance as well as reduce the carbon footprint.

Wandle Park

Project 1: River restoration

The river in Wandle Park was culverted underground when the park was being built. Currently there is an initiative to restore the park and bring the river to the surface headed by Friends of the Wandle. They have been granted £1.4 million for the purpose of restoration, with the deculvert project likely being the most expensive. For this reason we think it would be a good idea to provide additional funding and ensure this project is completed.

The council is very interested in having a “green mentality”, which is stated in the Environmental Procurement Policy. In the open space policy the council stresses maintaining natural habitat and involving the community through the open spaces, which would naturally occur with the implementation of this project. These are all ideas Groundwork and the Borough of Croydon are interested in.

In our direct observation, we felt something was missing, which would be the river. The River Wandle is what ties the regional park together and gives it identity. Furthermore, parks in the Wandle Valley are expected to have the River Wandle in it. In addition, current plant life and biodiversity were lacking and the river and island in the middle would bring back bird species, aquatic plant life and fish, where the latter two are nonexistent due to lack of water. The river would also make the park much more appealing, and work as a draw to bring more people to the open space.

The project has been proposed and approved already and is part of the vision of the Wandle Park restoration plan set forth by the community interest group Friends of the Wandle. The community interest in the project seems high, and when we administered our survey in Croydon, there was a lot of talk about the restoration of the river, as it was not an option on the survey.

Bringing the river from underground would have several effects on climate change mitigation. The existence of rivers has been proven to reduce urban heat island effects, as explained in the background chapter. The restoration of the river can also be done in such a way that it will minimize the flood risk with urban drainage systems.

Project 2: Planting Around the Outside of Wandle Park

Most of Wandle Park is open green space. The middle of the park is devoted to football pitches, the playground and skate park. Around the outside of the park, there is a ring of mature trees, but planting there is spotty and unbalanced with many trees concentrated in one area and much less in others. There were also no ornamental gardens for decoration and the park seemed plain.

As stated previously, borough council was interested in going green in their environmental policy. Planting trees would not only help offset carbon, which was one of the goals set forth in the policy, but also improve quality of the open space, which is outlined in the borough open space strategy. Planting is also inexpensive and can likely be funded easily.

Through direct observation, the trail around the park was well shaded by trees at points and completely exposed in others. On the website for the redevelopment of Wandle Park, the future plan involves several new sites for tree planting. It is also stressed that as many mature trees should be retained as possible, since some will need to be cut down in river restoration. Not only have we found planting to be an important project for Wandle Park, but the fact that it is stressed in the redevelopment plan confirms how important it will be.

The community is very interested in planting as 75% of people surveyed identified planting as a project they would like to see implemented. More so, half of the surveyed marked they would be willing to volunteer their time for Groundwork, meaning the spark for community involvement definitely exists. This may be tied together and volunteers could help by planting trees, making them feel even more involved in the park and community as a whole.

There are a lot of climate change mitigation implications associated with planting. First there is the obvious effect of carbon dioxide removal through cellular respiration of plant life. For this region, we recommend fast-growing hardwood trees for maximum carbon sequestration in the open spaces around the outside of the park. In addition to the direct carbon scrubbing effect, there is also a beautifying factor that would draw more attention to the park. The more citizens utilize the park implies less use of electricity in homes. This is why the restoration plan also outlines planting ornamental gardens and shrubs for decorative purposes. Of course, these too are plants and would have the same carbon sequestration potential as trees, just on a smaller scale.

Project 3: Green Education Programs in Wandle Park

Green education programs are already implemented over some parks in the Wandle Valley, such as Morden Hall Park in Merton which has an education program for children. This would be useful in Wandle Park given the number of play features such as the playground, presence of the park rangers, football and cricket pitches, a skate park and a great amount of open space.

The council stresses green awareness in their environmental policy. The open space policy also emphasizes community involvement, which would naturally happen with a green education system. From the survey given at the Wandle Valley festival 44% indicated they would like to see green education in play areas. The council also explicitly stated in their open space policy that they would like to to “Increase opportunities for lifelong learning (the understanding of conservation and care of open spaces, heritage and historical use of sites, wildlife and planting), also identify links with schools to specific open spaces,” (COSP, 2005).

The benefit of play programs in open spaces is awareness. You can also teach from a young age about environmental awareness and teach good habits from a young age. Obviously the implications of this project on climate change are direct, where you can teach children, and even adults, to practice better environmental habits. Furthermore, since so many of the surveyed were willing to volunteer it would have implications for people to volunteer in this project as well.

Conclusion

Groundwork's Wandle Valley Regional Park will serve several purposes to the four communities along the River Wandle. The urban green spaces along the Wandle will not only provide local recreation but become areas where citizens can participate in green initiatives and become educated about sustainable technologies that can foster environmentally sound decisions on an individual level. In our project, our team has developed a framework to assess urban green spaces. We analyzed four spaces, one in each borough along the River Wandle, and developed list of climate change mitigation strategies based on the needs, local interest, and assets of each space.

Our team identified several important areas of research in our work in assessing the spaces in the borough. We determined that environmental issues such as land use, wildlife, and flood risk are important due to the duty of environmental organizations to maintain natural habitats in parks while still encouraging citizen use and preparing for climate risks. Social issues such as citizen involvement, local clubs and groups within the park, and the existence of existing projects pertaining to sustainability and park improvement are essential because of the goal of communities to foster citizen usages of green spaces, and to determine the interests of citizens in the open spaces in their immediate proximity. Regulatory issues such as structures in place, ownership, and surrounding area type play a role in limiting and focusing the possibilities of project implementation due to policies in place, the ability fund development, and assets available. Lastly, energy usage for issues such as heating, lighting, and maintenance play a role in assessing the sustainability and the role of spaces, either as an emitter or off-setter, in terms of carbon emissions. Our project suggestions were developed based on these principles and our team analyzed all these issues before producing these suggestions tailored to each green space we analyzed.

Due to limitations in time, our team focused on specific forms of alternative energies and green projects while there are many other options that could be available for their open spaces. Our team would suggest that Groundwork continue to look into new green technologies, both existing and developing, and consider the benefits to urban green spaces in the Wandle Valley Regional Park. Also, our team would encourage Groundwork to continue to conduct research on

the interest of local citizens to ensure the diverse community involvement they seek to foster in urban green spaces.

Our team would also encourage the local councils to keep more specific data on the energy expenditures of its parks. In our research, our team discovered that due to contracting issues, the energy totals of each park are typically unavailable. Having energy audits for individual green spaces would enable the councils to ensure that their green spaces have an appropriate carbon footprint, especially considering the importance of sustainability outlined in most of the boroughs' climate policies.

In our research of climate change, urban green spaces, and green technologies, our team has gained an appreciation for the environmental impact of open spaces on surrounding areas. Our team would encourage Groundwork and the local councils to continue their development on the Wandle Valley Regional Park. Despite the issues presented by the transitional phase of park development, unifying the urban green spaces along the River Wandle into the Wandle Valley Regional Park would not only help create a unified green community but also offer locals of all the boroughs opportunities to take information on sustainability (through projects like those we have suggested) that they could observe in the parks and apply it in their homes, creating a greener South London.

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Appendix BA: EU Climate Change Mitigation Strategy and the Kyoto Protocol

The Kyoto Protocol

The United Kingdom, London in particular, has taken outstanding initiative in the realm of climate change. This does not start with London, as some may think. Here in the United States the idea of climate change mitigation is somewhat foreign. This is due to the fact that the US is

CO₂ emissions increase for the period 1990–2010

	Percentage annually
USA	1.38
EU	1.05
JPN	0.94
RoAI	1.9
EEFSU	−0.74
FSU	−1.18
CEE	0.45

Figure B9: Change in CO₂ emissions

From: An economic assessment of the Kyoto Protocol

one of the only countries to not ratify the Kyoto Protocol, where the UK and several other European countries have. The Kyoto Protocol in its most basic form is a regulation to decrease greenhouse gasses (mainly carbon dioxide) by putting essentially installing a maximum emissions policy. The main reason for this is due to the staggering increase in carbon emissions since the early 1990's, as show by Figure B9.

An analysis put out by OPEC shows the implications of the Kyoto Protocol on Europe: “the increasing ability to introduce more efficient technology; increased incentives to save energy as a result of increasing import dependency; a gradual shift away from energy subsidies; and the expected strengthening of energy prices over the forecast period.” (Ghanem, et. al) This is what the Kyoto Protocol aims to achieve by 2020, and how OPEC sees it playing out if some reasonable assumptions are made. These include, but are not limited to increases in alternative

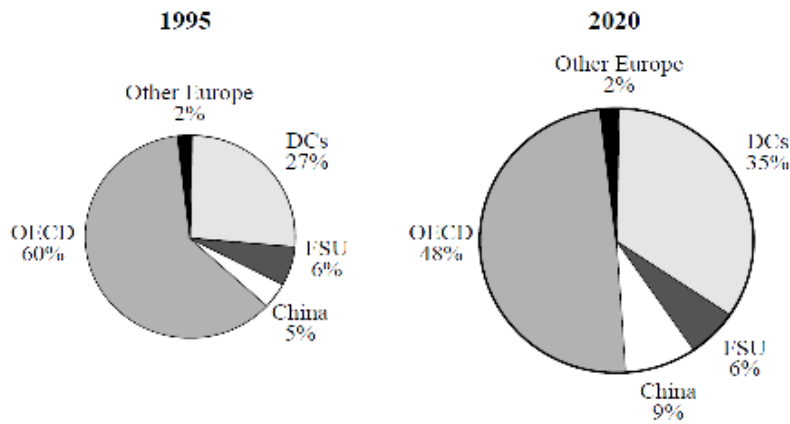


Figure B10: Changes in energy demand

From: Oil and Energy Outlook to 2020: Implications of the Kyoto Protocol

energy, less use of gasoline, and less of a rise in energy demand in the near future. This is shown in Figure B10, along with a possible predicted world oil demand. The UK itself is in the OECD portion, which aims to have much reduction in oil demand.

The Kyoto Protocol is not as straightforward as it seems. As it is said very often, Annex 1, or heavily industrialized countries are the main problem. For that reason, these countries require the most decrease in carbon emissions. Thus, countries can obtain decreases in emissions in the form of “credits”, with one unit of a drop in carbon dioxide emissions being a credit. These credits can be used as a trading mechanism; where drops in emissions can be exchanged for currency. Since a radical drop in emissions in large countries are required to adhere to the Protocol, is hard to achieve in more industrial countries. Therefore an Annex 1 country may want to buy credits from another country that is less industrialized and perhaps had an easier time in reduction. “According to a first scenario, only Annex I countries participate in the trading mechanism.” (Dagoumas et. al) This trading system gives smaller countries incentive to reduce carbon emissions so credits may be traded for cash and alleviate economic stress.

European Union Climate Change Policies

The European Union has also played a major role in trying to push the climate change agenda. The EU recently held a conference to decide what to do with respect to the struggling European economy. Aside from a large stimulus package being signed there were major agreements on climate change mitigation. “European leaders simultaneously struck a climate change and energy deal that, on paper at least, meets the so-called Triple-20 threshold - cuts of 20 per cent to greenhouse gas emissions and overall energy use by 2020, while shifting at least 20 per cent of energy needs to renewable sources by the same date.” (Potter, M.) This is a long term plan which is supposedly filled with loopholes and stipulations in the fine print. However, this is for Europe in general and may not also hold true for London and the UK itself.

The European Union has provided multiple strategies in this dire time. “The prompt adoption of biofuels, renewable energy sources, greater energy efficiency and nuclear power can slow down what would otherwise be a worldwide disaster, said the Intergovernmental Panel on Climate Change's working group.” (Clover, C) This quickly summarizes the action the EU has been taking on climate change mitigation, which are close to the main strategies of the Groundwork initiative. There also exists a separate plan from the EU called the GRaBS initiative which is also close to Groundwork in the sense that it wants to incorporate green and blue spaces for carbon reduction, much like our project.

Appendix BB: Alternative Energy Summaries

Wind power

Wind energy is considered one of the cleanest sources of energy available. A large turbine is attached to a three bladed fan which turns with respect to wind velocity, thus turning a generator at the base of the turbine creating electricity. Key factors include wind speed in the surrounding area, discussed in a 2002 (Mutschler & Hoffman), for example if there is not enough wind, the turbine will not spin and would not generate power. Turbines are also associated with high start-up costs and do not begin to pay off for some time, making it a difficult investment for some individuals and companies. Lastly turbines citizens may have issues with turbines due to their aesthetic appearance. Tsoutsos et al. in a study of public opinions on turbines found that the main detracting factor for citizen acceptance of wind power and wind power farms was the unattractive appearance of turbines (Tsoutsos et al. 2008).

Solar power

Solar, or photovoltaic energy, is also a popular form of alternative energy. This uses radiation from the sun which is absorbed by a solar panel, or photovoltaic cell, and is converted into electricity as a means of power. Again, solar power is a viable option but also has high start-

TABLE 16.5
Forecasts for Alternative Electric
Energy Generation Costs

Technology	Generation Cost (Cents/ kWh)
Onshore wind	3-4
Gas turbine	3-4
Offshore wind	3-5
Coal thermal	3-5
Nuclear	4-6
Biomass	4-6
Ocean Wave	4-8
Photovoltaic	15-20

Note: U.S. cents/kWh by 2020 based on 2004 price index.

up costs. The table below from a study of wind and solar power (Patel, 2002), shows the future projected cost of solar power and how the input of money will be greater than other alternative

energy sources. The high cost paired with the lack of energy pay-out in the predicted for the future requires heavy consideration before implementation.

Solar water heating

In addition to photovoltaic cells which convert sunlight to electricity, solar energy may also be harnessed as heat energy. This uses many lenses and/or mirrors to concentrate solar radiation to a beam which is then used as a heat source, in this case to heat water. This water may then be used as steam which may then be applied as steam would be used by combustion of fossil fuels in a furnace to create steam would in a traditional power plant. This technology is much cheaper, but is significantly less effective than normal combustion would be.

A common use for solar water heating is to provide heating to homes and structures. The heat from this water can be dispersed throughout a building or structure and prevent the need for other heating technologies, thus reducing the need for carbon dioxide producing heating systems. This technology is fairly easy and cost effective to implement. The table below from Energy Saving Trust shows the cost and CO₂ savings from using solar water heating.

Fuel Displaced	£ Saving per year	CO ₂ saving per year
Gas	£65	325 kg
Electricity	£95	635 kg
Oil	£85	365 kg
Solid	£55	645 kg

All savings are approximate and are based on the hot water heating requirements of a 3 bed semi detached home.

Biomass heating (Pyrolysis)

Usage of biomass as a means of energy is a very easy way to cut down on petrol fuel usage. Petroleum was a convenient source with high energy yields, but has undesirable exhaust, such as much carbon dioxide. Also, the fossil fuel nature of petroleum means that it is not renewable and therefore, in the long-term, could be entirely depleted. Essentially, all that is needed is another material that may burn and yield energy. Any organic material should be applicable in a form of biomass, such as wood, hemp, or any other material which contains an

easily ignitable hydrocarbon. Once combusted the heat energy would be used to heat steam and thus spin a generator.

One form of biomass heating that could be used to generate heat is pyrolysis. Pyrolysis is the burning of organic wastes and compost to generate energy. In London, much of the waste is already incinerated for spacial reasoning so the prospect of generating useful energy from this process could be very helpful.

There are few drawbacks to use of biomass, but one would possibly of having to switch furnaces to accommodate the different material to be combusted.

Ground sourced heating/cooling

Ground heating/cooling is an interesting form of alternative energy. This can either harness heat absorbed by bodies of water at the surface or utilize the lack of heat at the bottom of the body of water as a means of cooling. This could be considered as a natural refrigeration loop and would eliminate the need for an external cooling system, which would normally require energy to heat and cool the refrigerant, thus decreasing emissions as well. There is really no drawback, only the fact that the body of water must be proportional to the unit of operation for cooling and heating needs for the commercial process.

Hydroelectric power

Hydroelectric power is very common as well. This uses a flowing body of water as a means to spin a large water wheel thus spinning a generator and directly creating electricity. This is convenient if the current of the flowing water is fast enough. However it may be considered a waste if the current is not fast enough as with wind energy is to wind velocity.

Appendix BC—Interview Questions

What elements are you hoping this park will address environmentally?

What elements are you hoping this park will address socially?

What elements are you hoping this park will address economically?

Do you have any maps or studies that show topography issues of your space?

Do you have an analysis of the soil type within your open space?

Is your open space within the flood risk or flood catchments area?

Has your open space had any flooding issues? If so, what occurred?

What type of plants do you have in your open space? Are they native species?

What animals currently inhabit in your open space? Are they native species?

What is the yardage of your open space?

What local zoning regulations did you follow when implementing this open space?

Did local zoning regulations restrict your open space development in any way?

Are you aware of any local zoning regulations that would prohibit the implementation of solar panels or wind turbines on your open space?

In your opinion, would wind turbines or solar panels have a positive or negative impact on your open space? Why?

(If we could not find in preliminary research) Who currently owns the land this open space is located on?

Do they have an active role in the maintenance, planning, and use of your open space?

(If there are buildings located on the parcel) What is the use of the structures on your open space?

(If it is no clearly visible) What types of developments (residential, industrial, commercial) surround your open space?

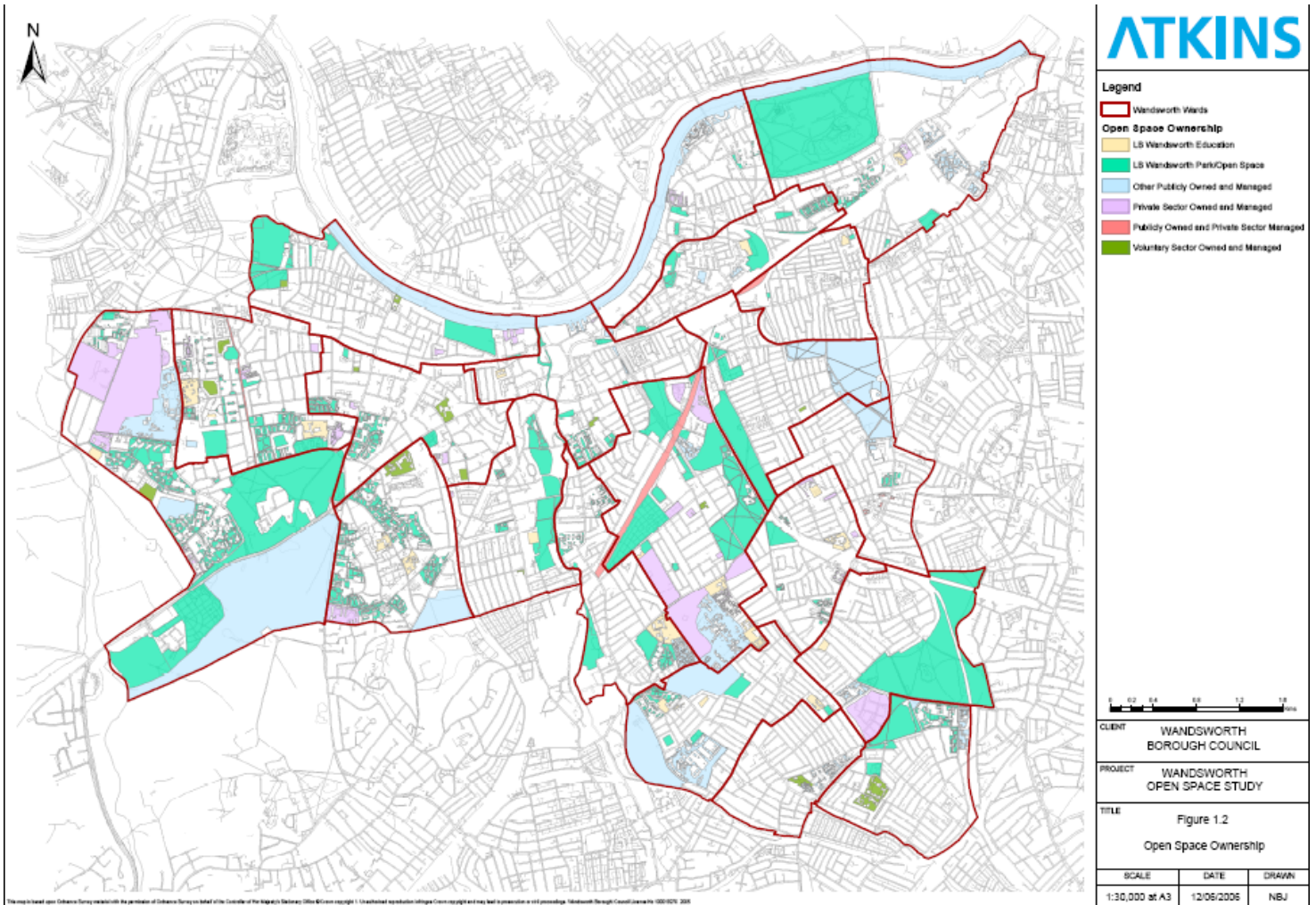
How do citizens use your open space currently?

About how many citizens use your open space daily?

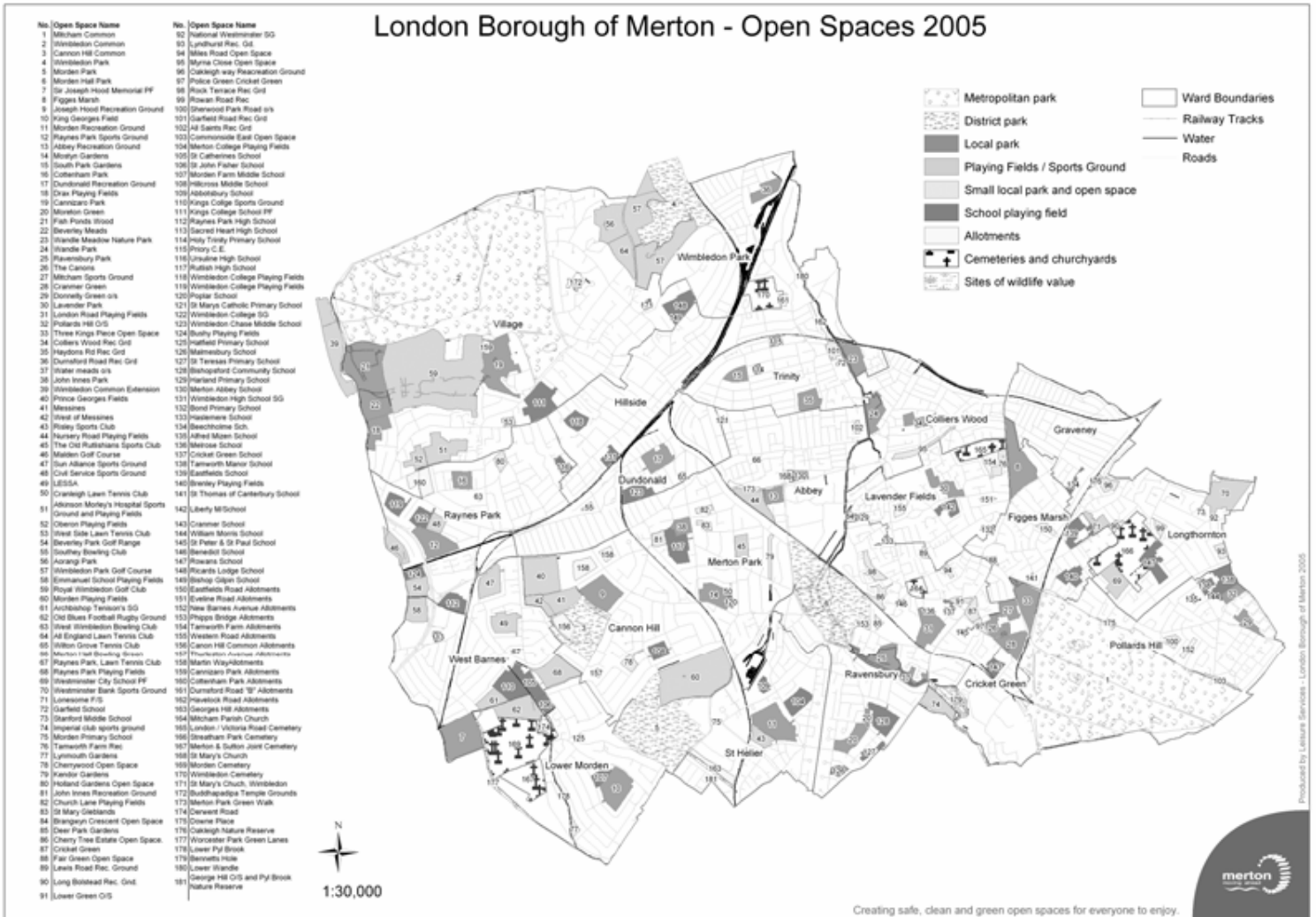
Do citizens play an active role in the decision making, maintenance, or development of your open space?

How accessible is your open space? How do citizens get to your open space (bike trails, bus routes)?

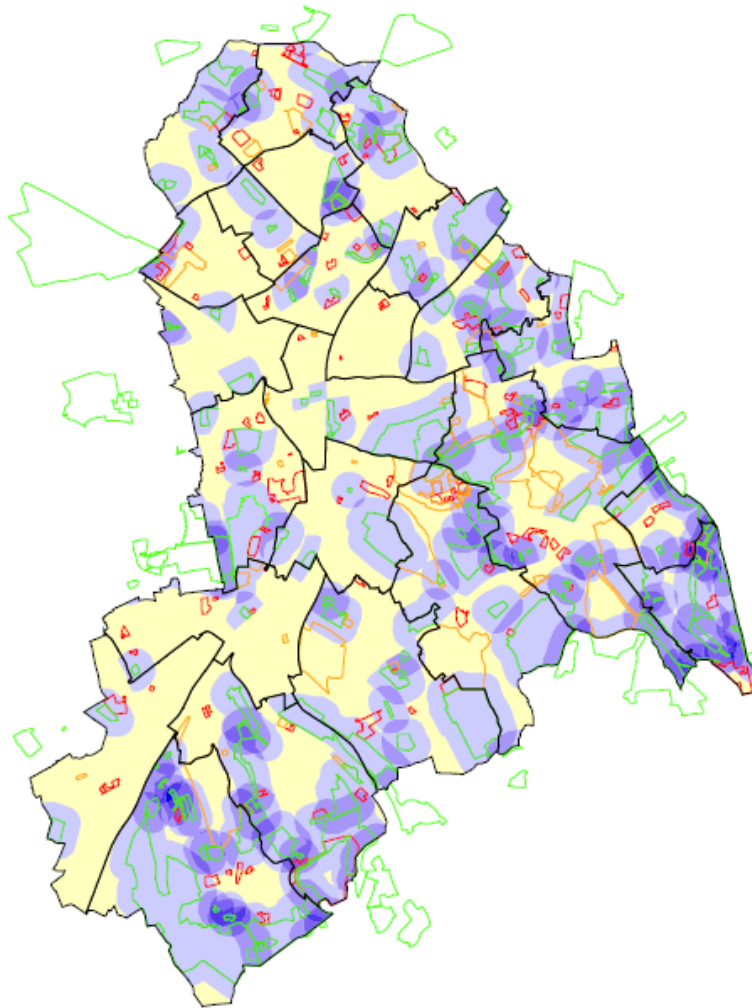
Appendix RA1 – Wandsworth Land Ownership



Appendix RA2 – Merton Land Ownership



Appendix RA3 – Croydon Land Ownership



Croydon Borough Council
Open Spaces Strategy
2004

Access to Unrestricted
Open Spaces

Figure No: 2

Legend



All Unrestricted Sites with a 400m
"Walking Distance" catchment. Density
of colour indicates the number of
accessible sites.

- 1
- 2
- 3
- 4
- 5
- 0 - Area of Deficiency

Open Spaces

- Unrestricted
- Limited
- Restricted

□ Croydon Ward Boundaries

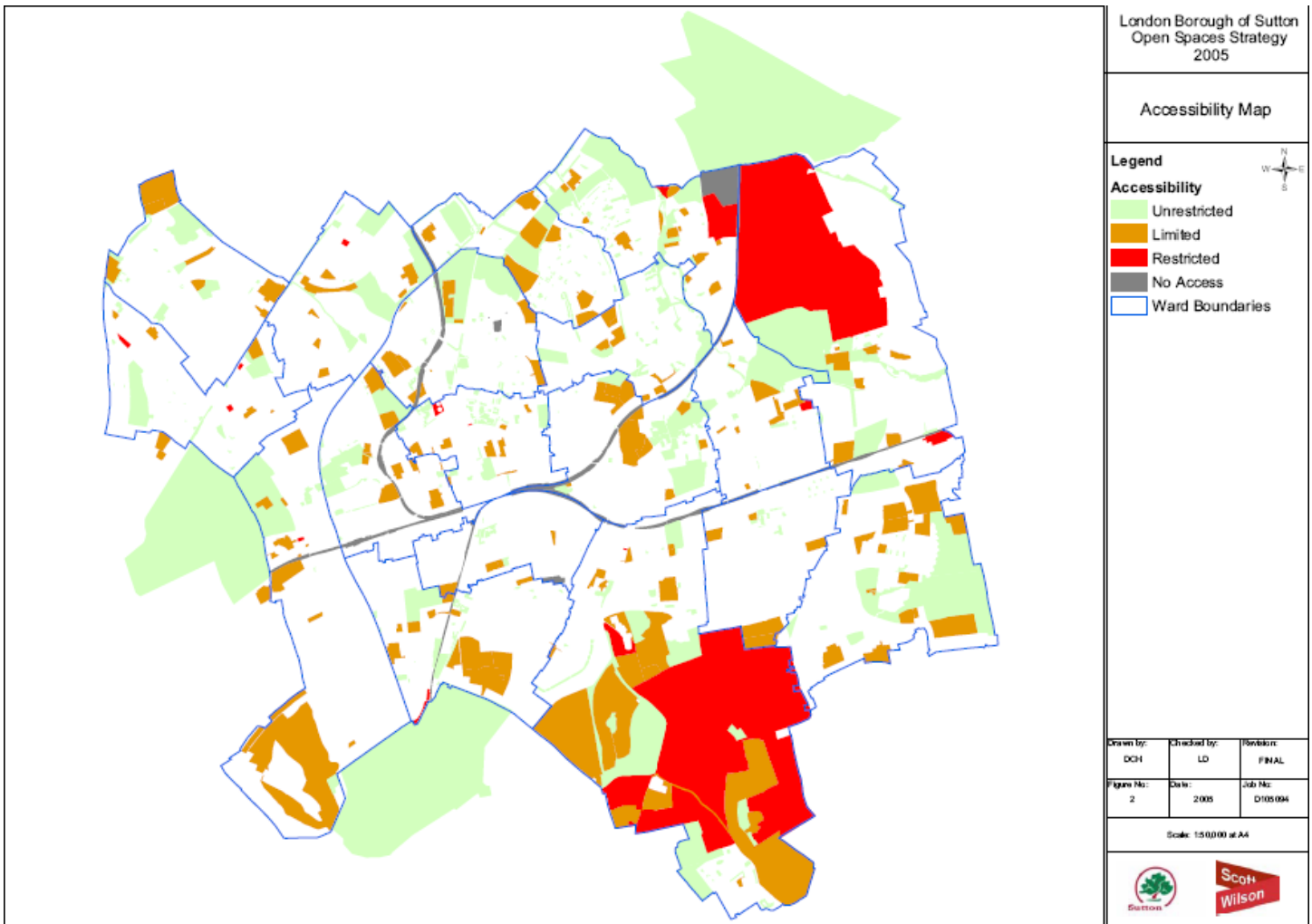
Drawn by: DCH	Checked by: RB	Revision: FINAL
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Figure No: 2	Date: 19 Oct 2004	Job No: D106621
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Scale: 1:90,000 at A4



Appendix RA4 – Sutton Land Ownership



Appendix RB1 – King Georges Park Aerial View





King George's Park Map Key

- | | |
|--------------------------------------|---|
| 01 Fountain | 06 Wandie Recreation Centre |
| 02 Day Care/Infant Playground | 07 Kinder Adventure Playground |
| 03 Tennis Hall | 08 London Marathon Event Stop |
| 04 Bowling Club Building | 09 Northfield Health, Fitness and Wellbeing* |
| 05 Garden | 10 Southfield College** |

0 50 100
Scale in metres

* Not a part of the park

Appendix RB2 – Morden Hall Park Aerial View



Appendix RB3 – Dale Park Aerial View



Appendix RB4 – Wandle Park Aerial View



Appendix RC1 - Minutes From Meeting with Jennifer Ullman

Jennifer Ullman- Part of the Wandsworth Council, consultant, vice chair of Wandle Forum

Areas in Wandsworth part of the Wandle Valley:

I. King Georges Park-long linear park

- Recontour the park bank
- Want to upgrade the park
 - Furniture
 - Plants
- One end there is a transport station and the area is up and coming, lots of young people, nicer area
- Other end is really poor, anti-social behaviour, poverty, there are very high population of ASBOs

II. Wandsworth Town Center

- Redevelopment of turning an old brewery into houses and shopping center
 - Make area more appealing
 - Improvement of the habitat
 - Building a pedestrian foot path
 - Making social aspect more positive

III. Mouth of River Wandle Flowing into Thames

- There is a single turbine that powers one light bulb
- There is a dam system already there that interferes with the river
 - Want to get rid of it but really hard to do
 - Too expensive
 - If they get rid of it the silt that was built up on one side of the dam will flow onto the other side and harm marine habitats

IV. Further Down

- The council owns less land, its privately owned
- There is a park, but no foot path
- There is a community garden, but there are private sections of allotments, people get their own little section of land to garden
 - Council wants to do something with it but there is a waiting list to get a plot of land for years

V. Wandle Trail

- Want to restore it
- Goes out of the way sometimes
- Want a bridge that crosses the river
- Want to improve signage

- Want to promote connectivity with Wandle Trail
- Portions of the trail aren't always lit or smooth

VI. Tooting (town)- not on river, but in vicinity

- economically bad area
- want to regenerate that part
- lots of immigrants- health care issues
 - Need to promote health topics
 - Education
 - Healthy diet
 - Mobility Maze
 - Problems with funding for maintenance

Control Issues:

- Whether or not the green spaces will be turned over to another body of people once it's a regional park
- Wandsworth officials may not want to give up the control and ownership of land; they want a say in what happens with the WVRP
- Ownership needs to be determined, pivotal issue.

What they want to see in a regional park:

- More bike and walking paths for pleasure, commuting for work, health
- Promote a bicycle scheme along the valley- similar to zip cars

Climate Change Aspects:

- Borehole with some leakage issues
- Reduce emissions from council vehicles/activities like cars and lawnmowers
- Figure out where the water comes from- decrease water use
- Have movement sensor lights
- There are a lot of old buildings but its really expensive to do any big changes
- Compost green fills
- Garbage is a big issue
 - Pryolosis

Appendix RC2 -Minutes From Meeting with Ed Cotterill

13th May 2009

Present:

Ed Cotterill-London Borough of Merton Climate Change Officer

Angela Gorman

Team WPI (Lindsay Brown, Brian Marino, Zach Roche, Katherine Rondina)

Climate Proofing Problems:

- Water spill out of the River Wandle into the parks
- If the temperature rises and the water gets warmer, the water may become a breeding ground for disease-spreading insects

Reduction of CO₂ by River Wandle Ideas:

- Considering the use of biomass a fuel
- Remove rubbish to increase areas for planting usage
- Use willow trees to remove ground toxins

Carbon Off Setting Idea:

- Not as satisfying when donating to an unknown source (IE an airline) because one doesn't know where their money is going
- Local Off setting fund as an Idea
 - Money goes to local projects
 - People would be able to get feedback of what has been done (emails, physically seeing what is happening)
 - People would feel more involved
 - Locals would be able to see the carbon offsetting efforts locally and would serve as a form of climate change education
 - People are really interested in recycling due to its physical nature, and adding a physical element to carbon reduction may raise public interest

Carbon Off Setting Project- topic for case study

- How it would be set up
- How to get information to people
- The local people attitudes
 - Are people more likely to give money if they could see the offsets? (see what happened physically)
- Some examples:
 - Tree planting
 - Carbon-meter
 - Alternative energy implementation

Appendix RC3 - Minutes From Meeting with Wandsworth

21st May 2009

Present:

Mike Brook- Wandsworth Council

Mandy King- Wandsworth Sustainability Officer

Oliver Reutter- Intern

Angela Gorman

Team WPI

- Mike Brook
 - In charge of business and economic regenerations
 - Improve town sectors
 - Interest in the connection between economics and environment
 - Green Economy
 - Practicality at local level
- Oliver Reutter
 - Intern for one of Mr. Brooke's current projects
 - Background in engineering, planning, and sustainable construction
- Mandy King
 - Wandsworth Sustainability officer
 - Background in corporate support for climate change
 - Mentioned looking into several documents:
 - Flooding plan by Oxford (DEFRA)
 - "Climate Change to Present Analysis"
 - "London's Warming"
- Developing Ideas in Wandsworth
 - Reducing carbon footprints
 - Sustainable energy and local energy systems
 - Using the Wandle to build an inter-borough relationship
 - Flood-proofing (Adam Hutchings)
 - Interest in creating flood storage along river.
 - Where could this be done?
 - "Predict and provide" strategg.
- What practical models can be used in projects
 - Charity marketing strategy
 - Use of government or commercial sponsors
 - Planning agreements may provide flexibility
 - Scoping exercises
 - How many people carbon offset flights?
 - Could they instead do this at the local level?
 - Waitrose supports green efforts with drop box
 - Donation matching
 - Does recognition play a role in donation?
 - Could this apply in generating alternative energy?
- Pressure to build on flood plains

- Limited housing with increasing population
- Housing may be at risk in floods
- Climate change may have an affect on flood risk
- Projects that interest the council
 - King George's Park
 - Different 'implementables' in park
 - Focus on interactive/education
 - Acknowledgement of river (currently hard to find)
 - Lavender hill replanting
 - Green Roofs
 - Biomass fuel
 - Biodiversity and access to nature
 - "Rebending" the river.

Appendix RC4 - Minutes From Meeting with Neil Ireland

21st May 2009

Present:

Neil Ireland- London Wildlife Trust

Angela Gorman

Team WPI

- Wandle Valley History
 - Introduction of railway 'expands' London
 - Sudden development spikes in the past 100 years due to inexpensive prices of land
- Boroughs are under a lot of pressure to build more housing by the government
- There is a problem with the water based on the species living in the water
- Bird Migration areas
 - Protect area vs. having access to it for people
 - Boardwalks as an idea, goes through sanctuary so people can access it but at the same time not really bother the birds, it leads the walkers
- Beddington is a sewage farm
- There are grids that take out larger debris from sewage, but people were careless and let out a lot of sewage from this
 - Result was 5 miles of dead river, at least 7,000 dead fish
- Tanker of agricultural diesel was dropped into the river, and damaged that area of the river
- There is a combined outfall sewer which is connected to the road for water runoff and goes into the river, but the council is trying to fix it
- The ground is sinking because we are abstracting the water for drinking
 - Abstraction of the Thames is where the majority of the water comes from
 - People should manage their water better so less abstraction
 - Grey water scheme-using same water from shower to the toilet
- Current project—reintroducing native species
 - Water voles
 - Earthworms
- Idea for project-
 - Removal of invasive species---trees and weeds
 - Issues with plants such as Japanese knotweed
 - River restoration
 - Removal of dissolved oxygen or eutrophic dead zones
 - Bringing back the natural flow of the river
 - Reintroducing the bends that were removed
 - Uncovering pieces that were built over (as in Croydon)

Appendix RD1 – Survey Questions

WANDLE VALLEY REGIONAL PARK- DEVELOPMENT SURVEY

Which borough do you currently live in?

- Merton Wandsworth Sutton Croydon Other

Post Code: _____

What natural features would you like to see revitalized in the Wandle Valley?

What do you think is natural about the Wandle Valley?

Please tick 3 of the projects/improvements that you would like to see in local parks:

- Improving access to the River Wandle (providing paths and signs to the river) Water storage areas added to the Wandle (reduce flood risk or for park water needs)
- Planting projects in unused areas Green roofs on structures or buildings
- Green education added to play areas Solar panels /Solar powered lighting

Would you be interested in volunteering on any of the projects listed above?

- Yes, I would be interested in volunteering.
- No, I'm not interested/ unable to volunteer.

Thank you for your time!

**Groundwork London
Natural England**

Appendix RD2 –Survey Results

Borough	Number of Surveys Recorded	Willing Volunteers					
		Project Supported	Planting Projects	Green Education in Play Areas	Water Storage (Floods)	Green Roofs	Solar Panels/ Solar Powered Lighting
Wandsworth	37						
Merton	33			12			
Sutton	30			11			
Croydon	16			6			
Other	14			8			
Total	130			2			
				39			
Borough	Areas For Improvement Recommended	Wildlife	Park Improvement				
	Accessibility	Cleanup of River/ Banks	Wildlife	Park Improvement			
Wandsworth	11	13	10	7			
Merton	16	5	30	25			
Sutton	5	6	5	3			
Croydon	2	5	1	3			
Other	2	3	2	2			
Total	36	32	48	40			
Borough	Project Supported	Planting Projects	Green Education in Play Areas	Water Storage (Floods)	Green Roofs	Solar Panels/ Solar Powered Lighting	
Wandsworth	38	24	19	16	11	12	
Merton	21	17	13	9	9	9	
Sutton	14	14	14	12	11	18	
Croydon	12	12	7	9	4	5	
Other	6	12	5	7	3	6	
Total	91	79	58	53	38	50	

Appendix RE1: Accessibility Strategy Chart

<u>Improving Access</u>	<u>Wandsworth</u>	<u>Merton</u>
Does direct observation indicate this problem?	Only accessibility to the river	No, accessibility is not an issue
Is the council concerned with this?	Stressed heavily in parks management policy	
Would this be expensive?	No, cheap and effective way to draw citizens	
How could the community get involved?	Volunteer time or money	
Is this outlined in borough climate change mitigation strategy?	No	
Is this outlined in borough open space strategy?	No	
Will this cause political issues?	No, straightforward minor project	
Would this be difficult considering topography?	Yes, the river is quite hidden	
Where specifically in the park is this an issue?	Eastern border, where the river runs	
Is land ownership an issue?	No the park is council property	
What other explicit evidence is there in support of this project?	Overhead maps, pictures, council documents	
Is there an existing top up?	No	
What can be done?	Signs directing to the river, make a clearing	
	<u>Sutton</u>	<u>Croydon</u>
Does direct observation indicate this problem?	Yes, to the park and river	No, accessibility is not an issue
Is the council concerned with this?	Park quality is stressed in SOSS	
Would this be expensive?	Possibly as the park is in poor condition	
How could the community get involved?	Volunteer time or money	
Is this outlined in borough climate change mitigation strategy?	No	
Is this outlined in borough open space strategy?	Yes, primary objective in SOSS	
Will this cause political issues?	No, park restoration is approved	
Would this be difficult considering topography?	Yes, transport to the park and river	
Where specifically in the park is this an issue?	The entire park is not accessible	
Is land ownership an issue?	Possibly, surrounding area is residential	
What other explicit evidence is there in support of this project?	Overhead maps, pictures, council documents	
Is there an existing top up?	No	
What can be done?	Clear river path, shuttle bus	
How does this tie into climate change mitigation?	If the river is more accessible, it will draw more people to the park, thus increasing usage and decreasing other activities (sitting inside using electricity)	

Appendix RE2: Water Storage Strategy Chart

Water storage	Wandsworth	Merton
Does direct observation indicate this problem?	No, the river is very low	Yes, in the marshland
Is the council concerned with this?		Yes, Strategic Flood Risk Assessment
Would this be expensive?		Only if reuse is intended
How could the community get involved?		Donations
Is this outlined in borough climate change mitigation strategy?		No
Is this outlined in borough open space strategy?		No
Will this cause political issues?		Likely not
Would this be difficult considering topography?		No, the marshlands are a large site
Where specifically in the park is this an issue?		Marshlands
Is land ownership an issue?		Yes, the National Trust are park proprietors
What other explicit evidence is there in support of this project?		Flood risk 3 according to EAP
Is there an existing top up?		SuDS
What can be done?		Drainage holes, water storage system
	Sutton	Croydon
Does direct observation indicate this problem?	Yes the river is ground level	No, the river is underground
Is the council concerned with this?	Yes, Strategic Flood Risk Assessment	
Would this be expensive?	Only if reuse is intended	
How could the community get involved?	Donations	
Is this outlined in borough climate change mitigation strategy?	N/A	
Is this outlined in borough open space strategy?	No	
Will this cause political issues?	Likely not	
Would this be difficult considering topography?	Possibly, the river is somewhat hidden	
Where specifically in the park is this an issue?	River bank	
Is land ownership an issue?	No, the park is council owned	
What other explicit evidence is there in support of this project?	Flood risk 3 according to EAP	
Is there an existing top up?	SuDS	
What can be done?	Drainage holes, water storage system	

How does this tie into climate change mitigation?

Flooding is a telltale sign of climate change and water level rises due to melting of polar ice caps. Also reusing water will eliminate the need to bring in water for plants and other water needs.

Appendix RE3: Solar Panels Strategy Chart

Solar panels/solar lighting	Wandsworth	Merton
Does direct observation indicate this problem?	Yes, feasible	Yes, feasible
Is the council concerned with this?	Yes, council interview stressed	Yes, need for more sustainability
Would this be expensive?	Yes, but would pay off shortly	Yes, but would pay off shortly
How could the community get involved?	Donations	Donations
Is this outlined in borough climate change mitigation strategy?	Yes, EAP issue 1	Yes, BMCCS page 7-9
Is this outlined in borough open space strategy?	No	No
Will this cause political issues?	Yes, investment is high, payoff is slow	Yes, investment is high, payoff is slow
Would this be difficult considering topography?	No	No
Where specifically in the park is this an issue?	Implementation on lights	Implement on National Trust buildings
Is land ownership an issue?	No, council owned	Yes, National Trust are proprietors
What other explicit evidence is there in support of this project?	Carbon offsetting calculator	Carbon offsetting calculator
Is there an existing top up?	No	No
What can be done?		
	Sutton	Croydon
Does direct observation indicate this problem?	Yes, feasible	Yes, feasible
Is the council concerned with this?	Yes, need for more sustainability	Yes, need for more sustainability
Would this be expensive?	Yes, but would pay off shortly	Yes, but would pay off shortly
How could the community get involved?	Donations	Donations
Is this outlined in borough climate change mitigation strategy?	N/A	No
Is this outlined in borough open space strategy?	No	No
Will this cause political issues?	Yes, investment is high, payoff is slow	Yes, investment is high, payoff is
Would this be difficult considering topography?	No	No
Where specifically in the park is this an issue?	Implementation on lights	Implement on Ranger's station
Is land ownership an issue?	No, council owned	No, council owned
What other explicit evidence is there in support of this project?	Carbon offsetting calculator	Carbon offsetting calculator
Is there an existing top up?	No	No
What can be done?	Place solar panels on lampposts, buildings or where ever else possible	
How does this tie into climate change mitigation?	Less reliance on petrol based fuels and less emissions released into the atmosphere	

Appendix RE4: Hydroelectric Energy Strategy Chart

<u>Hydroelectric energy</u>	<u>Wandsworth</u>	<u>Merton</u>
Does direct observation indicate this problem?	No, slow river flow	Yes
Is the council concerned with this?		Yes, alternative energy
Would this be expensive?		No, water wheel exists
How could the community get involved?		Restoration project
Is this outlined in borough climate change mitigation strategy?		Yes, alternative energy implication
Is this outlined in borough open space strategy?		No
Will this cause political issues?		Not likely, the fixture exists
Would this be difficult considering topography?		No
Where specifically in the park is this an issue?		At the water wheel
Is land ownership an issue?		Yes, the National Trust are proprietors of the park
What other explicit evidence is there in support of this project?		National Trust HOP initiative
Is there an existing top up?		Yes, HOP
What can be done?		Water wheel restoration
	<u>Sutton</u>	<u>Croydon</u>
Does direct observation indicate this problem?	No, slow river flow	No, slow river flow
Is the council concerned with this?		
Would this be expensive?		
How could the community get involved?		
Is this outlined in borough climate change mitigation strategy?		
Is this outlined in borough open space strategy?		
Will this cause political issues?		
Would this be difficult considering topography?		
Where specifically in the park is this an issue?		
Is land ownership an issue?		
What other explicit evidence is there in support of this project?		
Is there an existing top up?		
What can be done?		

How does this tie into climate change mitigation?

Less reliance on petrol based fuels and less emissions released into the atmosphere
 Making Morden Hall Park self sustainable will eliminate need for energy usage from electric companies.

Appendix RE5: Green Education Strategy Chart

<u>Green education</u>	<u>Wandsworth</u>	<u>Merton</u>	<u>Sutton</u>	<u>Croydon</u>
Does direct observation indicate this problem?				
Is the council concerned with this?				
Would this be expensive?				
How could the community get involved?				
Is this outlined in borough climate change mitigation strategy?				
Is this outlined in borough open space strategy?				
Will this cause political issues?				
Would this be difficult considering topography?				
Where specifically in the park is this an issue?				
Is land ownership an issue?				
What other explicit evidence is there in support of this project?				
Is there an existing top up?				
What can be done?				
How does this tie into climate change mitigation?	Increasing awareness as to what is happening in the realm of climate change, and how parks can mitigate.			
	**Though this does not fit into our matrix now, it will in our final objective when we have specific cases			
	**National Trust and Groundwork both have existing initiatives (HOP, Playrangers)			