LANDSCAPE ARCHITECTURE FOUNDATION

Klyde Warren Park—
Methodology for Landscape Performance Benefits

The University of Texas at Arlington's Case Study Investigations 2013; Klyde Warren Park, University of Texas at Dallas Campus Identity and Landscape Framework Plan and Buffalo Bayou Promenade[1]

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Buffalo Bayou Promenade, SWA Group
University of Texas at Dallas Campus Identity Landscape Framework Plan, PWP Landscape Architecture

Overview of UT Arlington's Research Strategy for All Three Case Studies
Introduction:
The purpose of this research is to investigate the landscape performance of three acclaimed landscape architectural projects: 1) Klyde Warren Park, Dallas, Texas; 2) University of Texas at Dallas Campus Identity and Landscape Framework Plan, Texas 3) Buffalo Bayou Promenade, Houston, Texas. This research is conducted as part of 2013 Case Study Investigation (CSI) program funded by Landscape Architecture Foundation (LAF). It is conducted in collaboration with the project landscape architecture firms: 1) Office of James Burnett (OJB); 2) PWP Landscape Architecture (PWP); and 3) SWA Group (SWA).

(Source: Office of James Burnett, 2013)

[1] This white paper can be sited as; Ozdil, T., & Modi, S, & Stewart, D.(2013). 2013 LAF's CSI Program Landscape Performance Series: Klyde Warren Park Methodology. The University of Texas at Arlington. Arlington, Texas.

The case studies are pre-outlined by LAF to present project profile and overview, sustainable features, challenges/solutions, lessons learned, role of landscape architects, cost comparisons, and performance benefits. Within the LAF framework UT Arlington research team, with its professional firm partners, collected, reviwed, and analyzed/synthesized project related data for over 20 weeks to prepare the case studies published online at LAF website. The UT Arlington research team organized its investigation strategy and efforts under the three sub-category headings; environmental, economic, and social (including cultural and aesthetic) to establish a comprehensive and systematic framework for the research, ease the research process for multiple case studies, and to not loose sight to document diverse set of findings. These sub-categories are used primarily to identify and organize the performance benefits of landscape architecture projects in this collaborative investigation.

The UT Arlington research combines quantitative and qualitative methods to document three landscape architectural projects, and to assess their performance benefits (Deming et. al., 2011; Ozdil, 2008; Murphy, 2005; Moughtin, 1999). Methodological underpinnings of this case study research are primarily derived from a systematic review of performance criterias and variables from: (1) the Landscape Architecture Foundation's landscape performance series *Case Study Briefs* (LAF, 2013), (2) the case study methods that are developed for designers and planners in related literature (Francis, 1999; Gehl, 1988; Preiser et. al., 1988; Marcus et. al. 1998), and (3) the Primary data collection methods through; surveys (Dilman, 1978), site observations, behavior mapping, and assessment techniques (Marcus et. al. 1998; Whyte, 1980 & 1990), (4) and finally project related secondary data collected from project firms, project stakeholders, public resources and databases. The data gathered from all the research instruments are further analyzed, synthesized and summarized as the performance benefits for the three case studies under investigation. The findings are organized within the LAF framework, as it is outlined earlier in this document for online publication. The research is designed to highlight the values and the significance of these three landscape architecture projects by utilizing objective measures and by documenting and evaluating their performances to inform future urban landscapes.

Data Collections Methods:
The research involves collection of primary and secondary data through on-site or online survey, site observations and systematic review of available secondary data. As a first step, the research team acquired necessary permissions from Institutional Review Board at UT Arlington prior to primary data collection involving human subjects.

Survey: A survey instrument is developed to collect social performance data for all three sites. The survey is developed to measure user perception on topics such as; quality of life, sense of identity, health and educational benefits, safety and security, presence of arts, and availability of informal and organized events, and etc. The survey is informed by relevant literature as well as by other survey instruments prepared for parks and other landscapes projects (such as Dallas Park & Recreation Survey, New York's Central Park Survey to name a few). The survey instrument and the variables questioned within is kept almost identical in all three cases in order to develop a more homogenous measure to study varying sites, and provide LAF with replicable and generalizable instrument. The survey simply asks the visitors for their perceptions and experiences of the site.

The survey is composed of three parts. The first part of the questionnaire attempts to document user profiles as well as user perception and choices on activities available on the site by using

multiple choice questions. The second part of the survey asks users to rate performance related statements with Likert scale questions. The final portion of the survey was kept for additional comments/concerns of visitors who want to share additional information with the research team.

The survey was voluntary and the identity of the respondents was assured to be kept confidential to ease privacy concerns. The survey is kept short (15 minutes to take complete) and prepared for both online and on-site platforms in order to increase its utilization by potential respondents. Due to time and resources limitations, researchers utilized online and on-site survey interchangeably in some case studies. Surveys for all three sites are conducted over the summer months. The surveys are conducted on both weekdays and weekends in random intervals for better representation of the varying visitors using each site. While on-site surveys had more concentrated time frame (day or week) online surveys were open to users for a longer period of time.

Site Observations: Passive observations, photography, video recording, site inventory and analysis techniques (such as use of street furniture counts/measurements, etc.), as well as behavior mapping and tracing methods are also utilized in some instances to better understand the case study features and the performance of the case study sites. The research team primarily benefited from site visits and observations to understand the user behavior about the way the spaces are being used. Observational methods utilized in this research did not involve any intrusive interaction with the subjects and necessary precautions are taken not to impede or govern the subjects' activities. Although photography or video recording is used, the identity of the space users is blurred unless they allow researchers to use their images. The research team in all three case studies informed the stakeholders prior to site visits, and acquired necessary permissions. While on site for data collection, the research team used signs at various locations and informed consent forms to secure permissions from the subjects.

Archival and Secondary Data: This research is heavily benefited from archival and secondary data attained from project firms, project stakeholders, public resources, and private databases. As part of LAF's mission this research was a product of a partnership among academic research team, project firm, and LAF. Where and when data were available from the secondary sources such as from the landscape architecture firm, client(s), project partners, scholarly literature, and publicly the project team systematically collected and organized the data, diligently reviewed its content, assessed its rigor and integrity. The research team later used the relevant data to document the project, and assessed the landscape performance for all three sites.

Data Analysis and Research Design:
The UT Arlington team designed its research strategy under three focused thematic areas; environmental, economic, and social (including cultural and aesthetic) for all three case studies. In the beginning of the investigation, the research team benefited from this strategy to conduct a systematic research that produces replicable performance criterias and methods for all three sites. After the measurable criterias are identified and the possibilies are exhaushed, the UT Arlington team further refined its approach by customising performance criteria and procedures to each case study site to better document and report the varying qualities of each site independently. While achieving a comparable set of performance benefits for all sites was the goal and this strategy produces the greater framework for the research, customising detailed performance criteria later in the process helped the research team to overcome the concerns about data availability, varying project typologies, project goals and outcomes.

The findings of the investigations in all cases focused on first, site related performance benefits, then its immediate adjecencies, and finally on the project block group/neigborhood/district or zip code. For example, performance benefits that are most direct and telling about the project site is more emphasized in comparison to indirect performance benefits and findings about the project adjacencies, or neigborhoods. This strategy is also used in the reporting of the findings to clarify the document and to ease the review.

In conclusion, the data collected through these strategies were systematically reviewed and appropriate methods for analysis for specific performance criterias are highlighted in the detailed methodology below. The following section presents research design specifics for Klyde Warren Park, a basic summary of the performance criteria under investigation, and the data sources and the procedure involved in measuring that particular performance criteria.

Overview of UT Arlington's Research Strategy for Klyde Warren Park:

Figure.1 Klyde Warren Park, Before and After (Source: The Office of James Burnett, 2013)

Bridging the divide between Uptown Dallas and the Arts District, the largest suspended infrastructure to contain a park, 5.2 acre Klyde Warren Park is created over an existing 8-lane Woodall Rogers freeway in October 2012. This innovative and landmark public space has been a vehicle to physically, socially and culturally connect the two bustling districts in the heart of downtown Dallas. The landscape architect, Office of James Burnett, developed complex technical engineering solutions in collaboration with innovative engineering consultants to address the seemingly impossible task of suspending infrastructure above a busy freeway. The design and engineering challenge required the rigidity to structurally support massive loads and the dynamism to foster living, breathing ecosystems. The project exemplifies the design innovation and progressive thinking through its programming. The park promotes environmental responsibility,

public health, recreation, art and community with numerous active and passively programmed spaces for the park user's enjoyment. The park stimulates commerce with a sit-down restaurant and an associated grab-n-go kiosk that will serve lite fare. Food trucks, which have become popular with the downtown lunch crowd, and a series of public events that are externally sponsored provide future economic stimulus.

The research team fully followed the research design strategies outlined in the earlier portion of this document for the Klyde Warren Park case study (see figure below) by exploring all social, economic and environmental performance measures. Given the specific focus of the project the research team emphasized performance criteria's that are more telling about the perception of the users, programmatic elements of the park, innovative construction practices, as well as its economic impact to its immediate context. The park's proximity allowed research team to emphasize on-site surveys and site observations as effective data collection strategies. The next section outlines the specific performance benefits documented for Klyde Warren Park by illustrating data sources and procedures followed as well as the limitations that are encountered measuring the particular performance criteria.

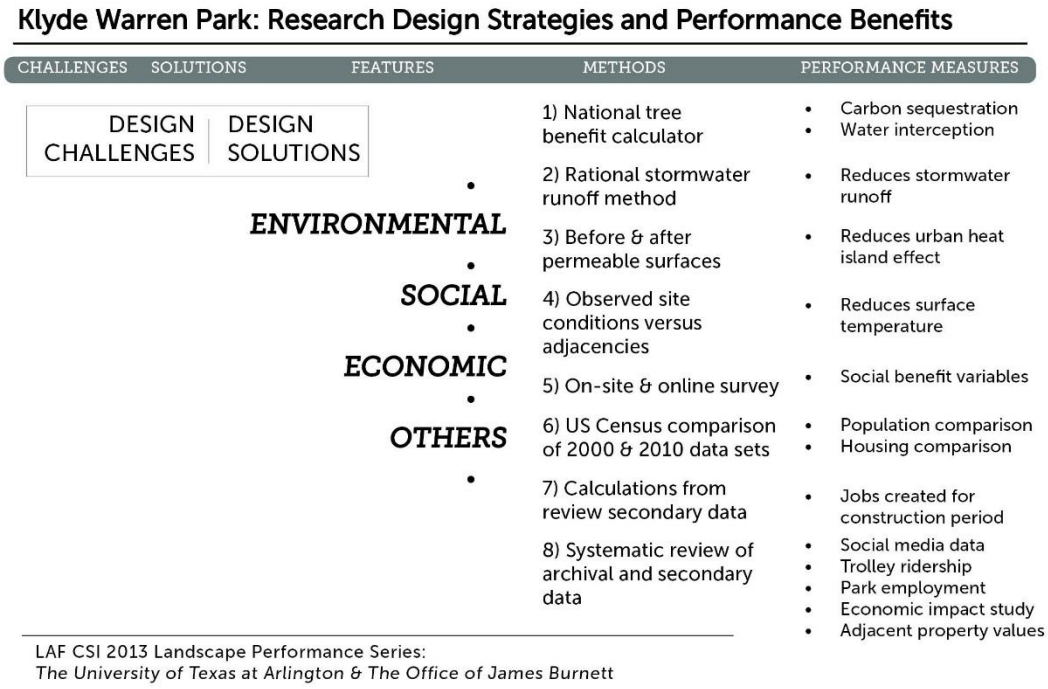

Figure.2 Research Strategy and Design

Performance Indicator: The following bullet points are listed below in their full form. They are formatted to comply with the online portal restrictions. The list below contains more detail.

Environmental:

Sequesters 8.39 metric tons (18,500 lbs) of CO2 annually through newly planted trees. This is equivalent to CO2 emitted from driving approximately 22,636 miles in a single passenger vehicle.

Scientific name	DBH (inches)	CO2 sequestered by one tree (lbs)	Quantity of trees	Total CO2 sequestered (lbs)
Betula nigra 'Dura Heat'	4	88	38	3344
Pistascia chinensis	4	88	20	1760
Quercus macrocarpa	4	157	1	157
Ulmus parvifolia 'Allee'	4	88	11	968
Lagerstroemia indica 'Sarah's Favorite'	4	23	13	299
Quercus shumardii	4	81	147	11907
Total			**230**	**18435**

Table.1: Tree's potential for carbon sequestration.

Methods: As illustrated in the table above the carbon sequestered is calculated with National Tree Benefit Calculator (http://www.treebenefits.com/calculator/).

For example: A single *pistascia chinensis* of 4" DBH sequesters 88 lbs of CO2. There are total 20 *pistascia chinensis* in the planting plan of Klyde Warren Park. Thus, the total amount of CO2 sequestered by 20 *pistascia chinensis* would be:

88 lbs*20 = 1760 lbs

One metric ton comprises of 2204 lbs. Thus, the total CO2 sequestered with the help of all the trees would be:

18,435/2204 ~ **8.39 metric tones**

Annual Vehicle Distance Travelled in Miles and Related Data - 2011 (1) By Highway Category and Vehicle Type March 2013						
YEAR	IITEM Motor-Vehicle Travel:(millions of vehicle-miles)	LIGHT DUTY VEHICLES SHORT WB (2)	MOTOR-CYCLES	SUBTOTALS		ALL MOTOR VEHICLES
				ALL LIGHT DUTY VEHICLES (2)	SINGLE-UNIT 2-AXLE 6-TIRE OR MORE & COMBINATION TRUCKS	
2011	Number of motor vehicle registered	192,513,278	8,330,210	233,841,422	10,270,693	253,108,389
2010		190,202,782	8,009,503	230,444,440	10,770,054	250,070,048
2011	Average miles traveled per vehicle	10,614	2,221	11,318	26,016	11,640
2010		10,650	2,311	11,493	26,604	11,866

2011	Average fuel consumption per vehicle (gallons)	460	51	530	4,126	666
2010		456	53	534	4,180	681
2011	Average miles traveled per gallon of fuel consumed	23.1	43.5	21.4	6.3	17.5
2010		23.3	43.4	21.5	6.4	17.4

Table.2: Carbon emissions comparison to annual vehicle distance travelled.

The numbers for the miles travelled in a year (11,318) and average (21.4mpg) of the passenger vehicle is set as bench mark (for comparison of the CO2 emitted) from Federal Highway Administration (FHWA) 2013 data as can be seen below:

Source: http://www.fhwa.dot.gov/policyinformation/statistics/2011/vm1.cfm
With the help of Carbon Calculator (http://www.americanforests.org/discover-forests/carbon-calculator/), a gas fuelled passenger vehicle travelling 11,318 miles in a year at 21.4 mpg average emits 9394 lbs of CO2 which is equivalent to 4.24 metric tons.

9394/2204 ~ 4.24 metric tones

The total CO2 sequestered by trees is equivalent to approximately CO2 emitted from 2 passenger vehicles in a year.

8.39/4.24 ~ 2 passenger vehicles

11,318 miles*2 = **22,636 miles**

Finally, the 8.39 metric tons of CO2 sequestered by the trees is equivalent to 22,63 miles travelled in a year in a single passenger vehicle.

Limitations: Since the project is recently completed in October 2012, the plants are still not fully matured. The DBH for the plants is considered as 4" as per the information sourced from The Office of James Burnett. The data highlighted in the table for the passenger vehicle to set as a benchmark is the US national average of the year 2011. (Data is retrieved in 2013 from FHWA website).

Intercepts approximately 64,214 gallons of stormwater runoff through the tree canopies only which is equivalent to water usage of 642 American residents for a day.

Common name	DBH (inches)	Stormwater intercepted by one tree (gallons)	Quantity of trees	Total stormwater runoff intercepted (gallons)
Betula nigra 'Dura Heat'	4	402	38	15276
Pistascia chinensis	4	402	20	8040
Quercus macrocarpa	4	604	1	604
Ulmus parvifolia 'Allee'	4	402	11	4422
Lagerstroemia indica 'Sarah's Favorite'	4	136	13	1768

Quercus shumardii	4	232	147	34104
Total			**230**	**64214**

Table.3: Tree's potential for water interception.

Methods: As illustrated in the table above the stormwater intercepted is calculated with National Tree Benefit Calculator (http://www.treebenefits.com/calculator/).

For an example: A single *pistascia chinensis* of 6" DBH intercepts 402 gallons of stormwater runoff. There are total 20 *pistascia chinensis* in the planting plan of Klyde Warren Park. Thus, the total amount of stormwater intercepted by 20 *pistascia chinensis* would be:

402 gallons*20 = 8040 gallons

The EPA's Water Trivia Facts states that an American resident uses 100 gallons of water in a day (http://water.epa.gov/learn/kids/drinkingwater/water_trivia_facts.cfm).

64214 gallons/100 gallons ~ **642 American residents**

Finally, 642 American residents uses 64214 gallons of water in a day, equivalent to the stormwater intercepted by the trees in Klyde Warren Park.

Limitations: Since the project is recently completed in October 2012, the plants are still not fully matured. The DBH for the plants is considered as 4" as per the information sourced from The Office of James Burnett.

Reduces stormwater runoff by 3.63 cubic feet per second compared to 9.88 cubic feet per second of storm water runoff of pre-development conditions (calculation is based on one time 2" rain event). 5.2 acre KWP provides approximately 36.73 % reduction in stormwater runoff.

Stormwater runoff - post-development					
Description	**Area (sq. ft)**	**i (inches)**	**Area (acres)**	**C (Co-efficient number)**	**Q=CiA (cu.ft/sec)**
Concrete streets	23840	2	0.5473	0.9500	1.0399
Lawn & planting	89027	2	2.0438	0.3500	1.4306
Paving	65681	2	1.5078	0.9000	2.7141
Gravel	32034	2	0.7354	0.6500	0.9560
Building structures	2650	2	0.0608	0.9000	0.1095
Under construction	13280		0.3049		0.0000
Total	**226512**		**5.2000**		**6.2501**

Stormwater runoff - pre-development					
Description	**Area (sq. ft)**	**i (inches)**	**Area (acres)**	**C (Co-efficient number)**	**Q=CiA (cu.ft/sec)**

Concrete streets	226512	2	5.2000	0.9500	9.8800
Total	**226512**		**5.2000**		**9.8800**

Table.4: Pre and post development runoff comparison.

Methods: As illustrated in the tables above the stormwater runoff is calculated with Rational Method (Q=CiA). The Co-efficient numbers for different materials is referenced from the LARE reference manual.

For an example: A 23840 sq. ft of concrete surface will create a 1.0399 cubic ft per second of runoff in a single rain event of 2". (Please note that the area used in the following calculation is converted into acres. An acre of area is equivalent to 43,560 sq. ft of area):

CiA = Q

0.95*2 inches*0.55 acres = 1.0399 cu. ft/sec

As seen from the tables above the total stormwater runoff post-development is 6.25 cu.ft/sec and the total stormwater runoff pre-development is 9.88 cu.ft/sec.

9.88 cu.ft/sec - 6.25 cu.ft/sec = 3.63 cu.ft/sec

Thus, reducing the stormwater run-off post development by **3.63 cu.ft/sec.**

Considering the pre-development stormwater run-off as 100 %, the post-development runoff is 63.27%, as a result, reducing the stormwater runoff by **36.73%**

Finally, overall there is 3.63 cu.ft/sec reduction in the stormwater runoff which is 36.73% reduction for the whole site of Klyde Warren Park.

Limitations: Since the restaurant area of the Klyde Warren Park is still under construction, while doing the calculations that area was considered to be able to get a total area of the park as 5.2 acres. But since that area is not included in the scope of the study, for the stormwater runoff calculations that area is excluded.

Adds 53% permeable surface compare to prior condition of 100% impermeability which alleviates the stormwater run-off by 36.73% reduction of the stormwater run-off. The increase in permeability also, directly impacts urban heat island effect through mitigation of surface temperature and reflectivity.

Permeable and impermeable surfaces - post-development		
Description	**Area (sq. ft)**	**Percentage (%)**
impermeable surfaces	105451	47.00
permeable surfaces	121061	53.00
Total	**226512**	**100**

Permeable and impermeable surfaces - post-development		
Description	**Area (sq. ft)**	**Percentage (%)**

impermeable surfaces	226512	100.00
permeable surfaces	0	0.00
Total	**226512**	**100**

Table.5: Pre and post development permeable surface comparison.

Methods: As illustrated in the tables above the percentages of the impermeable and permeable surfaces is calculated. Post-development, there are 46.55% impermeable surfaces and 53.45% permeable surfaces. Predevelopment, there are 100% impermeable surfaces and 0% permeable surfaces.

Thus, the increase in permeable surfaces is:

53.00% – 0.00% = **53% increase in permeable surfaces**

Finally, post-development there is an increase of 53% in permeable surfaces.

Limitations: Since the restaurant area of the Klyde Warren Park is still under construction, while doing the calculations that area was considered to be able to get a total area of the park as 5.2 acres. That area is still considered as impermeable surface as upon completion it is going to be a building structure. The permeable surfaces and impermeable surfaces are considered after reviewing the images and the plans provided by the firm. Lawn and planting, and gravel surfaces are considered as the permeable surfaces while concrete streets, paving, building structures and under construction area are considered as the impermeable surfaces.

Reduces temperature in the park by approximately 5.5 degrees Fahrenheit compared to the zip code average temperature in which the park is located, during the week of observations (Park Foundation, 2013; AccuWeather, 2013).

Temperature readings during the week of observations		
Day, date and time range	**temperature (°F)**	
	Klyde Warren Park	**Zipcode average**
Wednesday (26th June 2013) - 2:00pm to 6:00pm	91	97
Friday (28th June 2013) - 10:00 am to 2:00 pm	94.5	104
Saturday 29th June - 3:00 pm to 7:00pm	99	100
Average	**94.83**	**100.33**
Difference in temperature	**5.50**	

Table.6: Site and zip code temperature comparison.

Methods: As illustrated in the tables above temperature measurements were taken at different times of the day. This temperature measurements data is sourced from the Park Foundation. The average temperature on Klyde Warren Park is 94.83 degrees Fahrenheit.

Further, the zip code average is sourced from AccuWeather for the month of June 2013 (Source: http://www.accuweather.com/en/us/dallas-tx/75201/june-weather/351194) Average temperature for the zip code is 100.33 degrees Fahrenheit.

Finally, the difference in the average temperatures is 5.50 degrees Fahrenheit as a result of the Klyde Warren Park.

Limitations: Since the park is located over an 8-lane freeway, it was difficult to take the temperature measurements of the immediate surroundings of the park for comparison. However, the temperatures are acquired for the zip code in which the park is located through a weather related website. Also, the measurements are a secondary data source attributed to The Park Foundation.

Social

According to the Klyde Warren Park User Survey conducted on-site by the UT Arlington research team (N: 224), users agree that KWP:

- **Is perceived favorably by 90.8% of the survey respondents (72.9% strongly agree).**
- **Improves the quality of life for 90.9% of the survey respondents primarily through reduced mental stress, better perception of place, and a place to be outdoors.**
- **Promotes healthy living for 86.3% of the survey respondents primarily through a place to relax, to enjoy passive activity, and for vigorous walking.**
- **Promotes a safe & secure environment for 83.9% of the survey respondents primarily through the lighting design, open visibility, and presence of others.**
- **Promotes art and artistic activities for 81.7% of the survey respondents primarily through garden design, water features, and access to performing arts.**
- **Creates a sense of identity for 79.0% of the survey respondents.**
- **Accessible for all (American Disability Act-ADA) for 73.4% of the survey respondents.**
- **Increases outdoor activity for 69.0% of the survey respondents.**
- **Promotes a better understanding of sustainability for 64.4% of the survey respondents.**
- **Promotes educational activities for 63.3% of the survey respondents primarily through children's education, outdoor classrooms, and a place to read.**
- **Promotes scheduled/organized events for 63.0% of the survey respondents.**
- **Encourages them to live within walking distance for 45.4% of the survey respondents (while 24% disagree with this statement).**

Survey notes: 224 Klyde Warren Park users are randomly surveyed in person within the final week of June, 2013 by UT Arlington research team. **50%** of the park users surveyed noted themselves as '**resident'** while **46.8%** as '**visitor'.** Survey findings also illustrated that **56.8%** of the users were visiting the park **first time** while **37.3%** visits the park **at least one time per month**. Additionally, nearly **70%** of the respondents arrived KWP by using a **personal vehicle** while **14.6%** arrived KWP **on foot** and **13.2%** by using various form of **public transportation**.

Methods and Limitations: Please see data collection methods portion of this document.

**Not all of the survey results/findings are reported in their entirety do to LAF's online formatting restrictions, therefore the list only includes a sample of the survey findings. For further information, contact the Research Fellow for this case study: Dr. Taner R. Ozdil, ASLA, tozdil@uta.edu.*

Encourages social values beyond its boundaries with a digital media presence. In the first six months KWP's social media has gained 14,683 Facebook 'likes' (plus 45,212 'tagged' photos at the park), 6,980 Twitter followers and 959 Instagram followers. From its launch on October 1, 2012, the park website has experienced 344,227 visits with an average visit length of 2 minutes and 33 seconds.

Methods: Systematic review of archival and secondary data provided by The Park at Dallas Foundation (2013).
Limitations: Klyde Warren Park has been in operation under a year, so the social media data is enhanced by the initial spike of popularity from the park's opening. After a few years, a collection of this data will underlay different results.

Economic:

Increases ridership on the McKinney Avenue Trolley by 61% since the opening of KWP (McKinney Avenue Transit Authority, 2013). As a result of KWP the trolley line is re-routed around the park and 3 new trolley stops are added adjacent to the park providing greater connectivity with downtown and uptown. As a result, $9.9 million funds for construction are allocated for the expansion of trolley providing economic impact to the district.

Methods: Systematic review of archival and secondary data derived from www.dallasnews.com, The Park at Dallas Foundation and DART (Dallas Area Rapid Transit).
Limitations: The increase in trolley ridership can only be viewed as an indirect effect of Klyde Warren Park. Other variables may be causing the increase as well. Although reliable sources are adopted for this research the information provided above comes from secondary sources and may have inherent data omissions and errors that cannot be detected or confirmed by UT Arlington research team.

Utilizes Public Improvement District (PID) to fund future operating and maintenance cost through a tax levied on surrounding property owners. Projected revenues from the PID include $610,490.83(2014) with yearly incremental increases up to $1,220,981.66(2020). (Dallas Office of Economic Development, 2013).

Definition: Public Improvement Districts (PIDs) are special assessment areas created at the request of the property owners for enhanced services like: marketing and promotion, additional security, landscaping and lighting, and cultural or recreational improvements. Property owners pay a special annual assessment used to fund eligible PID expenditures. Specifically, the tax comprises $0.025 per $100 of appraised land value (per the evaluation from the Dallas County Tax Appraisal District). (DEDC, 2013)

Methods: Systematic review of archival and secondary data derived from www.dallasnews.com and the Dallas Office of Economic Development (June 27, 2013 PID publication).
Limitations: The PID has not been voted in yet as standard policy. The planned PID has been met with a series of hurdles, but a compromise has been met to lead to a final vote in the beginning of August, 2013.

Created 170 jobs during the construction period of KWP (timeline is May 2010 through October 2012) which is equivalent to 353,260 estimated total man-hours. The breakdown of total documented man-hours include: 213,260 construction, 100,000 consultant, and 40,000 donated hours.

Methods: Secondary source of (estimated) construction man-hours derived from Keith Bjerke, Consulting Project Manager (Bjerke Management Solutions). The indirect jobs calculations are shown below.

Total construction man-hours: 213,260/ (40 hr/wk) = 5332 “40 hour work weeks”/ 130 construction weeks = 41 new jobs
Consultant hours: 100,000/ (40 hr/wk) = 2500 “”/ 130 “” = 19 new jobs
Donated hours: 40,000/ (40 hr/wk) = 1000 “”/ 130 “” = 8 new jobs
Limitations: Construction is still currently in progress to complete the café’ and other final details for the park completion, so these summer hours have not been taken into account for this calculation.

Creates 8 full-time positions and 5 part time positions to conduct the park’s ongoing maintenance and operations. Additionally, 2 custodial personnel on-site from Monday to Thursday and 3 custodial personnel on-site Friday to Sunday.

Methods: Systematic review of archival and secondary data source provided by The Park at Dallas Foundation.
Limitations: This data is subject to change based on market conditions.

Generates approx. $312.7 million in economic benefit and $12.7 million in tax revenue. 107 direct and 75 indirect employment opportunities are projected to be created as well during this timeframe. Projections based off of the Insight Research Corporation's 2006 Economic Impact report for the Woodall Rodgers Deck Park (now KWP).

Methods: Systematic review of archival and secondary sources derived from the Insight Research Corporation (2006) economic impact study for, at the time, the proposed Woodall Rodgers Deck Park (now Klyde Warren Park).
Limitation: Projections can only be viewed as indirect effect of Klyde Warren Park’s inception. Although reliable sources are adopted for this research the information provided above comes from secondary sources and may have inherent data omissions and errors that cannot be detected or confirmed by UT Arlington research team.

Lowered the dead load on the deck by using approximately 180 tons of geo foam versus the industry standard of a soil medium (approximately 12,000 tons if used). To achieve this dramatic weight reduction, the approximate cost of the geo foam is $481,482 ($65 per cubic yard) versus the approximate cost of soil $488,160 ($50.85 per cubic yard).

Methods: Systematic review of secondary data source of www.dmagazine.com, 2012 where material numbers are attributed. Calculations used the geo foam price of $65 per cubic yard (source attributed to Geofoam, 2013) and the soil price of $50.85 per cubic yard (source attributed to Soil Building Systems, 2013).

Limitations: The exact costs for the materials were not available for this calculation. Additional research was used to approximate $/per cubic yard. Although reliable sources are adopted for this research the information provided above comes from secondary sources and may have inherent data omissions and errors that cannot be detected or confirmed by UT Arlington research team.

Saves annually approx. 94,000 kilowatts of electricity by the use of high efficiency LED lighting system. At an average market rate of $0.12 kWh, the 5.2 acre park saves approximately $11,279.40 per year (D Magazine, 2012; Bjerke Management Solutions, 2013).

Methods: The 94,000 kilowatts value is derived from the secondary source of www.dmagazine.com (2012) and the cost savings are derived from the two equations (Rapidtables.com, 2013) listed below:

Energy Consumption Calculation: E(kWh/day) = P(W) × t(h/day) × 3600(s/h) / 1000(W/kW)
Energy Cost Calculation: Cost ($/day) = E(kWh/day) × Cost(cent/kWh) / 100(cent/$)
Limitations: The calculations include using an average $/kWh for the City of Dallas and basing the electricity usage on the site for 24 hours per day.

Impacts area through an 8.8% projected population increase in the two block group housing KWP for the year 2017 (SimplyMap, 2013).

Impacts housing in its adjacency by increasing the range of units by 4.1-4.8% while decreasing the number of vacant units by 12.1-13.1% in the two block groups where KWP resides between the year 2010 and 2017 The number of renter occupied units are projected to increase in the south block group approximately 18.9% while in the north block group approximately 44.0%. Projections are based from 2010 US Census data as well as other city and county data by.

Methods: The data was organized with the SimplyMap software to compare the current 2010 US Census data with projected 2012 and 2017 data.
Limitations: The main limitation is that the data is based on projections, but due to the Klyde Warren Park's opening within the past year, there is currently no post construction census data available. A secondary limitation is the use of block groups that contain many other desired locations/destinations similar to Klyde Warren Park. The park can only be looked at as an indirect catalyst for the housing market change.

From 2010 (latest US Census data) to 2017 (projected US Census data by SimplyMap) the two adjacent block groups to Klyde Warren Park (BG0021002-Dallas Arts District) & (BG0017042-Uptown District) will see changes within their housing markets.
**(A) = (BG0021002-Dallas Arts District) & (B) = (BG0017042-Uptown District)*

Figure 3: Map of Midtown and Downtown block groups with Buffalo Bayou Promenade.

	Arts District	Uptown District	
Variable	BG0021002, Dallas Cnty, TX	BG0017042, Dallas Cnty, TX	USA
# Housing, Renter Occupied, 2010	475	168	38288286
# Housing, Renter Occupied, 2012	535	230	41730955
# Housing, Renter Occupied, 2017	565	242	45527611
Percent Change	18.9%	44.0%	18.9%
# Housing, Units, 2010	664	294	131704730
# Housing, Units, 2012	679	299	133667681
# Housing, Units, 2017	696	306	141903899
Percent Change	4.8%	4.1%	7.7%
# Population (Pop), 2010	748	324	308745538

# Population (Pop), 2012	778	335	312796426
# Population (Pop), 2017	817	352	324478770
Percent Change	9.2%	8.6%	5.1%
# Vacant Units, 2010	149	61	14988438
# Vacant Units, 2012	144	59	15642254
# Vacant Units, 2017	131	53	18002658
Percent Change	-12.1%	-13.1%	20.1%

Table.7 US Census 2010 Housing Data: Adopted from SimplyMap, 2013

Activates real estate projects in its boundaries. Museum Tower and 2000 McKinney have been constructed immediately adjacent to KWP during the construction of the park. These projects alone brought 442,355 square feet rentable office space and 115 luxury residential units. Both buildings project to bring a total market value of $291,175,000 in 2013 (2000 McKinney; DCAD, 2013; Museum Tower; 2013 & Dallas News, 2012).

Increases property value. The 21 story 2000 McKinney had a total market value of $32,255,970 in 2008 versus its projected market value of $91,175,000 in 2013. Newly completed in 2013, Museum Tower has a market value of approximately $200,000,000. The 42 story residential tower have a minimum value of $800 per square foot (2000 McKinney, 2013; DCAD, 2013; Museum Tower; 2013 & Dallas News, 2012).

Methods: Primary data sourced from the Dallas Central Appraisal District (DCAD) & www.dallasnews.com (for Museum Tower). Projects were chosen for their adjacent location to Klyde Warren Park and the significant (commercial & residential) leasable units that they contain. **Limitations:** Since the relative short time frame of Klyde Warren Park's completion, but from the economic recession in 2008, an increase in these property values can be indirectly attributed to the park's inception. Although reliable sources are adopted for this research the information provided above comes from secondary sources and may have inherent data omissions and errors that cannot be detected or confirmed by UT Arlington research team.

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