Assessing Site Selection of College Student Housing: Commuting Efficiency across Time

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ABSTRACT

Universities around the world are promoting walking for their students because it provides many health and environmental benefits at the personal as well as the community level. This paper aims to help universities, city planners and housing investors in the process of efficient site selection for future student housing projects, by analyzing off-campus students' commuting habits and travel time preferences to and from the university campuses. An online survey is operated to collect responses of students (n= 527) from two Jordanian universities located within the city of Irbid (N-Jordan). Results indicate that the mean value for students' longest preferred one-way walking duration is 17.04± 8.25 minutes for the whole sample. A statistically significant negative correlation is found between students' longest preferred one-way walking duration and age. The percentage of students who would accept this duration was represented in a formula in order to calculate the accumulated walking potential of varied sites around university campuses. The paper presented a local scenario using GIS mapping where this process was implemented to evaluate prospect vacant sites' walking potential around Yarmouk University, Irbid, Jordan.

KEYWORDS: Commuting, Healthy environments, Housing, Land-use Planning, Walking potential.

INTRODUCTION

Universities are seriously concerned about the impacts of their transportation systems upon the environment and upon the health of their students and staff members, and this is why many universities around the globe are implementing a number of measures and actions which are aimed at making their transportation systems healthier and more environment-friendly (Balsas, 2003; Rose, 2008; Shannon et al., 2006; Tolley, 1996; Toor, 2003). The most important of these measures for university students is the use of active travel modes such as walking and cycling, which not only minimizes the negative impacts of university transportation upon the environment but also at the same time provides health benefits for students and staff (Balsas, 2002; Shannon et al., 2006).

Several studies gave general attention to job-housing balance focusing on close proximity from housing to work place and on reducing commuting and promoting job decentralization (Chowdhury et al., 2012; Hamilton, 1982; Horner and Marion, 2009). Horner and Marion (2009) focused on evaluating the spatial relationships between employment and residential locations.

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The scope of this research was rather focused on future planning of student housing projects. It predicated the argument on university students' preference for walking duration and what this may suggest in site selection of future student housing.

From a perspective concerned with physical activity, travel is one of two categories: active and inactive travel. According to the Public Health Agency of Canada (2011), active travel refers to any form of human-powered transportation including walking, cycling, using a wheelchair, in-line skating or skateboarding, while active or 'passive' forms of transport are modes that involve none or too little physical activity which include motorized modes such as cars, buses and trains.

On the one hand, inactive commuting has many negative effects on the health and well-being of humans, and according to Sallis et al. (2004) the physical inactive lifestyles are one of the major public health challenges of our time. Moreover, Mindell (2001) argues that the health burden of physical inactivity due to car-dependency is parallel to smoking. Inactive travel modes were also found to be associated with many diseases and health problems including: stress (Costa et al., 1988; Evans and Wener, 2006; Lopez, 2007); hypertension and sleeping disorders (Palmer et al., 1980; Walsleben et al., 1999); cardiovascular diseases (Kageyama et al., 1998); blood pressure (Fisch et al., 1976); and premature births (Papiernik, 1981). In addition, inactive travel was found to be associated with overweight, obesity and obesity-related chronic diseases (Frank et al., 2004; Oja et al., 1998). Costa et al. (1988) mentioned that inactive commuting interferes with living and working conditions as it reduces the time available for discretionary leisure activities. This notion is also advocated by Wigan and Morris (1981). Inactive travel was also found to negatively affect individuals' well-being and satisfaction with life (Gee and Takeuchi, 2004; Stutzer and Frey, 2008). Additionally, many studies found negative effects of inactive commuting upon productivity and absenteeism (Costa et al., 1988; Taylor and Peacock, 1972; Van Ommeren et al., 2010; Zenou, 2002).

On the other hand, active travel modes such as walking and cycling were found to offer great health and performance benefits including: better health and reduced risks of morbidity and mortality (Blair and Connelly, 1996); protective effects against certain types of cancer, better family relationships, less depression and higher school grades (Field[a] et al., 2001); reductions in cardiovascular risk (Hamer and Chida, 2008); better self-rated health (Abu-Omar and Rutten, 2008); and protective effects against all-cause mortality rates (Andersen et al., 2000). Moreover, according to Litman (2003), the public health benefits of active transport go beyond individual health and also include reductions in traffic crashes and pollution emissions.

Because of the negative aspects of inactive travel and the many benefits of active travel, providing students with a chance to commute actively to and from the university campus becomes of vital importance. Tolley (1996) suggests that universities should encourage modal switching to walking and cycling as environment-friendly forms of transport, while Balsas (2003) states that universities aiming to achieve sustainable college transportation planning should be providing incentives for walking and bicycling. Moreover, Toor (2003) argues that improving infrastructure and programs to encourage walking and cycling is one of the main techniques of Transportation Demand Management (TDM).

Toor (2003) states that the amount of on-campus student housing is one of the key planning decisions that affect transportation of universities, and that providing on-campus housing is a main technique of TDM. Additionally, Tolley (1996) argues that the lack of financial potential to build additional students on-campus student housing will increase the duration of the journey to the campus. Moreover, among the measures proposed by Shannon et al. (2006) to increase the levels of active commuting and reduce the travel time barrier are: providing additional student housing on or near campus; encouraging the local government body to increase the amount and/or density of housing in the local area; and improving the pedestrian and bicycle network leading to campus. This leads to the notion that the planning of student housing on or near the university campus is of great importance when aiming to provide students with a valuable opportunity to actively commute to and from the campus.

Nevertheless, while the provision of student housing near or on the university campus can be of vital importance when trying to promote walking for students, the authors of this study suggest that site selection for student housing should take into consideration the duration or distance of the walking trip. According to Grava (2004), walking distance is one of the main functional limitations to walking. This means that certain student housing sites with walking distances that are longer than what the majority of students can tolerate may be limiting the potential for walking. Thus, these housing sites may be discouraging students from walking to the campus and at the same time forcing great numbers of them to use motorized travel modes instead. This not only deprives many students from the great health benefits of walking, but at the same time places greater load on the local traffic network and leads to more reliance on motorized travel and thus causes more pollution. This notion had led to the idea that the site selection for student housing should take into consideration a certain walking distance (or duration) that is acceptable by a considerable percentage of students. This is why the authors believe that identifying this most acceptable distance (or duration) that students are willing to walk is of great importance. This is believed to help in providing student housing in such a way in which students do not have to walk for more than what is accepted by them. This idea is the main core of this study, and this paper aims to provide a simple methodology to identify this preferred walking duration and to use it as a tool to compare different student housing sites according to their potential to promote walking to students.

METHODOLOGY

The study used an online survey to collect responses from students of two major university campuses in the city of Irbid, Jordan. The first campus is the Jordan University of Science and Technology (JUST) having nearly 21,600 students and the second is Yarmouk University (YU) of 27,000 students (information obtained from Dean of Students' Affairs at both universities in the Spring of 2011). Students were asked to report information such as gender, age, current campus commuting time, longest preferred one-way walking duration to or from the campus, and their actual primary mode of transportation used to commute to and from the university campus. The data was collected during a two month period (March 15th - May 15th, 2011).

Students were instructed that the longest preferred walking duration they were asked to report is the duration of the one-way trip that starts from the moment the student leaves his or her doorstep until the arrival at one of the campus gates and *vice versa* for the return trip. Since an internet-based survey was used, students were given the freedom to choose from a number of choices using a drop-down menu. The offered choices were (in minutes): '5 or less', '7', '10', '15', '20', '25', '30', '35', '40' and '45 or more'.

It should be first explained why the collected data included students' preference for a walking duration instead of a walking distance. It was found in a pilot study (and also presumed even earlier) that if students were asked to report their preferred walking distance they may not necessarily give adequately accurate numbers, especially for students who do not walk much. This was particularly evident prior to the survey when a number of students who walk to and from the YU campus were asked to report their actual walking distances and home locations. It was found later that the answers reported by the students in the pilot study were very inaccurate as the reported distances were quite different from the real distances measured digitally using an aerial photo (along the paths provided by the students themselves). On the other hand, it was presumed that most students are much better at estimating durations than distances since students usually measure their trips to the campus by minutes instead of kilometres, based on their keen effort to always reach classes on time and avoid being late. Additionally, it was assumed that it would be easy to convert durations to distances later if a suitable walking speed was determined.

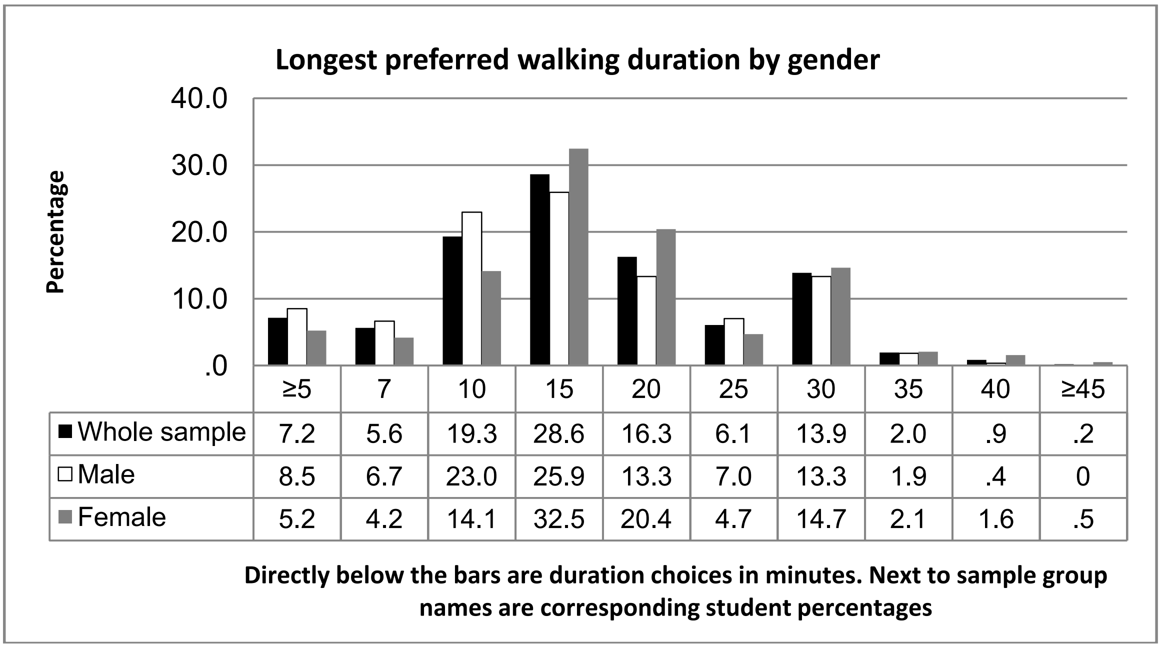


Figure (1): Longest preferred walking durations by gender

Table 1. Longest preferred walking durations for different sample groups

Group	N	Minimum	Maximum	Mean	Std. Deviation	Confidence Interval (90%)
Whole Sample	527	5.00	45.00	17.043	8.254	± 0.59
Male	311	5.00	40.00	16.300	8.196	± 0.763
Female	216	5.00	45.00	18.094	8.242	± 0.921
Passive	422	5.00	45.00	17.345	8.287	± 0.663
Drivers	29	5.00	35.00	14.448	7.604	± 1.851
Walking	76	5.00	30.00	15.895	8.133	± 1.205

As for the reported primary mode of travel, students were instructed that this represents the travel mode that is used in most of college days and that in the case that students use more than one travel mode they were instructed to report the travel mode that takes the majority of the trip duration. The purpose behind asking the students to identify their primary mode of travel was to investigate how students who are using different travel modes may prefer different walking durations. Students were given the freedom to choose from a dropdown menu and the available choices were: 'walk only'; 'bus'; 'taxi'; 'service car' (which is a public sharing car); 'car driving myself'; and 'car riding with others'. Students' age and gender were also collected in an attempt to discover how they may be affecting students' walking potential to and from the university campus.

RESULTS

The collected sample included 527 students, of which 377 were JUST students while the remaining 150 were YU students. 311 students (59 percent) of the whole sample were male students while female students were 216 (41 percent). Since the data was collected from the online questionnaires or at class with similar conditions, the researchers considered 90% confidence level for this study. The subjects who are consisted of 527 college students present a unified population in terms of age group and conditions (Table 1).

The sample was classified according to the used mode of travel into 3 groups. The first group is 'walking students', the second group is 'driving students' (who drive themselves to the campus), and the third group is 'passively commuting students' (this group includes students using passive motorized travel modes including buses, taxis, service cars and riding a car with others). Results for used travel mode came as follows: 422 students (80 percent) use passive motorized travel modes, 29 students (6 percent) drive themselves, and 76 students (14 percent) walk to and from the university campus. Student age came between 17 and 32 years and the mean values for student age were nearly 21.0 years for the whole sample; 21.4 years for male students; 20.5 years for female students; 20.9 years for passively commuting students; 21.8 years for driving students; and 22.0 years for walking students.

As shown in Figure 1 and Table 1, survey results revealed that the mean value for the longest preferred one-way walking duration for the whole sample (527 students) was 17.04 minutes, and that nearly two thirds (64.2 percent) of the whole sample prefer durations between 10 and 20 minutes. Moreover, results showed that the most selected choice (statistical mode) was 15 minutes and that very few students prefer walking for longer than 30 minutes. Using t-scores table at 90% confidence level; with degree of freedom=(n-1)=527-1=526, t= 1.645, standard error: 8.254/ (527)1/2 = 0.359, the confidence interval= Mean ± [(standard error)*(t-value)] can be calculated as follows:

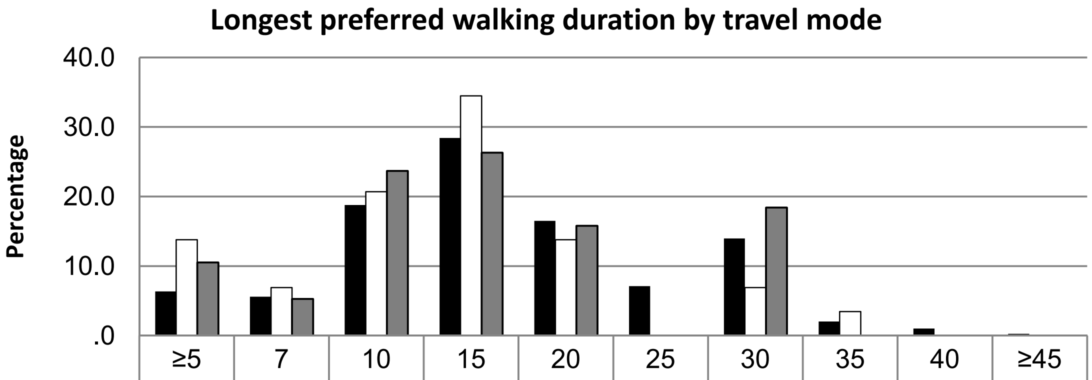
=17.043 ± [(0.359)*(1.645)] = 17.043 ± 0.590.

The mean value for walking duration for male students was found to be 16.3 minutes as opposed to that of female students which was 18.09 minutes. This shows that female students may prefer walking trips that are nearly 2 minutes (11 percent) longer than those of male students on average. Driving students gave the shortest mean value for a walking duration which is 14.45 minutes, while walking students gave a mean value of 15.89 minutes, and finally passively commuting students gave a mean value of 17.35 minutes. For driving students, this shorter duration may be due to the fact that they are more used to shorter commute durations than passively commuting students. The authors also assumed that this tendency of driving students to be less willing to walk may be a result of their more sedentary lifestyle since their commuting habits involve almost no walking as they move from their home door step directly to the car which is parked somewhere nearby. This contrasts with the commuting experience of students commuting for example by buses who have to walk for some distance before reaching the bus station. Nevertheless, this shorter preferred walking duration given by driving students may be due to the small sample size of only 29 students.

Considering the effect of the age factor upon students' potential for walking to and from the university campus, a statistically significant negative correlation was found between a student's longest preferred one-way walking duration and his or her age with a correlation coefficient of -0.139 and a p-value of 0.003 (for students aged between 18 and 24, N=457). Data for students aged 17 and between 25 and 32 was omitted from the test because of the very small sample size. While there is a relatively weak correlation, this may nevertheless demonstrate that older university students somehow tend to prefer shorter walks to and from the university campus. This idea is very evident in Figure 3. Using linear regression analysis, it was found that the formula for the relationship between preferred duration and age is:

$$y = -1.01x + 37 \quad (1)$$

where y is the preferred walking duration and x is the student's age. The longest preferred walking duration is decreased by nearly 24 seconds per year of age. Data in Figure 3 illustrates how 24 year old students on average prefer walks that are nearly 6 minutes shorter than 18 year old students. Therefore, the authors believe that it may be good practice if older students are given the nearest of housing units whenever possible, especially in situations when there are multiple dorm buildings varying significantly in their walking duration from the university campus.



	≥5	7	10	15	20	25	30	35	40	≥45
Passive	6.3	5.6	18.8	28.4	16.5	7.1	14.0	2.0	1.0	.3
Drivers	13.8	6.9	20.7	34.5	13.8	0	6.9	3.4	0	0
Walking	10.5	5.3	23.7	26.3	15.8	0	18.4	0	0	0

Directly below the bars are duration choices in minutes. Next to sample group names are corresponding student percentages

Figure (2): Longest preferred walking durations by travel mode

It was assumed that since walking students are more familiar with walking as a travel mode than drivers or passively-commuting students, their preferred walking duration of 15.89 minutes should be the most realistic one and the one that should be taken into consideration. This idea was also stressed by the fact that walking students who participated in the survey reported a mean duration of 14.15 minutes for their actual one-way walking duration which is very close to their average reported preferred duration. Nevertheless, as the whole sample's preference for a walking duration which is nearly 17 minutes is only one minute longer than that of walking students, it was felt safe to consider it the average longest preferred walking duration for all students.

APPLICATION: A HYPOTHETICAL SCENARIO

The idea behind this paper was to introduce a methodology to locate student housing units in a way that maximizes opportunities for walking to and from the university campus using students' own preference for walking duration. In order to illustrate the idea of the study, results of the survey were used to prepare a hypothetical scenario for Yarmouk University (YU) which shows the proposed methodology. In this scenario, results shown above were used to compare different vacant sites around the YU campus at a 2.5km radius according to their potential to promote walking for students. The proposed scenario is more concerned with showing the methodology rather than actual results.

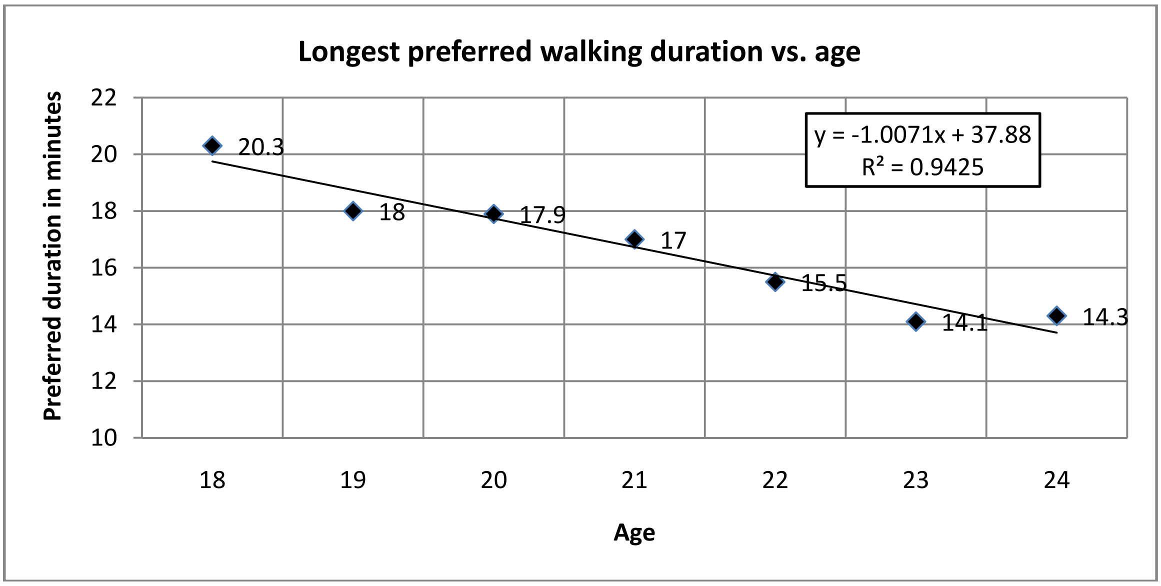


Figure (3): Graph showing how the mean value for students' longest preferred walking duration changes with age

As mentioned above, students' longest preferred walking duration for students from YU and JUST was identified at nearly 17 minutes for the whole sample. According to Grava (2004), within this duration a university student walking 'briskly' can travel 1.7 km at 6.4 km/hour (this ignores any road-crossing waiting time or any kind of delay endured during the walking trip). It was assumed that students would be walking to the campus using this speed in order to avoid arriving late. Simply put, this walking distance represents the maximum distance a housing unit should be located away from the campus if promoting walking to students is a high priority. It is believed that a considerable percentage of students would walk to and from the campus if their housing units are located at a distance equal to or less than this. Also, any housing units located farther than the longest preferred distance will mostly make students refrain from walking to the campus and use motorized modes such as buses and taxis instead. While a single value for the preferred walking duration can be used to specify a rough maximum for walking distance that should not be exceeded when selecting housing sites, the authors assumed that using this single value may not be adequately accurate in most cases. It was thought that a more precise method to locate student housing should involve the accumulated student percentages for each of the different walking durations as shown in the graph in Figure 4. This graph was constructed based on results of the survey shown above. It shows each of the walking durations included in the survey and their corresponding accumulated student percentages. For each given duration, each of these percentages represents the portion of students who would accept such a duration as a daily walking trip to or from the campus. For example, the graph illustrates that nearly 40 percent of students would accept a walking duration that is 20 minutes long, while the remaining 60 percent would mostly find it too long for them. For any given walking duration and using simple interpolation, the graph can simply give the percentage of students most likely to accept such duration. Using this technique, it is possible to know the potential of a particular housing site to invite students to walk to the campus by simply matching the site's trip duration with its student percentage and see how many students find this duration acceptable. Moreover, it is possible to compare several housing sites with varying walking durations from the campus by finding which sites invite more students to walk.

Using statistical methods, it was found that the trend line in the graph can be a curve as expressed by the formula:

$$y = 0.053x^2 - 5.414x + 130.0 \qquad (2)$$
$$r^2 = 0.987, r=0.9935$$

where x is the duration of the walking trip in minutes and y is the percentage of students who would accept such duration.

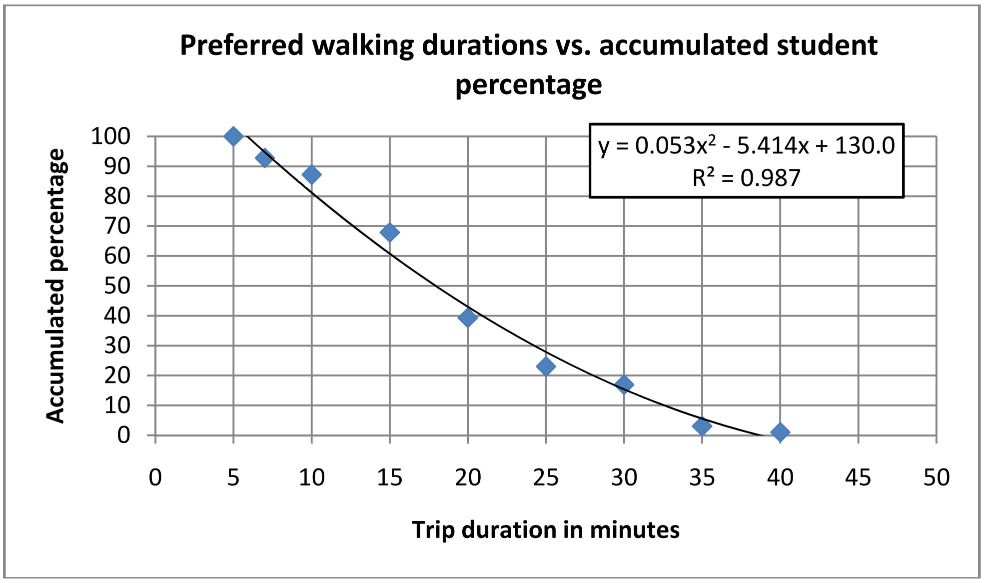


Figure (4): Graph showing preferred walking durations and matching accumulated student percentage

The accumulated student percentage for a site's walking trip will be used to describe the site's potential to invite students to walk to and from the university campus. This percentage will be called the *walking potential* (WP) of a given site. The technique explained above is the main tool used in the provided scenario. In simple terms, the main idea is to calculate the walking trip duration of each of a group of proposed sites around YU and find each site's matching student percentage or WP.

a. Step 1: Locating vacant plots of land around the campus

The first step was to locate vacant plots of land around the YU campus suitable for student housing using GIS tool. The area around the YU campus is mostly residential and commercial. Most of the residential buildings around the YU campus are mid-rise private-sector student housing, while there are all different types of shops and restaurants around the campus serving mainly the large student population. The required data for the study include a road network map, location of open property areas, and the maximum speed limit for route segments (km/h). Based on the satellite image (2012 with 0.6 meter spatial resolution), the road network layer was created. Initially, a *polyline shapefile* that represents the road network was created in ArcCatalog and it was given UTM Zone36 coordinate system, then it was added to ArcMap as an overlay layer above the city map layer to be used in the analysis. A digitizing process was made to create the road network of the area of study. Three classes of roads were defined as "Class one (>16m wide)", "Class two (16-8m wide)" and "Class three (<8m wide) (Figure 5)." These classes were visually modified according to Google Earch 2013. They included a total of 1209 digitized road segments where each segment was given attributes (Figure 5). Using recent aerial photos of the YU campus and its surroundings (Google Earth, 2013), the area around the campus was digitized for vacant plots of land with areas within a range of 42,000-8,000 m^2,which is an area range that is suitable for the construction of a student housing project. Figure 6 shows a map of vacant sites based on property size.

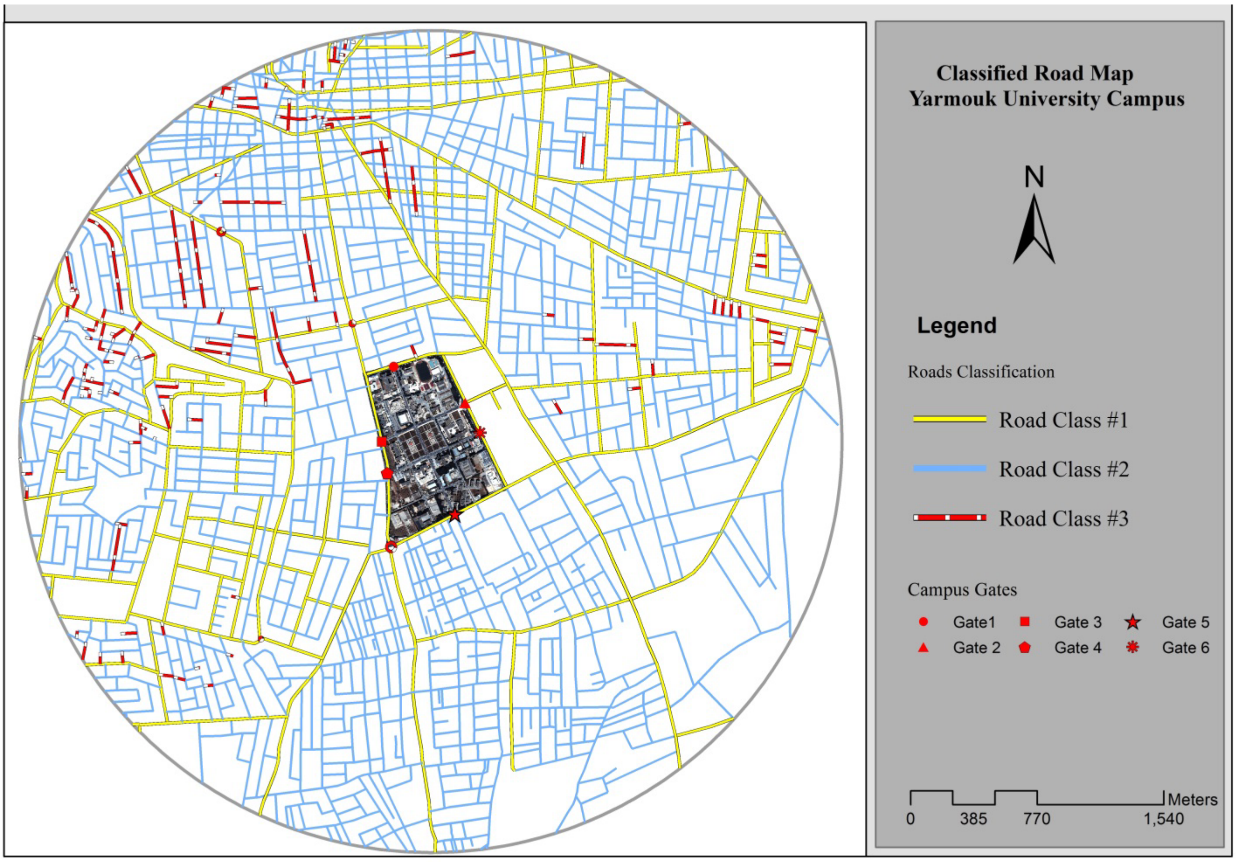


Figure (5): Road classification map

b. Step 2: Determining walking paths for the vacant sites

The YU campus is walled with 6 gates which are shown in Figure 5 as red dots. The path selection was made in a way that makes the paths move along the shortest way to travel to and from the campus, moving along existing walking pavements and crossing roads when necessary. This was possible after the authors visited the sites several times and got adequately familiar with the area. The walking paths were drawn using GIS mapping tool (Figure 5). Each of the walking paths starts from the heart point of each vacant site, and they move all the way to the nearest campus gate. The road network was examined with assisted travel time information to find the quickest route in the area by using the Network Analysis Extension of ArcGIS10 software. The steps to find the optimal route were as follows: Three kinds of data related to the roads were used to find the fastest route, which are the length, the speed limit and the travel time of each street segment in the network (Table 2). The time delay due to pedestrians when crossing different classes of the roads was determined based on road type classification and it was added to the actual (calculated) travel time on the road network.

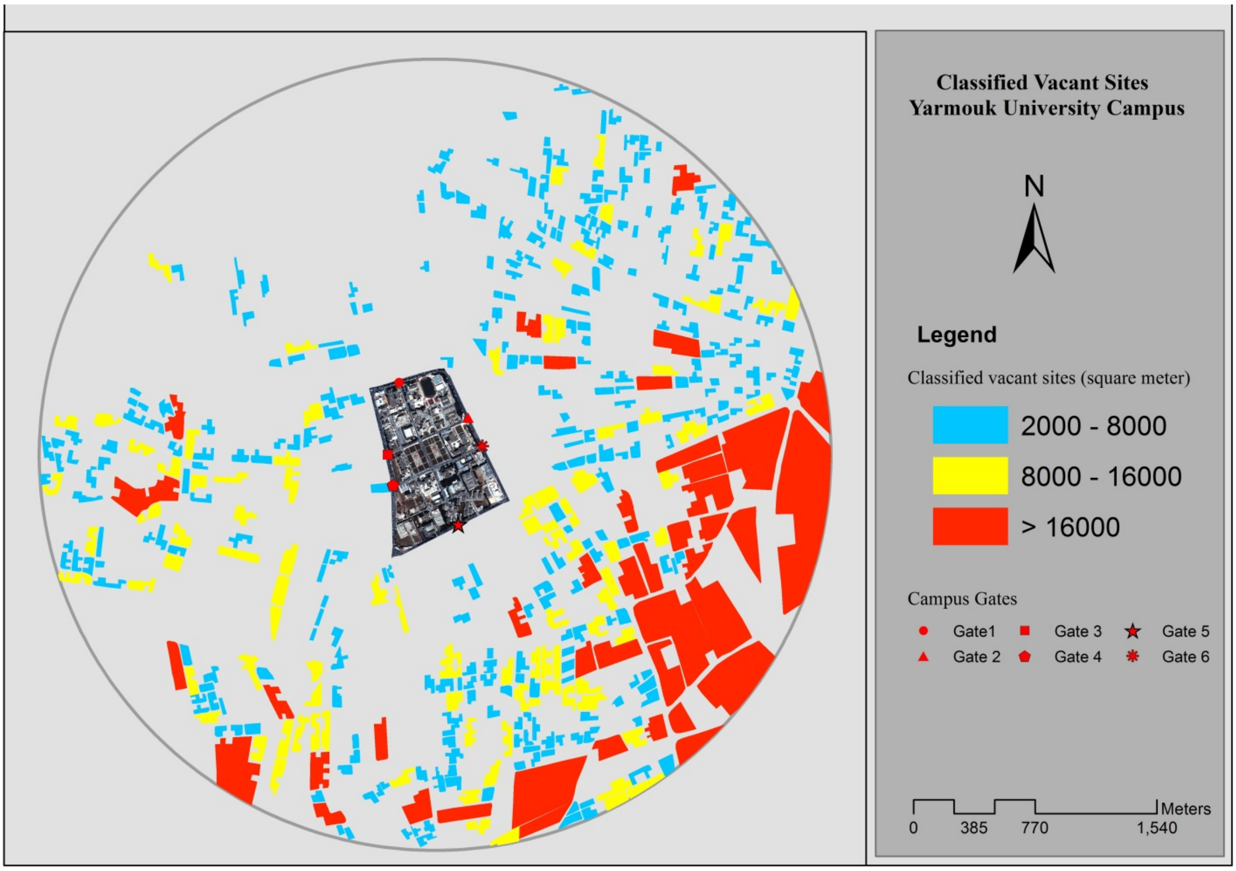


Figure (6): The map of available vacant sites based on property size

All of the proposed walking paths incorporate one or more road crossings which vary in the time needed to wait until crossing is possible. The roads were classified into three classes according to their width and traffic flow: large crossings which are mostly main roads with 6 lanes of cars and heavy traffic (>16m wide); medium crossings which incorporate 3 or 4 lanes of cars with medium traffic density (8-16m wide); and small crossings which are up to 2-lane local neighbourhood roads with very little traffic (0-8m wide). Such classification was thought to be important since different roads with varying widths and traffic densities would require different crossing times.

c. Step 3: Calculating the one-way walking duration of the vacant sites

Once the proposed walking paths of the vacant sites were determined, the length of each of these paths was measured in meters using GIS tool. These measured lengths along with other path information are shown in Tables 3-5. In order to calculate the walking duration of each path, speed calculation method was used which involved at first calculating a 'raw' walking duration by dividing the length of the walking path by a predetermined walking speed then adding road-crossing waiting times. It was assumed that it was important to add crossing waiting times since this gives more realistic walking durations and since in some situations these waiting times may be quite long.

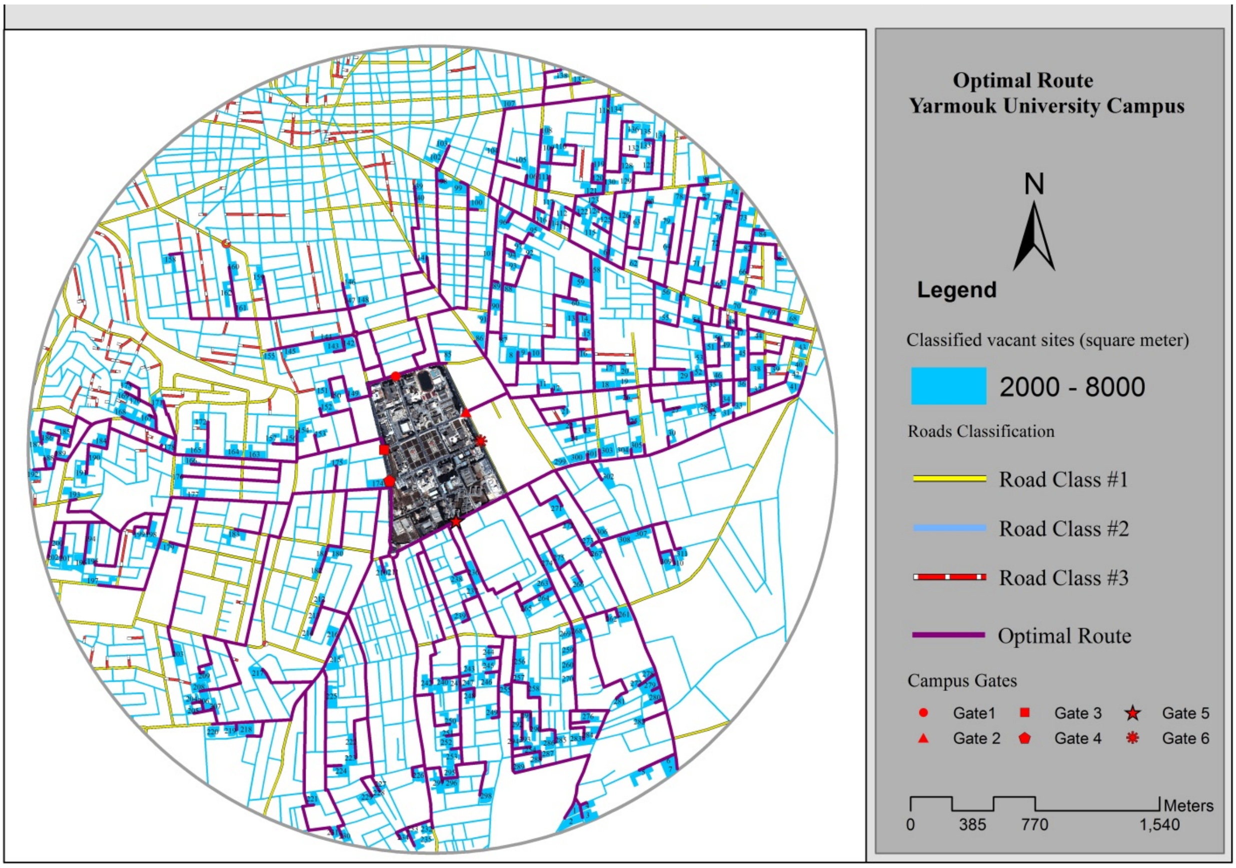


Figure (7): Optimal route; map between the campus gates and the vacant sites (2,000-8,000m²)

Table 2. Road network attribute table components

Field Name	Description
ID	Unique ID for each object
St_Type	The road type(Class 1, 2 or 3)
St_Length	The length of road in meters
St_Speed	The speed limit for the pedestrian in km/h
Travel_Time	The travel time in minutes

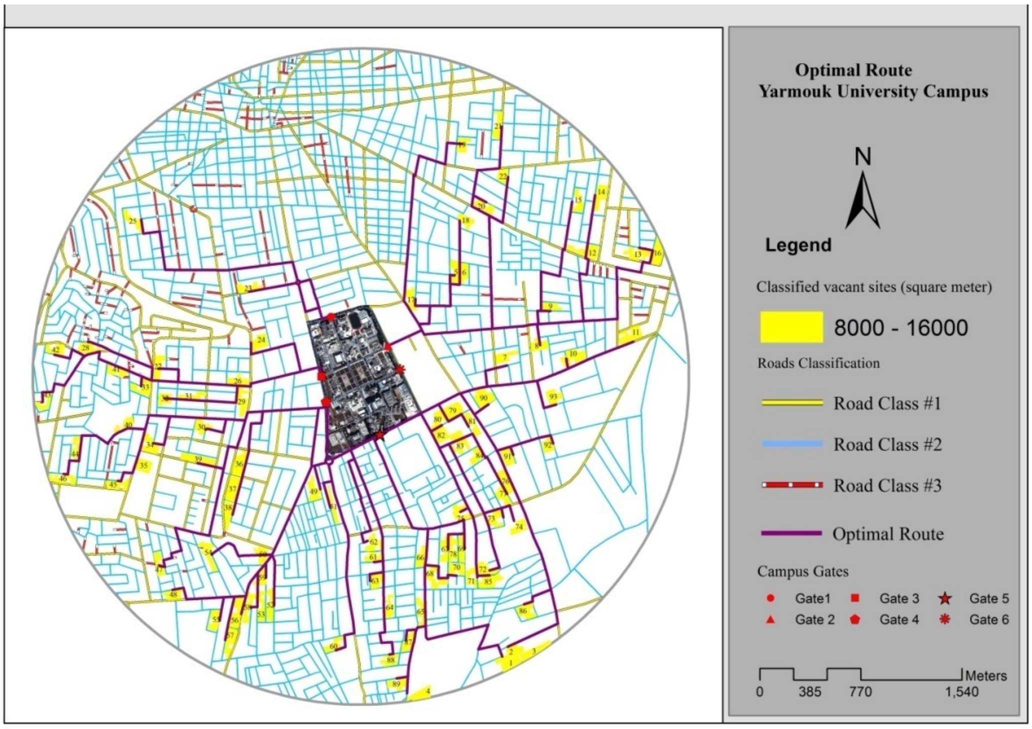


Figure (8): Optimal route map between the campus gates and the vacant sites (8,001-16,000m^2)

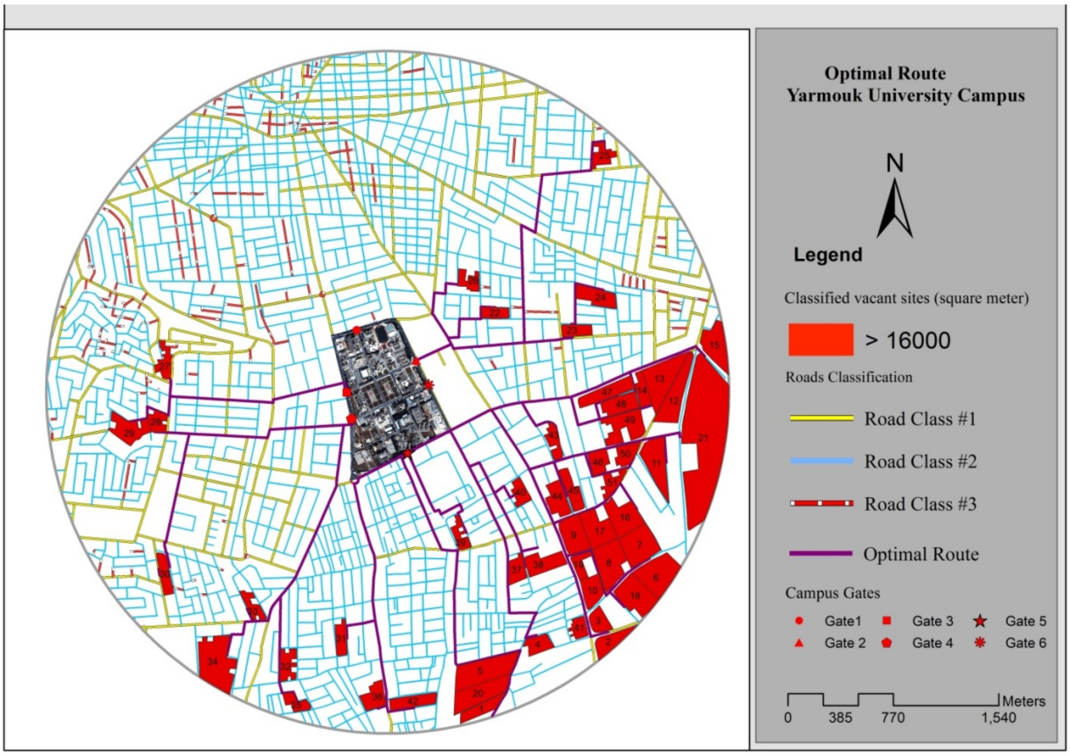


Figure (9): Optimal route map between the campus gates and the vacant sites greater than 16,000m^2

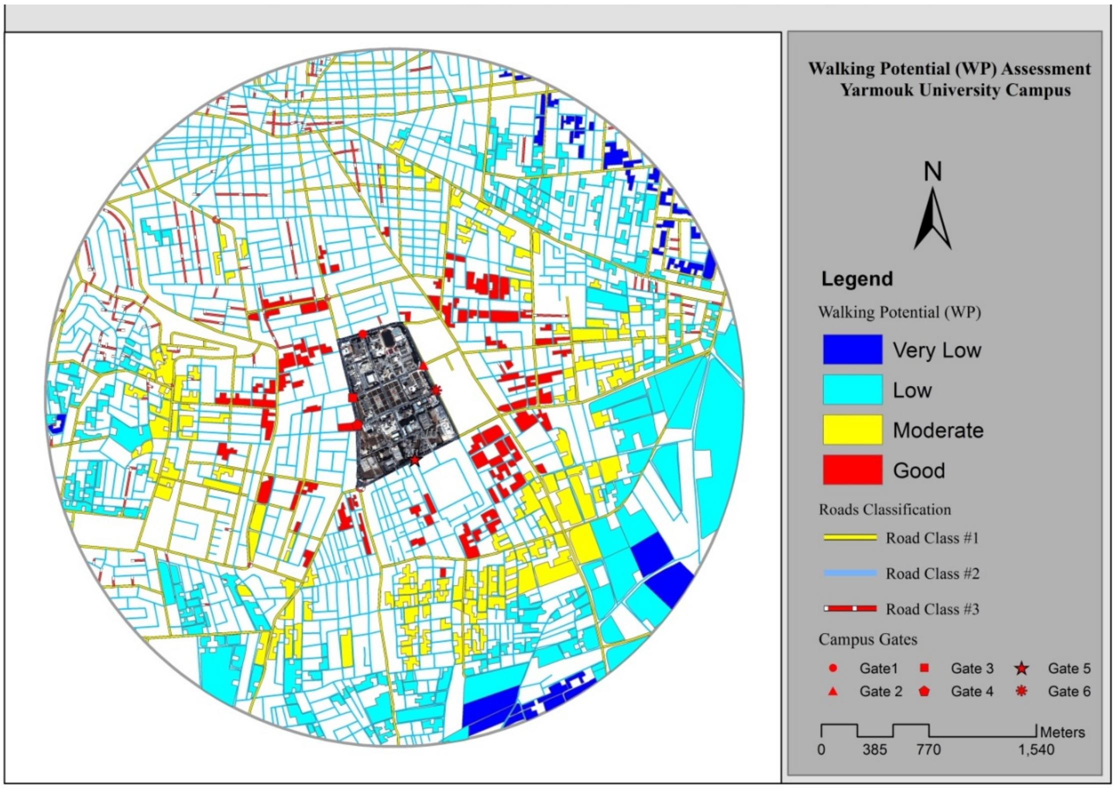


Figure (10): Walking potential (WP) for vacant sites

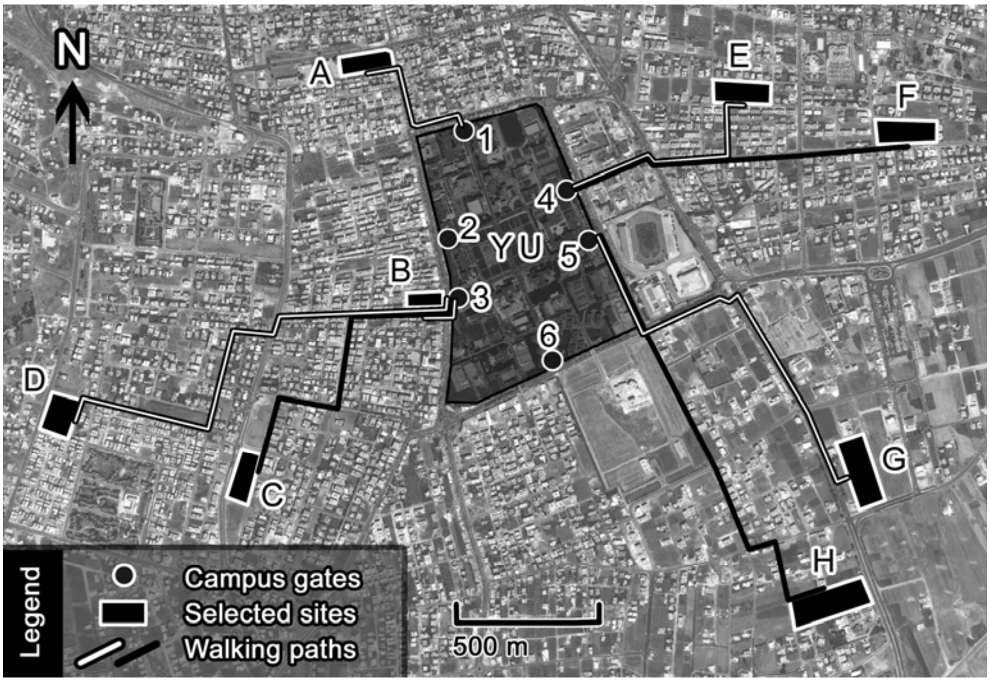


Figure (11): Selected vacant sites with proposed walking paths to YU campus

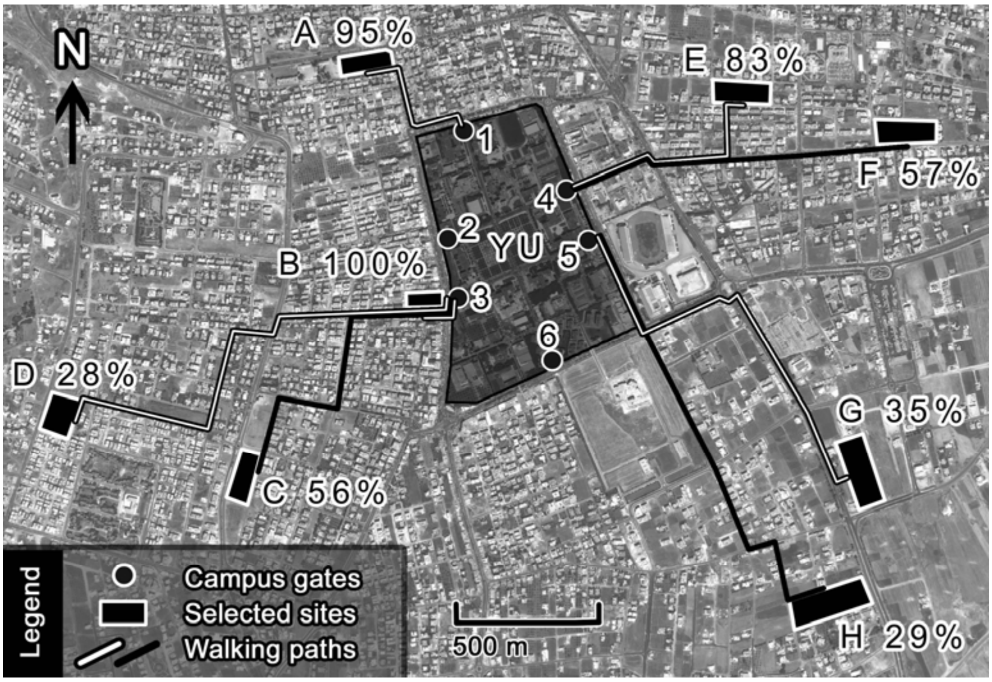


Figure (12): Final WP values for YU vacant sites

It was assumed that students will be walking 'briskly' to and from the university campus. As mentioned earlier, this equals a speed of 6.4 km/hour (Grava, 2004). However, it is proposed that universities may try to define a speed that is representative of their student population. Once the speed was determined, the 'raw' one-way walking duration which excludes road-crossing waiting times was calculated for each of the walking paths as can be seen in Tables 3-5. Next, it was necessary to determine the road-crossing times of each of the walking paths. The authors were able to visit some of the road crossings, observe people trying to cross and take note of these road-crossing waiting times. After a sufficient number of observations, it was possible to approximate road-crossing waiting times for each of the three road classes as follows (rounded to the nearest 5 seconds): 30 seconds for large crossings; 15 seconds for medium crossings; and 5 seconds for small crossings. Finally, a 'total' walking duration for each of the paths was calculated by adding road-crossing waiting times to the raw walking duration as also shown in Tables 3-5.

d. Step 4: Calculating the walking potential (WP) of each of the proposed sites

Using the graph in Figure 4, it was possible to determine the accumulated student percentages or WPs for the vacant sites, as shown in Tables 3-5 and Figures 7-9. Each of these numbers represents the percentage of students who prefer walking trips with durations that are equal or shorter than the walking duration of that particular housing site. It is believed that these final student percentages or WPs describe the sites' potential to promote walking for students. They simply show to what extent each of the sites invites students to walk to and from the campus. These final student percentages allowed for a comparison between the sites. ArcMap was combined with the road network layer and then it was joined with the other assist layers which were created using ArcCatalog to find the quickest optimal route between the university gates and the open areas that might be used for building student residence. The routes appear on the Map and in the Route Category on the Network Analyst Window. Note that three areas were classified previously are used separately to compute the optimal route between campus gates and the possible vacant sites. Figure 7 and Table 3 show the optimal route between the campus gates and the vacant sites which is between 2,000-8,000 m^2. Table 3 contains total trip duration and walking potential (WP) between gates and vacant sites that are 2,000-8,000 m^2 in size. Similarly, optimal routes were calculated for other vacant sites' areas of 8,001-16,000m2 (Figure 8 and Table 4) and >16,000m2 (Figure 9 and Table 5).

Table 3. Total trip duration and walking potential (WP) between gates and vacant sites (2,000-8,000m^2)

Site Name	Trip Duration	WP	Site Name	Trip Duration	WP	Site Name	Trip Duration	WP
Gate #3 - Loc 174	1.1675	123.7911	Gate #6 - Loc 269	14.0360	64.5074	Gate #3 - Loc 227	20.9455	39.9326
Gate #1 - Loc 85	3.2564	112.9721	Gate #6 - Loc 30	14.2028	63.8545	Gate #4 - Loc 62	21.0975	39.4489
Gate #6 - Loc 236	4.2026	108.2243	Gate #6 - Loc 248	14.4058	63.0639	Gate #3 - Loc 228	21.1155	39.3919
Gate #1 - Loc 149	4.4791	106.8547	Gate #2 - Loc 176	14.4189	63.0127	Gate #4 - Loc 125	21.1164	39.3890
Gate #6 - Loc 238	4.8612	104.9751	Gate #3 - Loc 225	14.4719	62.8073	Gate #3 - Loc 220	21.1656	39.2332
Gate #3 - Loc 175	5.4041	102.3317	Gate #6 - Loc 258	14.5630	62.4545	Gate #4 - Loc 70	21.2938	38.8279
Gate #6 - Loc 237	5.4564	102.0790	Gate #6 - Loc 307	14.5995	62.3134	Gate #4 - Loc 38	21.3467	38.6614
Gate #2 - Loc 153	5.8447	100.2094	Gate #1 - Loc 140	14.6697	62.0423	Gate #6 - Loc 277	21.3498	38.6518
Gate #4 - Loc 11	5.8578	100.1468	Gate #1 - Loc 162	14.6929	61.9530	Gate #4 - Loc 107	21.3592	38.6222
Gate #3 - Loc 211	6.0180	99.3806	Gate #4 - Loc 97	14.8640	61.2950	Gate #6 - Loc 279	21.3811	38.5530
Gate #1 - Loc 142	6.0996	98.9912	Gate #1 - Loc 100	14.8817	61.2273	Gate #2 - Loc 190	21.4586	38.3099
Gate #3 - Loc 210	6.1267	98.8618	Gate #2 - Loc 178	15.0736	60.4937	Gate #3 - Loc 221	21.6011	37.8642
Gate #4 - Loc 8	6.3079	98.0005	Gate #4 - Loc 52	15.0968	60.4050	Gate #4 - Loc 64	21.6462	37.7237
Gate #4 - Loc 12	6.3510	97.7962	Gate #6 - Loc 259	15.1075	60.3642	Gate #6 - Loc 281	21.6573	37.6891
Gate #4 - Loc 9	6.5171	97.0103	Gate #4 - Loc 29	15.1345	60.2615	Gate #3 - Loc 194	21.7146	37.5107
Gate #1 - Loc 144	6.5512	96.8497	Gate #4 - Loc 27	15.2857	59.6870	Gate #4 - Loc 44	21.7591	37.3725
Gate #2 - Loc 152	6.6845	96.2212	Gate #1 - Loc 139	15.3743	59.3517	Gate #6 - Loc 276	21.8236	37.1725
Gate #4 - Loc 86	6.7036	96.1317	Gate #4 - Loc 59	15.5485	58.6947	Gate #3 - Loc 207	21.9256	36.8573
Gate #1 - Loc 147	6.8299	95.5384	Gate #4 - Loc 35	15.6589	58.2796	Gate #4 - Loc 124	21.9288	36.8475
Gate #3 - Loc 180	6.8949	95.2341	Gate #6 - Loc 262	15.6830	58.1893	Gate #6 - Loc 298	21.9323	36.8366
Gate #6 - Loc 299	7.0291	94.6068	Gate #4 - Loc 58	15.8128	57.7037	Gate #4 - Loc 42	21.9513	36.7779
Gate #1 - Loc 143	7.0967	94.2911	Gate #1 - Loc 98	15.9646	57.1380	Gate #3 - Loc 195	21.9758	36.7026
Gate #4 - Loc 10	7.1957	93.8303	Gate #4 - Loc 46	16.0084	56.9751	Gate #6 - Loc 41	22.0972	36.3293
Gate #1 - Loc 151	7.2470	93.5921	Gate #6 - Loc 260	16.0387	56.8626	Gate #6 - Loc 280	22.1407	36.1961
Gate #4 - Loc 21	7.3150	93.2764	Gate #6 - Loc 249	16.0956	56.6518	Gate #4 - Loc 39	22.2663	35.8122
Gate #1 - Loc 148	7.3674	93.0335	Gate #4 - Loc 95	16.1813	56.3347	Gate #4 - Loc 123	22.2962	35.7210
Gate #2 - Loc 156	7.3963	92.9000	Gate #1 - Loc 99	16.1858	56.3181	Gate #3 - Loc 229	22.3076	35.6863
Gate #2 - Loc 154	7.6274	91.8331	Gate #1 - Loc 160	16.2280	56.1623	Gate #4 - Loc 109	22.3177	35.6556
Gate #1 - Loc 150	7.7806	91.1287	Gate #6 - Loc 261	16.3200	55.8231	Gate #4 - Loc 126	22.3493	35.5593
Gate #4 - Loc 22	7.8029	91.0266	Gate #6 - Loc 292	16.5012	55.1578	Gate #3 - Loc 209	22.4178	35.3515
Gate #1 - Loc 146	7.9379	90.4086	Gate #6 - Loc 294	16.6278	54.6950	Gate #4 - Loc 65	22.4386	35.2884
Gate #4 - Loc 91	7.9462	90.3703	Gate #3 - Loc 179	16.6636	54.5645	Gate #2 - Loc 191	22.4791	35.1656
Gate #3 - Loc 181	7.9764	90.2325	Gate #6 - Loc 291	16.7131	54.3844	Gate #3 - Loc 203	22.5998	34.8009

Gate #6 - Loc 300	8.0106	90.0764	Gate #6 - Loc 251	16.7500	54.2502	Gate #4 - Loc 108	22.6032	34.7909
Gate #4 - Loc 87	8.3231	88.6556	Gate #4 - Loc 28	16.7599	54.2140	Gate #6 - Loc 233	22.7823	34.2528
Gate #2 - Loc 157	8.5036	87.8393	Gate #4 - Loc 53	16.7820	54.1337	Gate #3 - Loc 197	22.8482	34.0556
Gate #6 - Loc 271	8.5578	87.5950	Gate #4 - Loc 55	16.8336	53.9465	Gate #4 - Loc 71	22.8701	33.9902
Gate #1 - Loc 145	8.8418	86.3198	Gate #6 - Loc 270	16.8778	53.7861	Gate #4 - Loc 63	22.9031	33.8919
Gate #6 - Loc 274	8.8458	86.3019	Gate #6 - Loc 252	16.9100	53.6698	Gate #4 - Loc 79	23.0542	33.4425
Gate #2 - Loc 163	8.8519	86.2748	Gate #4 - Loc 96	17.0357	53.2156	Gate #3 - Loc 205	23.0575	33.4327
Gate #6 - Loc 239	8.8729	86.1810	Gate #1 - Loc 102	17.0917	53.0138	Gate #6 - Loc 283	23.1013	33.3029
Gate #6 - Loc 301	9.0596	85.3477	Gate #3 - Loc 217	17.2556	52.4257	Gate #3 - Loc 206	23.1137	33.2662
Gate #3 - Loc 182	9.0825	85.2457	Gate #3 - Loc 198	17.3514	52.0828	Gate #3 - Loc 208	23.2465	32.8740
Gate #4 - Loc 18	9.2154	84.6553	Gate #4 - Loc 51	17.3614	52.0474	Gate #3 - Loc 196	23.2680	32.8107
Gate #4 - Loc 24	9.3211	84.1872	Gate #4 - Loc 32	17.3808	51.9780	Gate #3 - Loc 193	23.3631	32.5314
Gate #6 - Loc 275	9.4020	83.8295	Gate #2 - Loc 171	17.3943	51.9297	Gate #4 - Loc 130	23.5085	32.1059
Gate #4 - Loc 90	9.5414	83.2151	Gate #2 - Loc 167	17.4125	51.8650	Gate #3 - Loc 200	23.5334	32.0332
Gate #4 - Loc 23	9.6516	82.7310	Gate #4 - Loc 36	17.4199	51.8384	Gate #6 - Loc 235	23.5389	32.0173
Gate #6 - Loc 265	9.7151	82.4522	Gate #6 - Loc 253	17.4997	51.5546	Gate #6 - Loc 234	23.6075	31.8177
Gate #6 - Loc 272	9.7765	82.1832	Gate #6 - Loc 293	17.5024	51.5448	Gate #6 - Loc 40	23.6465	31.7045
Gate #6 - Loc 303	9.9678	81.3480	Gate #6 - Loc 290	17.6373	51.0663	Gate #6 - Loc 284	23.8434	31.1347
Gate #1 - Loc 155	10.1139	80.7129	Gate #6 - Loc 250	17.6919	50.8729	Gate #3 - Loc 204	23.8467	31.1254
Gate #2 - Loc 164	10.1614	80.5070	Gate #6 - Loc 309	17.7738	50.5837	Gate #4 - Loc 120	23.9131	30.9342
Gate #6 - Loc 302	10.3215	79.8143	Gate #1 - Loc 103	18.0365	49.6612	Gate #6 - Loc 282	24.0018	30.6796
Gate #4 - Loc 19	10.3779	79.5708	Gate #6 - Loc 31	18.0875	49.4828	Gate #4 - Loc 129	24.0253	30.6124
Gate #3 - Loc 216	10.5114	78.9963	Gate #3 - Loc 222	18.1348	49.3175	Gate #2 - Loc 189	24.0774	30.4635
Gate #4 - Loc 89	10.6818	78.2655	Gate #2 - Loc 168	18.2435	48.9391	Gate #2 - Loc 185	24.2457	29.9840
Gate #4 - Loc 16	10.7177	78.1116	Gate #3 - Loc 199	18.2871	48.7876	Gate #4 - Loc 121	24.2471	29.9801
Gate #1 - Loc 141	10.8716	77.4550	Gate #6 - Loc 254	18.3044	48.7277	Gate #4 - Loc 80	24.4454	29.4190
Gate #6 - Loc 264	11.0120	76.8580	Gate #4 - Loc 34	18.3590	48.5381	Gate #3 - Loc 201	24.4475	29.4131
Gate #6 - Loc 244	11.0454	76.7163	Gate #6 - Loc 311	18.4462	48.2365	Gate #4 - Loc 72	24.4829	29.3134
Gate #4 - Loc 26	11.0738	76.5958	Gate #4 - Loc 33	18.4506	48.2212	Gate #4 - Loc 68	24.5070	29.2458
Gate #6 - Loc 306	11.1106	76.4399	Gate #4 - Loc 104	18.4679	48.1617	Gate #4 - Loc 43	24.6620	28.8113
Gate #4 - Loc 17	11.1280	76.3662	Gate #4 - Loc 45	18.5232	47.9707	Gate #4 - Loc 110	24.8589	28.2628
Gate #6 - Loc 263	11.1459	76.2904	Gate #4 - Loc 61	18.5321	47.9403	Gate #3 - Loc 202	24.9734	27.9461
Gate #4 - Loc 88	11.3662	75.3612	Gate #6 - Loc 226	18.6574	47.5090	Gate #2 - Loc 186	24.9767	27.9368
Gate #3 - Loc 212	11.3940	75.2441	Gate #6 - Loc 310	18.8083	46.9923	Gate #3 - Loc 231	25.1658	27.4166
Gate #4 - Loc 15	11.5442	74.6139	Gate #4 - Loc 106	18.8556	46.8310	Gate #4 - Loc 69	25.2654	27.1440
Gate #3 - Loc 213	11.6594	74.1321	Gate #6 - Loc 289	18.9607	46.4728	Gate #4 - Loc 78	25.3218	26.9900
Gate #6 - Loc 256	11.6616	74.1228	Gate #4 - Loc 50	18.9658	46.4556	Gate #6 - Loc 6	25.3720	26.8533
Gate #6 - Loc 304	11.6864	74.0193	Gate #2 - Loc 170	18.9809	46.4042	Gate #4 - Loc 119	25.4260	26.7068
Gate #6 - Loc 245	11.7597	73.7140	Gate #4 - Loc 114	18.9854	46.3889	Gate #2 - Loc 187	25.4293	26.6979
Gate #3 - Loc 215	11.8148	73.4845	Gate #4 - Loc 49	19.0107	46.3031	Gate #2 - Loc 188	25.4384	26.6730
Gate #3 - Loc 183	11.9130	73.0767	Gate #4 - Loc 116	19.0347	46.2214	Gate #4 - Loc 128	25.6035	26.2268

Gate #4 - Loc 101	11.9214	73.0419	Gate #3 - Loc 223	19.1262	45.9114	Gate #2 - Loc 192	25.6563	26.0845
Gate #4 - Loc 20	12.0646	72.4486	Gate #4 - Loc 54	19.2624	45.4517	Gate #6 - Loc 7	25.7034	25.9580
Gate #6 - Loc 273	12.2066	71.8628	Gate #4 - Loc 56	19.3369	45.2010	Gate #3 - Loc 230	25.9011	25.4293
Gate #4 - Loc 13	12.2784	71.5676	Gate #4 - Loc 105	19.3876	45.0308	Gate #4 - Loc 76	25.9868	25.2015
Gate #2 - Loc 165	12.4340	70.9292	Gate #6 - Loc 297	19.4301	44.8884	Gate #4 - Loc 127	26.2621	24.4746
Gate #6 - Loc 241	12.4509	70.8603	Gate #4 - Loc 57	19.4619	44.7819	Gate #4 - Loc 77	26.2933	24.3927
Gate #6 - Loc 243	12.6431	70.0758	Gate #4 - Loc 37	19.5500	44.4873	Gate #4 - Loc 138	26.3834	24.1571
Gate #6 - Loc 305	12.6841	69.9088	Gate #6 - Loc 287	19.6479	44.1611	Gate #4 - Loc 137	26.4944	23.8677
Gate #3 - Loc 177	12.7537	69.6261	Gate #2 - Loc 169	19.7266	43.8994	Gate #4 - Loc 82	27.0694	22.3900
Gate #3 - Loc 214	12.7996	69.4398	Gate #6 - Loc 295	19.8499	43.4912	Gate #4 - Loc 73	27.1002	22.3118
Gate #6 - Loc 267	12.8164	69.3717	Gate #4 - Loc 113	19.8592	43.4603	Gate #6 - Loc 5	27.2240	21.9987
Gate #4 - Loc 25	12.8237	69.3420	Gate #6 - Loc 296	19.8937	43.3462	Gate #4 - Loc 132	27.3465	21.6904
Gate #4 - Loc 93	12.8661	69.1703	Gate #2 - Loc 184	19.8986	43.3301	Gate #4 - Loc 75	27.4229	21.4989
Gate #6 - Loc 246	12.9092	68.9961	Gate #6 - Loc 288	20.0353	42.8801	Gate #4 - Loc 81	27.6107	21.0309
Gate #6 - Loc 266	12.9206	68.9501	Gate #3 - Loc 218	20.2145	42.2926	Gate #6 - Loc 1	27.9410	20.2169
Gate #6 - Loc 240	13.0826	68.2966	Gate #3 - Loc 219	20.2342	42.2285	Gate #4 - Loc 118	28.0856	19.8642
Gate #2 - Loc 166	13.1113	68.1809	Gate #4 - Loc 117	20.2485	42.1817	Gate #6 - Loc 4	28.2533	19.4579
Gate #4 - Loc 14	13.1267	68.1192	Gate #6 - Loc 278	20.3734	41.7748	Gate #4 - Loc 134	28.2800	19.3936
Gate #6 - Loc 308	13.2755	67.5223	Gate #1 - Loc 158	20.4360	41.5715	Gate #4 - Loc 131	28.3136	19.3127
Gate #6 - Loc 257	13.4439	66.8494	Gate #2 - Loc 173	20.4632	41.4834	Gate #4 - Loc 133	28.3244	19.2867
Gate #6 - Loc 255	13.4662	66.7602	Gate #4 - Loc 47	20.5465	41.2136	Gate #4 - Loc 84	28.3447	19.2377
Gate #6 - Loc 247	13.5597	66.3883	Gate #4 - Loc 122	20.6278	40.9515	Gate #4 - Loc 135	28.3454	19.2361
Gate #1 - Loc 161	13.5687	66.3525	Gate #3 - Loc 224	20.6354	40.9269	Gate #4 - Loc 67	28.4717	18.9334
Gate #1 - Loc 159	13.5918	66.2608	Gate #6 - Loc 285	20.6649	40.8320	Gate #4 - Loc 66	28.5200	18.8180
Gate #4 - Loc 60	13.6006	66.2260	Gate #4 - Loc 111	20.6746	40.8006	Gate #4 - Loc 74	28.5411	18.7678
Gate #4 - Loc 94	13.6671	65.9620	Gate #4 - Loc 48	20.7533	40.5478	Gate #6 - Loc 3	28.6087	18.6069
Gate #6 - Loc 242	13.8354	65.2966	Gate #4 - Loc 112	20.7744	40.4799	Gate #6 - Loc 2	28.6580	18.4898
Gate #2 - Loc 172	13.8720	65.1524	Gate #6 - Loc 286	20.8192	40.3363	Gate #4 - Loc 136	28.9953	17.6962
Gate #4 - Loc 92	13.9539	64.8299	Gate #4 - Loc 115	20.8850	40.1259	Gate #4 - Loc 83	29.5656	16.3820
Gate #6 - Loc 268	14.0099	64.6099	Gate #6 - Loc 232	20.9116	40.0408			

DISCUSSION AND CONCLUSIONS

The collected data includes current students' regular travel time, longest preferred one-way walking duration to and from the university campus, gender, age and used travel mode. Results indicate that the mean value for students' longest preferred one-way walking duration is 17.04± 8.25 minutes for the whole sample (16.3 ± 8.20 minutes for male students and 18.09 ± 8.24 minutes for female students). A statistically significant negative correlation is found between students' longest preferred one-way walking duration and age for students 18 to 24 years old (N=457) with a correlation coefficient of -0.139 and a *p-value* of 0.003. Using aerial photograph of the City of Irbid, vacant sites suitable for student housing with areas more than 2,000m^2 are considered in the walking potential calculations. As a result, vacant lands which are digitized at a 2.5km radius from the centre of the Yarmouk University campus, are classified into four

Table 4. Total trip duration and walking potential (WP) between gates and vacant sites (8,001-16,000 m^2)

Site Name	Trip Duration	WP	Site Name	Trip Duration	WP	Site Name	Trip Duration	WP
Gate #6 - Location 80	6.133596	98.8292	Gate #2 - Location 32	13.816811	65.3700	Gate #6 - Location 72	19.285507	45.3739
Gate #2 - Location 26	7.194044	93.8382	Gate #4 - Location 9	13.978871	64.7318	Gate #6 - Location 11	19.825802	43.5708
Gate #6 - Location 79	7.296662	93.3615	Gate #4 - Location 18	14.409198	63.0506	Gate #6 - Location 60	19.974132	43.0811
Gate #4 - Location 17	7.453545	92.6350	Gate #2 - Location 27	14.410442	63.0458	Gate #2 - Location 28	19.978875	43.0655
Gate #3 - Location 49	7.522786	92.3152	Gate #3 - Location 59	14.495925	62.7142	Gate #3 - Location 55	20.075718	42.7472
Gate #6 - Location 82	7.582688	92.0389	Gate #6 - Location 63	14.628413	62.2017	Gate #3 - Location 45	20.189603	42.3741
Gate #6 - Location 83	8.278516	88.8576	Gate #6 - Location 68	15.232587	59.8886	Gate #4 - Location 20	20.338603	41.8880
Gate #2 - Location 29	8.315236	88.6912	Gate #6 - Location 69	15.291793	59.6640	Gate #6 - Location 87	20.407808	41.6631
Gate #1 - Location 23	8.515	87.7881	Gate #2 - Location 33	15.4232	59.1669	Gate #3 - Location 57	20.722647	40.6461
Gate #6 - Location 51	8.603022	87.3916	Gate #3 - Location 34	15.557384	58.6611	Gate #1 - Location 25	20.901914	40.0717
Gate #2 - Location 24	8.610115	87.3596	Gate #6 - Location 93	15.560128	58.6508	Gate #4 - Location 12	21.320477	38.7440
Gate #6 - Location 81	8.978217	85.7104	Gate #6 - Location 10	15.589096	58.5419	Gate #4 - Location 22	21.544153	38.0420
Gate #6 - Location 90	9.790652	82.1215	Gate #6 - Location 77	15.733887	57.9988	Gate #3 - Location 44	21.702264	37.5491
Gate #3 - Location 36	10.012584	81.1532	Gate #6 - Location 73	15.909403	57.3434	Gate #6 - Location 88	21.716827	37.5038
Gate #4 - Location 5	10.036108	81.0509	Gate #6 - Location 64	15.935792	57.2452	Gate #4 - Location 19	21.856402	37.0711
Gate #4 - Location 6	10.597678	78.6258	Gate #6 - Location 65	16.466937	55.2833	Gate #3 - Location 48	22.642827	34.6714
Gate #3 - Location 30	10.840946	77.5856	Gate #2 - Location 41	16.545053	54.9973	Gate #2 - Location 42	23.044831	33.4702
Gate #6 - Location 84	11.404744	75.1991	Gate #3 - Location 40	16.565033	54.9243	Gate #4 - Location 15	23.630343	31.7513
Gate #6 - Location 7	11.448903	75.0136	Gate #6 - Location 78	16.700085	54.4316	Gate #6 - Location 89	23.765445	31.3598
Gate #2 - Location 31	11.765708	73.6888	Gate #6 - Location 67	16.723697	54.3457	Gate #3 - Location 47	24.048208	30.5468
Gate #6 - Location 62	11.811269	73.4992	Gate #3 - Location 53	16.841417	53.9181	Gate #6 - Location 4	24.332005	29.7393
Gate #3 - Location 37	11.925723	73.0238	Gate #3 - Location 52	16.917595	53.6422	Gate #3 - Location 46	24.97336	27.9460
Gate #6 - Location 66	12.419134	70.9902	Gate #6 - Location 92	16.972973	53.4421	Gate #6 - Location 86	25.11455	27.5571
Gate #6 - Location 61	12.662044	69.9985	Gate #6 - Location 74	17.090799	53.0173	Gate #4 - Location 14	25.505668	26.4908
Gate #6 - Location 75	13.382923	67.0925	Gate #3 - Location 58	17.344527	52.1075	Gate #4 - Location 16	26.09482	24.9153
Gate #3 - Location 50	13.411877	66.9770	Gate #6 - Location 70	17.460491	51.6939	Gate #4 - Location 21	26.101259	24.8983
Gate #3 - Location 39	13.479855	66.7060	Gate #3 - Location 56	17.728149	50.7449	Gate #2 - Location 43	26.15541	24.7554
Gate #6 - Location 91	13.50302	66.6138	Gate #3 - Location 35	17.814255	50.4412	Gate #6 - Location 3	27.293091	21.8246
Gate #4 - Location 8	13.511266	66.5809	Gate #6 - Location 71	17.992713	49.8143	Gate #4 - Location 13	27.310458	21.7809
Gate #3 - Location 38	13.747798	65.6427	Gate #3 - Location 54	18.03375	49.6706	Gate #6 - Location 2	28.961243	17.7759
Gate #6 - Location 76	13.78526	65.4946	Gate #6 - Location 85	18.872868	46.7719	Gate #6 - Location 1	29.262311	17.0766

Table 5. Total trip duration and walking potential (WP) between gates and vacant sites (greater than 16,000m^2)

Site Name	Trip Duration	WP	Site Name	Trip Duration	WP	Site Name	Trip Duration	WP
Gate #4 - Location 22	9.3531	84.0458	Gate #3 - Location 33	18.4473	48.2328	Gate #6 - Location 15	22.9081	33.8770
Gate #6 - Location 39	10.0778	80.8697	Gate #6 - Location 14	18.4617	48.1831	Gate #6 - Location 42	22.9553	33.7364
Gate #4 - Location 26	10.4063	79.4486	Gate #6 - Location 47	18.7438	47.2131	Gate #6 - Location 13	22.9993	33.6053
Gate #4 - Location 23	12.4887	70.7056	Gate #4 - Location 24	18.8098	46.9873	Gate #6 - Location 3	23.0037	33.5922
Gate #6 - Location 40	12.9804	68.7084	Gate #6 - Location 19	19.0067	46.3167	Gate #6 - Location 41	23.1464	33.1695
Gate #6 - Location 43	14.1770	63.9555	Gate #3 - Location 32	19.1525	45.8227	Gate #6 - Location 16	23.4501	32.2766
Gate #3 - Location 28	15.9054	57.3581	Gate #2 - Location 29	19.2337	45.5484	Gate #6 - Location 21	23.6974	31.5566
Gate #2 - Location 27	16.3674	55.6487	Gate #6 - Location 48	19.3758	45.0706	Gate #6 - Location 11	24.1426	30.2774
Gate #6 - Location 45	16.4170	55.4666	Gate #6 - Location 5	20.5931	41.0632	Gate #3 - Location 30	24.1651	30.2133
Gate #6 - Location 37	16.4767	55.2477	Gate #6 - Location 51	20.9349	39.9665	Gate #6 - Location 4	24.9542	27.9989
Gate #6 - Location 38	16.6184	54.7294	Gate #6 - Location 36	21.2004	39.1229	Gate #6 - Location 2	25.3199	26.9954
Gate #6 - Location 44	16.6547	54.5970	Gate #6 - Location 8	21.3658	38.6013	Gate #6 - Location 18	25.7293	25.8884
Gate #6 - Location 9	16.8627	53.8409	Gate #6 - Location 50	21.6145	37.8225	Gate #6 - Location 7	27.7165	20.7690
Gate #6 - Location 46	17.1874	52.6700	Gate #3 - Location 34	21.9342	36.8309	Gate #6 - Location 6	27.8881	20.3466
Gate #6 - Location 31	17.5982	51.2048	Gate #6 - Location 12	22.4025	35.3979	Gate #6 - Location 20	28.7142	18.3569
Gate #6 - Location 49	17.9838	49.8456	Gate #3 - Location 35	22.8334	34.1000	Gate #6 - Location 1	29.7167	16.0394
Gate #6 - Location 17	18.2916	48.7720	Gate #6 - Location 10	22.8826	33.9530	Gate #4 - Location 25	30.1307	15.1138

categories based on the walking potential (WP) (Figure 10). Vacant lands in red form the good walking potential category, degrading down towards moderate, low and very low WP sites as seen in the map (Figure 10). By this we have a fully evaluated context for the university vicinity based on WP in order to aid the selection of students' housing sites which promote walking. The proposed methodology is believed to help city planners, investors and decision makers in choosing better sites for student housing when walking is a high priority.

This paper provided a simple methodology to calculate and compare the potential of different housing sites to promote walking for university students by utilizing students' own preference for walking duration. It is believed that the proposed methodology has the potential to prove a valuable tool for universities in the process of site selection for student housing by choosing sites that are more inviting to walking. It determines which housing sites offer too little walking potential and should be avoided and which sites maximize opportunities for walking. Using this methodology is assumed to offer students great health and financial benefits and at the same time reduce loads on the local traffic network. It is also believed that the proposed methodology can be used for other site selection purposes other than housing, including commercial, schools or public buildings, utilizing the population's own preference for trip duration. It is even assumed that the idea can be used with more travel types other than walking such as cycling or even public or motorized transport. As planners and decision makers often take in mind the criteria of land cost, desirability and available area, to name just a few, now the WP of a site can provide a valuable new criterion to be added to the formula of housing site selection (Figure 10). It is proposed that WP values get used as input in GIS software as a separate layer and even be automatically calculated using special programming.

It is hoped that future research would be able to refine the proposed methodology even more and try to use it in more fields other than student housing. It is assumed that future studies should be able to define more factors to determine a site's WP other than the duration of its walking trip. Also, more precise techniques to estimate preferred trip durations or distances should be implemented and more accurate methods should be devised to determine trip paths and to estimate actual trip durations and distances of proposed sites. For example; future research such as economical studies (cost/benefit analysis of building university student housing); environmental studies (effects of cold, raining or snowing conditions on walking mode); and the proper design of sidewalks (according to standard specifications of road geometry) may be considered when calculating walking potential of sites.

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