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Analysing the usage of a segregated interurban cycleway (Greenway) in Ireland

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ABSTRACT

This paper analyses the usage of a pilot greenway in a rural environment in Ireland. The path is 42 km long and has several settlements and schools located along the route. A survey was conducted in five schools along the route, to determine the usage of the greenway by students and staff in the schools. This enabled observations to be made in relation to the usage of the greenway. Usage of the path is established by means of counters located along the route. Average hourly day profiles of usage along the path were created for different scenarios. This allowed the differences in usage to be examined. The impact of national and public holidays was also observed. Usage patterns are also analysed in relation to a number of weather variables. The relationships are determined by means of regression analysis. The cost of construction of the path is known and therefore by establishing the user numbers the cost per trip can be calculated. The average spend of a tourist in Ireland is known, and the quantity of tourists needed to pay for the path is estimated.

The analysis in this paper determined that there is a strong increase in the cycling and walking rate in the areas immediately surrounding the Greenway in persons accessing places of education. The paper also determined that usage is higher when there is a combination of the following variables; temperature is above13.15^{o}C and sunshine hours are between 9.4 and 2.3 hours.

INTRODUCTION AND BACKGROUND

In 2009, Ireland's first National Cycling Policy Framework was adopted. The specific objectives were to promote the development of walking and cycling in Ireland. One objective was to "*Provide designated rural signed cycle networks providing especially for visitors and recreational cycling*" (*1*). One such project is the Great Western Greenway (GWG) in the North West of Ireland. The first phase of this project, an 18 km (11.2miles) route from Newport to Mulranny was opened in April 2010. This phase was a "huge success" (*2*) and a €3.5 million ($5.07 million *) package was agreed to expand the route to 42 km (26.1miles). The 42 km (26.1miles) route is currently the longest off-road cycling and walking trail in the republic of Ireland. In 2009, it is estimated that cycling tourists spent €97 million ($140.5 million*) while in Ireland (*3*). The majority of the cyclists that were surveyed were satisfied with cycling in Ireland, however; 12% of those surveyed were either dissatisfied or very dissatisfied. With investments in infrastructure like the GWG it is hoped to increase the percentage of cyclist tourists that are satisfied with cycling in Ireland. This in turn may lead to an increase in expenditure from this category of tourist and also increase sustainable travel patterns within the area. A 'Safer Routes' to school study in 2005 (*4*) found that there was an ever increasing dependence on the car as a means of transport to school with corresponding decreases in walking and cycling in Ireland. Several pilot schemes were tried and tested. Studies of these schemes demonstrate that when there was a combination of investment in good quality infrastructure and promotion of sustainable travel within the local community, there was a decline in the car as the main mode of transport. One school in a pilot scheme recorded a 22% reduction in the usage of the car. From these pilot schemes various 'Green' campaigns have been created such as 'COW' (Cycle on Wednesdays), and 'WOOF' (Walk out on Fridays). Schools around the country are actively encouraged to participate. A Quarterly National Travel survey, conducted in 2009 (*5*), indicates that nationally, cycling accounts for approximately 1% of trips undertaken and approximately 16% of trips undertaken are by means of walking. This indicates that there is a low level of active travel in Ireland.

The research presented in this paper examines the usage of the Greenway. Several similar projects of this nature are currently under consideration in Ireland and this paper was undertaken to identify the success of these schemes. See Figure 1 for a sample section of the GWG. This paper analyses counter data and the school going population in the area. The GWG benefits locals in that it caters for safe sustainable travel in the area and also provides a leisure/fitness route. The economy benefits as this delivers an attractive facility for tourists and therefore encourages tourism in Ireland. There are numerous health benefits in terms of increased exercise for people utilising the facility and hence decreasing health expenditure. Infrastructure like this promotes cycling positively by providing a facility that will allow a potential cyclist commuter to experience the benefits of cycling in an attractive safe environment.

* All conversions were at exchange rate of €1 = $1.449

Figure 1 Image of the GWG

Source: Discover Ireland 2010 (*6*)

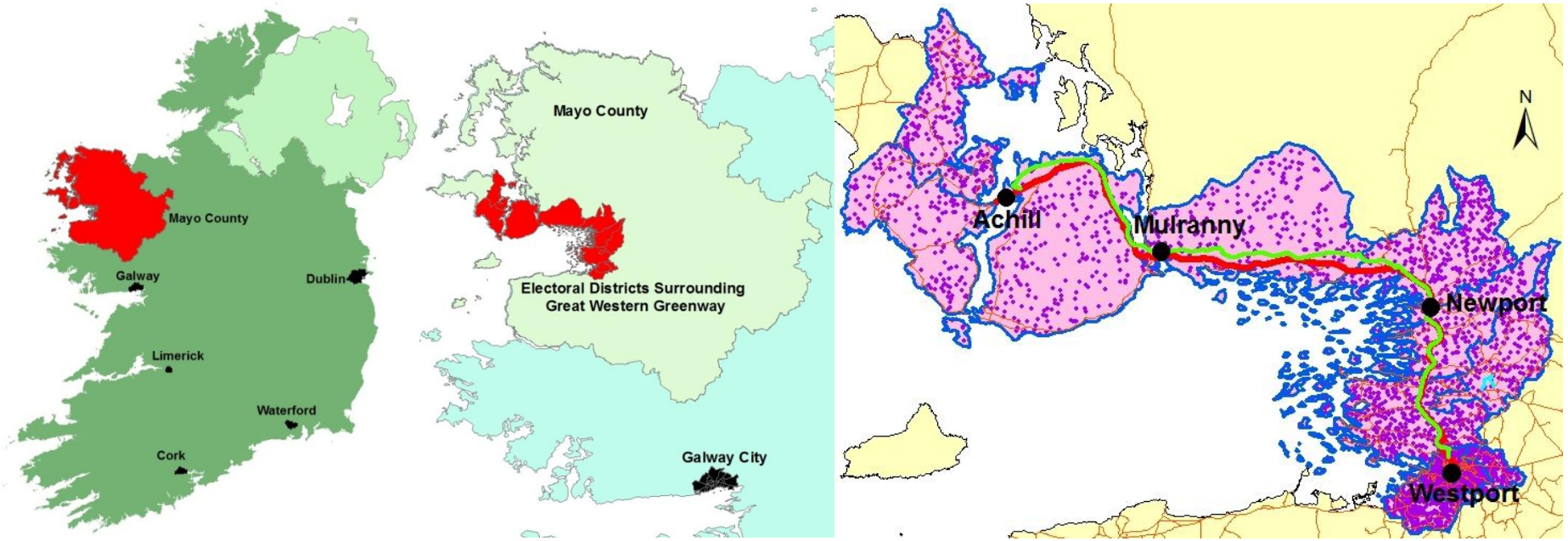
Figure 2 illustrates the location of the GWG in a national and local context. The left map indicates the location of the county in which the GWG is located. The middle map indicates the area surrounding the GWG in regard to the county. The right map displays the route of the GWG in green and the parallel Primary road is indicated in red. The routes are illustrated in the context of the surrounding area. Settlements along the route are indicated in black. The greenway traverses 10 electoral wards and from the 2006 census of Ireland statistics, the population density in each electoral ward is known. This is indicated by the purple dots with each dot representing one resident. Other roads in the area are displayed in green. It can be seen that the population in the eastern and southern sections is denser than the western sections.

The population in the area surrounding the GWG from the 2006 Census is 4,967. A Table of statistics for the area can be viewed in Table 1. These census figures were compiled in 2006, four years before the first phase of the GWG opened. Table 1 indicates that there are more males in the area than females, the car is the predominant means of transport, the age group '35 – 49 years' is the largest age group and 45.5% of household have two cars.

TABLE 1 2006 Census statistics for the area around the GWG

Category	Quantity	Percentage
Gender		
Male	2801	56.4%
Female	2166	43.6%
Means of Transport		
Walk/Cycle	765	15.4%
Bus/Rail	50	1%
Car	3193	64.3%
Work from Home	169	3.4%
Other	790	15.9%
Age		
15 – 24 years	581	11.7%
25 – 34 years	1272	25.6%
35 – 49 years	1833	36.9%
50 – 64 years	1167	23.5%
65 + years	114	2.3%
Cars in Households		
No Car	318	6.4%
1 Car	1585	31.9%
2 Cars	2260	45.5%
Three Cars	576	11.6%
Four or More Cars	228	4.6%

FIGURE 2 Maps containing location of Greenway. (Purple dots represent 1 person)



LITERATURE REVIEW

Cycling is a growing means of transport in Ireland for both utility and for leisure trips. There are a number of infrastructure and non-infrastructure projects currently being considered in Ireland to promote cycling as viable alternative to the car as a means of transport and also as a means of exercise. To maximise the value for the investments in these schemes it is important to look at research into the areas of cycle infrastructure planning and cyclist forecasting. Porter et al (*7*) reviewed existing methods for forecasting cyclists and pedestrians. The paper looks at the various methodologies and factors that are implicit in modelling trips of non-automised transport. The relationships between various factors were interpreted, and knowing these factors, non-motorised trip making could be determined. It summarised that there appeared to be a shortage of methods that were widely usable and that technical resources were limited. Levitte (*8*) focused on cycle demand analysis in the Greater Toronto Area. This paper found that cycle trails in the vicinity of schools, universities, shopping and employment centres were the most popular and successful facilities. This paper also concluded that multinomial regression models can be used to predict future demand by factoring changes in conditions from creating off-road routes.

Stinson and Bhat (*9*) determined the variables, which affect a cyclist's route choice from analysis of commuter cyclists using a stated preference survey. The paper concluded that the six most important factors in order of importance were lower travels times, road classification, types of cycle infrastructure, barriers between motorists and cyclists, pavement quality, and fewer intersections. These qualities varied from commuter to commuter. The main causes of the variances were a commuter's age, and residential location. Morris (*10*) showed that there is an increase in percentage of residents cycling for a "transportation trip" who live within one half mile of an urban cycle trail. This paper outlined factors influencing cycle commute rates on trails. This paper differed to Stinson's (*9*) analysis and identified many other externalities such as competing facilities, numbers using a facility, land use around facility and access points of the facility.

Several studies have looked at methods to increase cycling. Stinson and Bhat (*11*) determined that the most important factors affecting cycle commuting by means of an Internet based survey. The results indicate that the most effective policy to increase cycling was to increase cycle parking at employment facilities. Cyclist training and education would also be an easy method of increasing cycling. Birk and Geller (*12*) investigated the increase in cycling in Portland, Oregon over a thirteen-year period during which there were extensive improvements to cycling infrastructure. The paper shows that there was a 210% increase in cycling over the time period and a clear correlation between improvements in the cycle network and increases in the usage of the facilities.

A number of international case studies have been published on the benefits of greenways. In 2006, Richardson (*13*) examined the results of intercept surveys on Switzerland's National cycle network over a three-year period in year. The surveys gathered information at sixteen random locations around the network. Temperature, rainfall and cyclist numbers were noted over a period of time at these locations and certain times of the year every year for three years. Intercept surveys were carried out on a passing cyclist every time a certain number of cyclists passed. This information allowed for specific types of cycle flows (purpose/leisure/tourist) and weather patterns to be correlated. The intercept surveys allowed the trip types, distances

travelled and the contribution to the local economies to be determined. This paper concluded that there are about 7.2million day trips on the network and 350,000 overnight trips annually on the network.

Sener (*14*) examined a comprehensive set of attributes that influence cycle route choice. This was done so by using a stated preference survey by means of the Internet in conjunction with a mixed multinomial logit model. The attributes are broken down to:

- Cyclists' characteristics
- On-Street Parking
- Cycle facility type and amenities
- Roadway physical characteristics
- Roadway functional characteristics
- Roadway operational characteristics

The results of the paper concluded that cyclists have a preference for minimal parking, continuous facilities, lower traffic volume and speed, and fewer intersections along a cycle facility. The survey also highlighted the sensitivity of a commuter cyclist's travel time. The results determined that a cyclist is willing to cycle approximately 6.21 minutes more or pay $1.26 to avoid parallel parking on their commute route. These figures vary depending on the distance and time of the overall journey. Winters et al. (*15*) compared actual routes chosen by cyclists and compared this to the shortest path route. This was done so by using Geographic Information Systems and statistical analysis. Routes were reported in interviews and were digitised in ArcGIS. A logistical regression model was created to evaluate the simultaneous influence of multiple characteristics on the likelihood of a cycle trip detouring from the shortest path route. The results concluded that 75% of cycle trips were within 10% of the shortest distance and 90% were within 25%. The results indicated that cyclists are mostly to detour off the shortest path in order to travel along a route with more green cover and where cyclist activated crossing signals are available. The study determined that off road trails were preferred. In this study however there were only 74 people surveyed and of this only 6 could be considered regular cyclists. The cyclists in this study were mainly those that cycle once a month.

METHODOLOGY

School Surveys

The dataset used for the analysis of the school going population in the area surrounding the greenway was created from a survey carried out in the five schools located in the area adjacent to the GWG. The survey asked specific questions regarding age, gender, how far from school a person lives, usage of the GWG, and if so, for what purpose. There were four primary schools and one post-primary school. Primary schools in Ireland contain the junior cycle of students and the age range is approximately 4 to 13 years. Post-primary schools contain the senior cycle and the age range is approximately 13 to 18 years.

The school going population was 441 in the area surrounding the GWG at the time of the surveys. Of this total, 285 surveys were completed by students and staff in the schools. In total 272 students completed the surveys, which equates to a 62% response rate. The dataset includes information from the students and staff regarding time and distance from school, means of travel to school, age, number of siblings, usage of the GWG, and purpose of usage. Analysis can be performed on this dataset to determine the relationships between the various factors taken in the survey.

User data counters along Greenway

During construction of the GWG, several Sierzega Bike counters were installed along the route. Currently two of these counters are active. The two counters were located adjacent to the settlements of Achill and Mulranny and are approximately 12 km (7.5 miles) apart.

The counters are based on radar technology and record time, date, speed, and direction of the cyclist passing. The device operates by measuring the length of a passing object. The device is able to split larger objects into several shorter objects. For instance, if several cyclists pass at the same time, the software can determine from the length recorded how many cyclists are in the group. If the cyclists are in a group, side by side, the whole mass of the group will be longer than one cyclist. The device has been calibrated from extensive studies of cyclist groupings to determine the quantity of cyclists that would be in a measured group. This is not 100% accurate and may vary for certain conditions. Accuracy is high with recorded speed being accurate to +/-3% and length measurement of passing objects being accurate to +/-20% (*16*). The data recorded allowed many observations to be carried out such as average daily usage, average hourly day profiles, weekend and weekly usage. The data alone reveals many patterns and noteworthy observations.

This data is used in conjunction with weather data. Rainfall, mean wind speed, and mean temperature measurements were retrieved from an automatic Irish Meteorological Service weather station located in Newport. Sunshine hours were recorded in an Irish Meteorological Service Weather observatory located in Belmullet, approximately 35 km (21.7miles) away from the locations of the counters. The various weather parameters and the user figures can be correlated. Determining these relationships allow predictions of usage along the path according to weather forecasts. Regression analysis was also performed on the data allowing conclusions on the effects of weather on usage to be determined.

A multinomial logit regression model was estimated in this research. The choice variable examined in the model was the usage of the GWG. There were two levels of usage which were either above the daily average usage of the GWG or below. '1' represents below average usage, and '2' represents above average usage. Within the model the referent variable is '2'. The model estimated examined the impact of the weather parameters temperature, rainfall, wind and sun on the usage of the path. Each weather parameter was split into four sub-categories, each representing a quarter of the total for that parameter. A multinomial logistic regression analysis was constructed to analyse the relationship between these factors and the usage of the GWG. The model takes the following functional form:

$$\text{logit}(p) = \log \frac{p}{1-p} = \alpha + \beta I + e$$

where p is the probability that event Y occurs (decision to use the GWG), βI is the set of weather parameters, and e is a random error term. Table 5 details each of the weather parameters estimated and the resultant model.

SURVEY RESULTS AND ANALYSIS

The results from the school survey undertaken can be viewed in Table 2. Approximately 5% more females than males were surveyed. There was one post-

primary school surveyed and four primary schools surveyed therefore there is a greater number of primary students in the survey.

It can be seen that the car is the largest category for means of transport to school at 39.6% followed by bus at 31.2%. The survey also accounted for variance in commuter patterns. The largest category that varies between modes is 'Car/Cycle'. This category accounts for 10.5%. This may occur for several reasons, such as some students and staff may cycle to school just on specific days, or the weather may be a deciding factor for others. There are seven categories that vary between cycling and walking, and bus and car. These seven categories account for 22.9% of people commuting to the schools. 6.4% of those surveyed cycle and walk to school solely. This reveals that potentially up to 29.3% of people commuting to schools do so by cycling and walking.

The survey reveals the numbers that use the GWG in the schools. 77.5% of the people surveyed have used or currently use the GWG. Of those who use the GWG, it is used predominantly for recreational purposes with 28.3% using the route in order to travel to school and 71.7% using the route solely for recreational purposes. This represents 22.2% of the total number of those surveyed using the route to access school. This finding suggests that the majority of people who cycle and walk to school do so, by using the GWG with only 0.7% not using the GWG when cycling or walking to school.

TABLE 2 Results of schools survey along GWG

Category	Frequency	Percent
Age Categorised		
Missing	18	6.3
4 to 8	61	21.4
9 to 13	161	56.5
14 to 18	34	11.9
18 plus	11	3.9
Total	285	100.0
Gender		
Missing	2	0.7
Female	156	54.7
Male	127	44.6
Total	285	100.0
Student/Staff		
Staff	13	4.6
Student	272	95.4
Total	285	100.0
School Type		
Post Primary	41	14.4
Primary	244	85.6
Total	285	100.0
Siblings Categorised		
Missing	33	11.6
No Siblings	31	10.9
1 to 2 Sibling	148	51.9
3 to 4 Siblings	59	20.7
More than 4 Siblings	14	4.9
Total	285	100.0
Cars in Household		
Missing	33	11.6
0	1	0.4
1	61	21.4
2	138	48.4
2+	52	18.2
Total	285	100.0
Distance from School		
Missing	33	11.6
Under 2 km (1.2 miles)	66	23.2
Under 5 km (3.1 miles)	78	27.3
Under 10 km (6.2 miles)	66	23.2

More than 10 km (6.2 miles)	42	14.7
Total	285	100
Means of Travel to School		
Bus	89	31.2
Car	113	39.5
Cycle/Walk	18	6.4
Varies Car/Bus and Cycle/Walk	65	22.9
Total	285	100.
Use GWG		
Missing	1	0.4
No	63	22.1
Yes	221	77.5
Reason for Using GWG		
Missing	63	22.1
Recreational Purposes	159	55.7
Travel to School	3	1.1
Travel to School/Recreational Purposes	60	21.1
Total	285	100

Cross-tabulation of Survey Data

Table 3 contains cross-tabulation of specific categories and usage of the GWG. The categories chosen for cross-tabulation were 'Cars in Household', 'Distance from School', 'Gender', 'Means of Travel to School Categorised', and 'Student/Staff'. The cross-tabulation of these categories with usage of the GWG allows relationships to be observed.

Cars in Household

There is a clear relationship between the number of cars in a household and the usage of the GWG. There was only one instance where there were no cars in the household and the person used the GWG. This sole instance may skew the results slightly. The results indicate that the more cars present in a household the less a person will use the GWG. This is evidenced by the numbers stating that they use the GWG decreasing as the numbers of cars in the households increase. When there is one car in a household the numbers stating that they use the GWG is 83.6%. This decreases to 79.7% when there are two cars in a household and 67.3% when there are more than two cars in a household.

Distance from School

The results indicate that those who live between 2 and 5 km (1.2 and 3.1 miles) away from school are the largest percentage user of the GWG of those surveyed. The category 'Under 2 km (1.2 miles)' contains students and staff that reside less than 2 km (1.2 miles) from the school. In this category, 81.8% of the people surveyed use the GWG. This increases to 87.2% for those that reside in the 'Under 5 km (3.1 miles)' category. Four out of the five schools surveyed are located within an urban settlement. People originating within the settlements (Under 2 km (1.2 miles)) may not use the GWG to access the schools, as this may be indirect. After the 'Under 5 km (3.1 miles)' category, the usage of the GWG decreases. 77.3% and 59.5% of those who live 'Under 10 km (6.2 miles)' and 'More than 10 km (6.2 miles)' respectively from the school use the GWG. 5 km (3.1 miles) appears to be the peak distance at which someone will cycle to school in this survey. After 5 km (3.1 miles) less people are willing to use the GWG in order to access the school.

Gender

As stated previously there were approximately 5% more females surveyed than males. However, the results indicate that by percentage, slightly more males, use the GWG. The results show that 76.3% of females surveyed use the GWG whereas 78.7% of

males. As the results are so similar, it can be concluded that gender only plays a small role in the usage of the GWG.

Means of Travel to School Categorised

The results show that 100% of those in the 'Varies Walk/Cycle and Bus/Car' use the GWG, followed by 83.3% of those in the 'Cycle/Walk' category. Those that solely walk and cycle to school may not use the GWG because some may live adjacent to the school or within vicinity of the school. The GWG may not be the most direct route for those that reside within these settlements. Those that vary between modes may be part of 'Green School' campaigns within the school. All the primary schools along the GWG participate in this initiative. As mentioned previously, several 'Green Schools' campaigns have been created such as, 'Park and Strides', 'COW', and 'WOOF'. These campaigns have proved very successful within the schools along the corridor.62.6% and 80.6% of those who respectively travel to school by car and bus use the GWG. One reason those who travel to school by car may not use the GWG is that they may not have easy access to it and therefore may not be able to use it conveniently. Some of the bus routes to and from the schools travel parallel to GWG and therefore many who take the bus would also have easy access to the Greenway. There may be a higher possibility of those who take the bus choosing between taking the bus or the GWG whereas those who travel by car may have no other choice.

Age Categorised

Age was combined into four distinct categories. The four categories are '4 - 8 years', '9 – 13 years', '14 to 18', and '18+ years'. It can be observed from the results that the age group that uses the GWG most is the '9 – 13 years' age group. 84.5% of people who are in this age group use the GWG. This category also contains largest amount of respondents. As stated previously, the respondents in the '4-8 years' were restricted by the literacy levels being lower in this category, especially amongst the younger members of the category. However, 75.4% of this category uses the GWG. The response rate in the secondary school was low. This combined with the small size of the school with 77 students led to the '14 - 18 years' category being small with only 34 responses and only 52.9% of this category uses the GWG. The post-primary school is located at approximately 1 km (0.6 miles) from the current finishing point of the GWG. This point was also at the end of the second phase of the GWG and is one of the newer additions. The relative newness of the section and the relative low usage amongst the '14-18 years' ages' group may indicate that the GWG is yet to become well established in the area and thought of as a viable means of transport. The '18+ years' category includes all staff members in the schools and some students completing their education in the post-primary school. The results are similar to the '14 – 18 years' category with 54.5% using the GWG.

TABLE 3 Categories cross-tabulated with usage of the GWG

Category		Use GWG			
		Missing	No	Yes	Total
Cars in	Missing	0	9	24	33
	0 Cars	0	0	1	1
	1 Car	1	9	51	61
	2 Cars	0	28	110	138
	More than 2 Cars	0	17	35	52
	Total	1	63	221	285
Distance from	Missing	1	9	23	33
	Under 2 km (1.2 miles)	0	12	54	66
	Under 5 km (3.1miles)	0	10	68	78
	Under 10 km (6.2 miles)	0	15	51	66
	More than 10 km (6.2 miles)	0	17	25	42
	Total	1	63	221	285
Gender	Missing	0	0	2	2
	Female	0	37	119	156
	Male	1	26	100	127
	Total	1	63	221	285
Means of Travel Categorised	Bus	1	17	75	93
	Car	0	43	72	115
	Cycle/Walk	0	3	15	18
	Varies Car/Bus and Cycle/Walk	0	0	59	59
	Total	1	63	221	285
Age Categorised	4 – 8 years	0	15	46	61
	9 – 13 years	1	24	136	161
	14 -18 years	0	16	18	34
	18+ years	0	5	6	11
	Total	1	60	206	267

Comparing Survey Results to the 2006 Census data

From the 2006 census data (*17*), it is known that the national average for children in the age category of 5 to 12 cycling and walking to school is 25.85%. In the 13 to 18 years of age category, the cycling and walking rate to school in 2006 increases marginally to 27.11%. In the province that contains the GWG, the average cycling and walking rate for persons over the age of 5 accessing places of education is 11.15%. From the survey results, it is known that up 29.3% cycle/walk to school, therefore it can be concluded that Greenway has led to an increased cycling and walking rate to and from schools and has increased sustainable transport patterns in the area.

COUNTER DATA RESULTS AND ANALYSIS

The data from the two cycle counters can be viewed in Figures 3 and 4. External factors such as weather, holidays, days of the week and location were investigated as to how these impact upon usage of the path. Over the period recorded, there were several national holidays, and periods of good and poor weather. These external factors were noted and the relationships between usage and these factors were observed. The information contained in Figures 3 and 4 are over a period of 89 days.
Firstly, the daily numbers were compiled for both counters and the usage was plotted over time. Trend lines were inserted into the data in order to determine if there were any particular pattern observable and whether certain times of the year are busier than others. For the period recorded there were three national holiday periods. They are indicated by red marker in Figure 3.

It can be seen that for the Achill counter there is an increase in usage relative to the surrounding days for the national holiday periods of Easter and June. The data for the May National holiday period was absent so the daily average was inserted instead and which may not reflect accurately the usage over that weekend. The

Mulranny counters also reveal that the holiday periods only slightly increase the usage numbers along the path relative to the days surrounding these dates. These three holiday periods may also have been affected by adverse weather conditions. The three holiday periods, as can be seen in Figure 3 containing the weather charts, coincided with days of elevated rain, and wind. This would act as a deterrent to usage over these periods as discussed further into this text.

The averages for each hour of the day were calculated for all days, weekend days, and weekdays. This allowed an average hourly day profile to be created for the previously stated categories and different usage patterns between weekdays and weekend days to be observed. The charts created indicate that weekdays and weekend days carry similar quantities at both locations.

At the Mulranny counter, an average weekday will see approximately 351 users whereas a weekend day will see 411 users between the hours of 06:00 and 22:00. During the week, there is a commuter usage profile with a morning peak between 08:00 and 10:00. However, after 10:00, the path appears to be more mixed with recreational users as the usage remains level between 11:00 and 21:00.

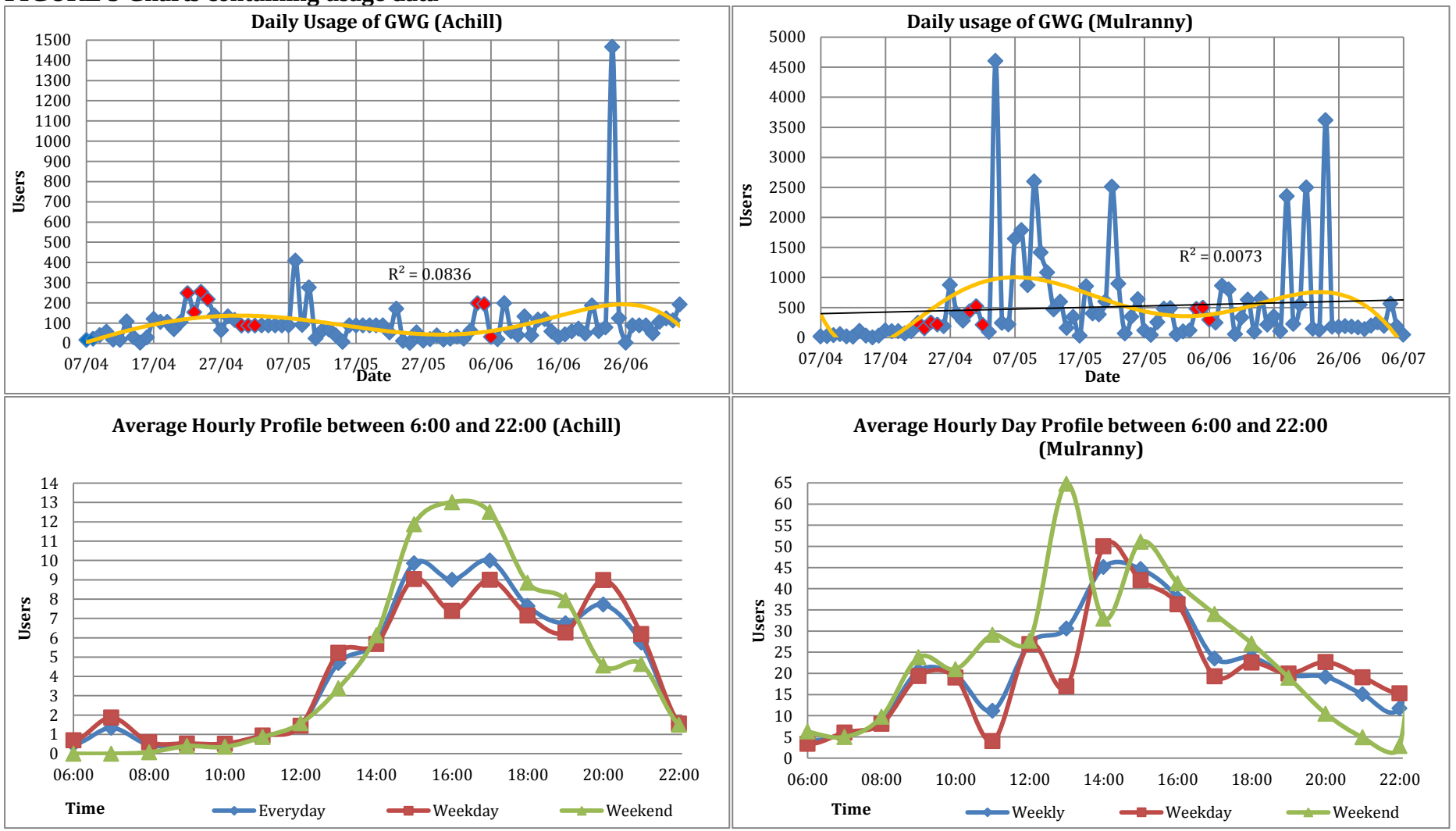
The overall cost of the GWG is approximately €5 million ($7.2 million*). The current economic crisis in Ireland has led to decreased spending on infrastructural projects. It is nationally important that projects that provide the greatest return to the state go ahead. Therefore determining the value of this project would provide a clear indication of whether similar projects should go ahead. Working on the assumption that usage of the GWG was to continue at the same level the Table 4 was created. It is known from Tourism Ireland (*18*) that the average spend by a tourist in Ireland is €502 ($727.40*). For the sensitivity analysis in Table 4, it is assumed that these tourists travel to Ireland solely because of the GWG. The usage data in Table 4 comes only from the Mulranny counter in order to prevent double counting of users who may travel along the entire length of the GWG. Table 4 indicates that if the previous assumptions proved true, then with the most pessimistic tourist levels after 7 years, the spend by tourists in the local area alone would justify the construction costs of the GWG.

TABLE 4 Quantifying the benefits from the cycleway

Usage over a 1 Year Period		144,000 Trips			
Usage over 10 Year Period		1,440,000 Trips			
Cost of Construction of GWG		€5 million ($7.2 million*)			
Cost per Trip over 10 Year Period		€3.47 ($5.07*)			
Average Spend of a tourist in Ireland in 2008		€502 ($727.40*)			
Sensitivity Analysis					
Assuming that a percentage of users are tourists visiting solely for the purpose of using the GWG, the following is known					
Assuming 1% of Users are Tourists		**Assuming 3% of Users are Tourists**		**Assuming 5% of Users are Tourists**	
Trips per year	1,440	**Trips per year**	4,320	**Trips per year**	7200
Spend in Area	€722,880 ($1.05 million*)	**Spend in Area**	€2,168,640 ($3.14 million*)	**Spend in Area**	€3,614,400 ($1.05 million*)
Payback Period	7 Years	**Payback Period**	3 Years	**Payback Period**	2 Years

Note: Peak on June 24th caused by charity event. Data included in daily data but excluded from the calculation of the hourly profile patterns as skewed the results. Achill counter also located far remote from schools and therefore may not record much of the daily usage by school

FIGURE 3 Charts containing usage data



How weather affects usage of path

Weather patterns are measured at an automatic weather station in Newport and manned weather station in Belmullet. The data from these stations were corroborated with the usage data from the counters along the GWG and regression analysis was performed. Graphs with weather records and user data imposed can be viewed in Figure 4, and the table containing the results of the multinomial regression analysis can be viewed in Table 5. These graphs indicate relationships between weather and the usage of the path. These are discussed in further detail in the following section.

Effects of the weather on usage

For the data retrieved from the Achill counter, it can be seen in Figure 4 that usage of the path is inversely proportional to the rainfall and the mean wind speed. Where there is a peak in rainfall and wind speed peak, there is a corresponding fall in the number of users along the path, and where there is a reduction in rain and wind there is a corresponding peak in usage along the path. This indicates that there may be a large proportion of fair weather users and tourists whereas commuters may not account for a large proportion of the users. These fair weather users would be affected most by weather patterns.

Similarly to rainfall and wind for the Achill data, there is a direct relationship between temperature and sunshine hours, and usage along the GWG. As can be seen in Figure 4, the trendlines of temperature, sunshine hours and usage are of very similar shapes with peaks and troughs corresponding in each.

The data retrieved from the Mulranny counter indicates a more complex relationship between weather and usage as can be seen in Figure 4. There is a corresponding inverse relationship between the usage and, rainfall and wind parameters; however it is not as clear or direct as the Achill counter. This may be due to several other external factors such as:

- Increased density in housing around the path therefore promoting local use
- There were several national holidays along with charity walks and cycles over the period of time used for the data. One such charity event occurred in Mulranny during a particularly windy and wet period and attracted a considerable group of people. These events may skew the data and not reflect accurately what would normally occur.
- The path links two of the largest settlements in the area therefore there may be a higher proportion of users who are commuters rather than tourists
- The Mulranny section of the GWG was the first phase of the project and has been in existence for over a year and therefore may have established regular users
- Mulranny is more popular as can be seen in the user numbers and therefore may have a higher base flow of users that will utilise the path in any condition

This complex relationship is maintained between temperature and sunshine hours, and usage. This could be attributed to the same reasons as stated for rainfall and wind.

Multinomial logistic regression analysis was performed on the data. The usage data from the Achill and Mulranny counters were combined to create a model that could be applied to all of the GWG,the results of which can be viewed in Table 5. The results indicate that if the usage is below average ('Usage_New' =1) then, the temperature will likely be below 11.55^{o}C, the rainfall will likely be greater than 0.1mm, and sunshine hours will be low. The results are referenced against high usage

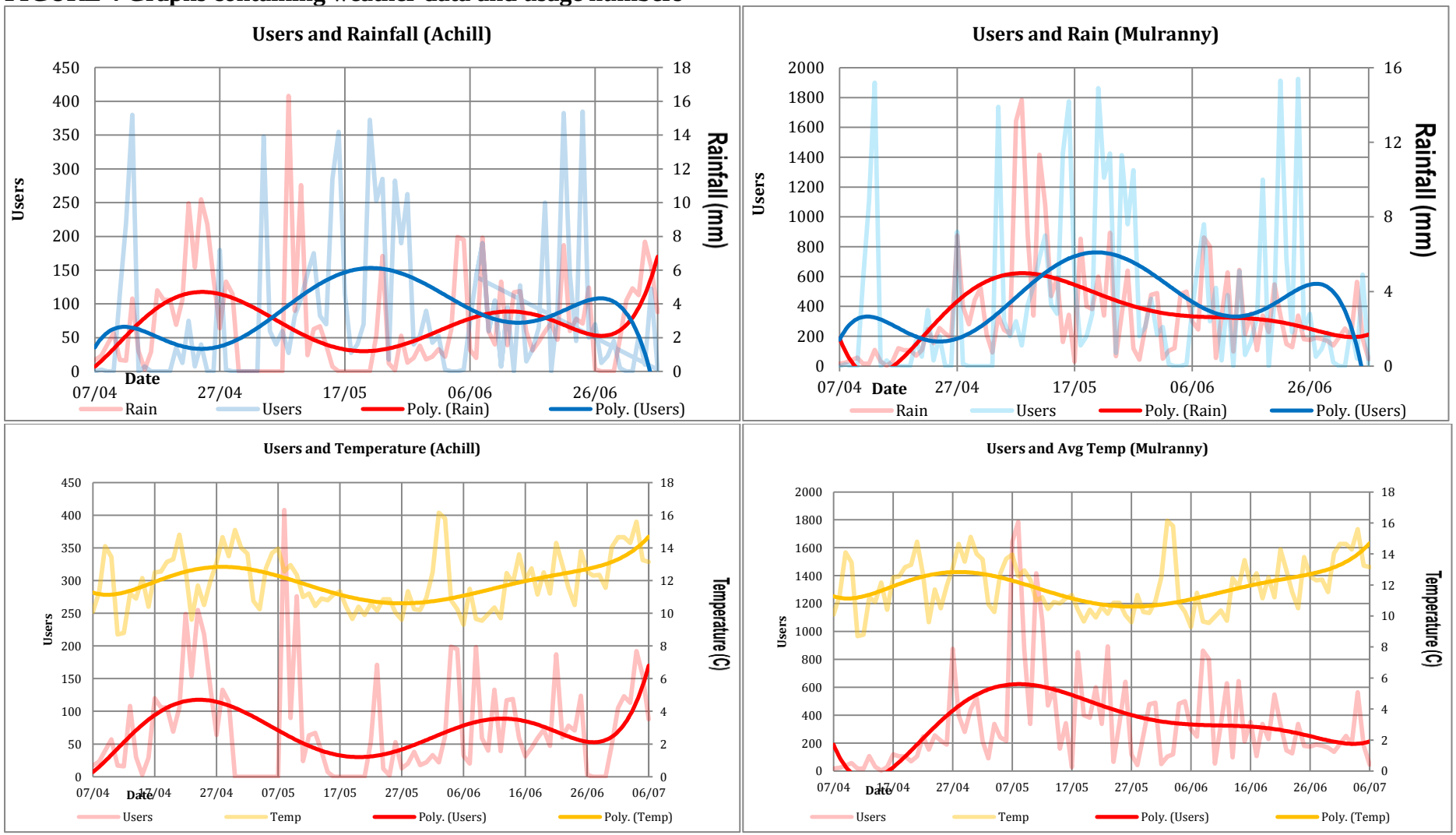
and therefore indicate that if the usage is high then the rainfall will be unlikely, temperature will likely be above 13.15^{0}C, and sunshine hours will be between 2.3 and 9.4 hours Regression analysis was performed without wind as a variable and the results only changed slightly. This indicates that wind is not an overly important factor in affecting usage along the path. This may be due that the mean wind speed rarely drops below 5m/s (11.18 mph). The location of the path is in one of the windiest parts of the country and therefore, a person deciding to cycle along the path will be aware that wind speed is high and will have factored this into the decision. Therefore any increase or decrease in wind speed will only slightly alter usage.

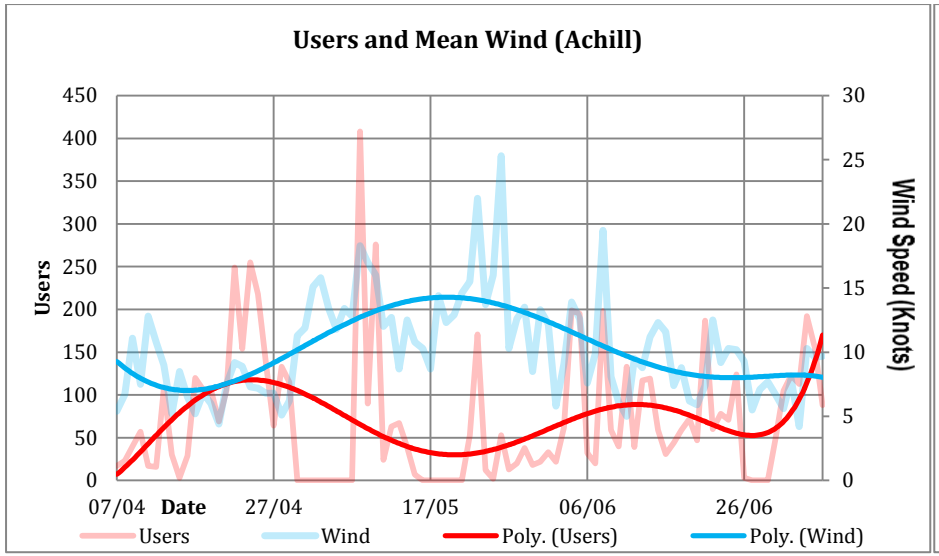
The rainfall and usage data is non-parametric; therefore the R^2 may appear to be low however they are reasonably accurate for this type of data.This may be due to the sporadic nature of the weather recorded with numerous peaks and troughs. The significance values are reasonably adequate for a sample size this small. The usage of the path is also sporadic in nature and is therefore it is difficult to create an accurate model.

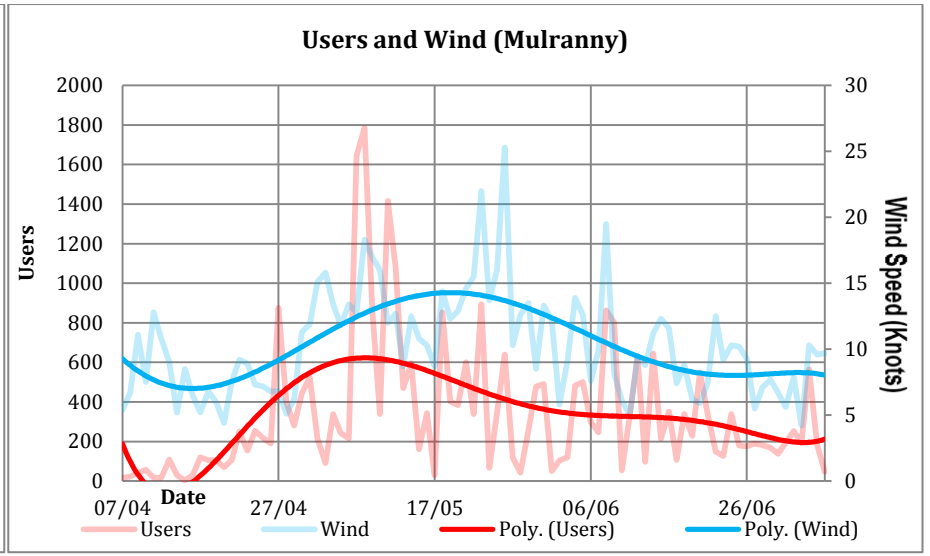
TABLE 5 Results of Multinomial logistic regression analysis performed on wind and temperature

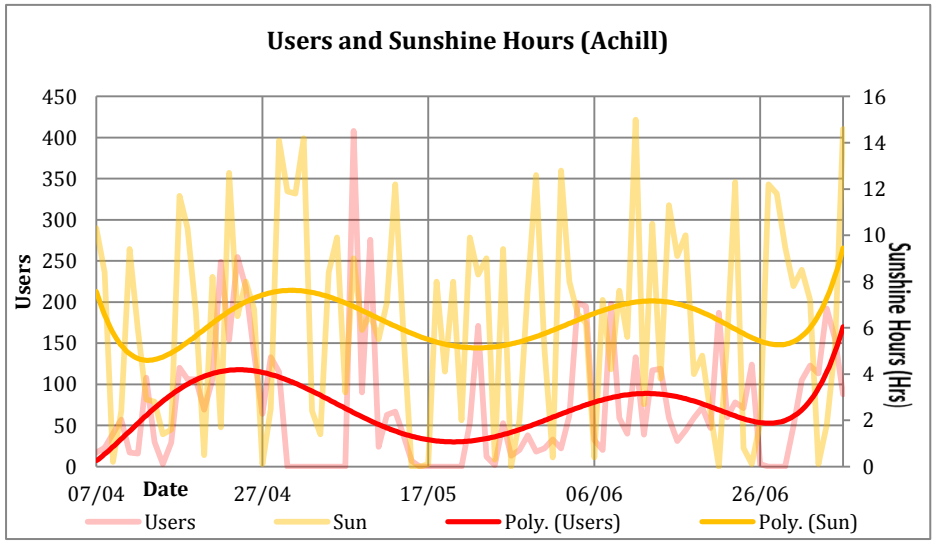
Usage_New[a]		**β**	**Sig.**
1.00	**Intercept**	-1.017	0.126
	Temperature		
	Temperature<=10.45ºC (50.81 ºF)	0.463	0.350
	Temperature>10.45ºC (50.81 ºF)	0.904	0.072
	Temperature>=11.55ºC (52.79 ºF)	0.083	0.857
	Temperature>=13.15ºC (55.67 ºF)	Ref	Ref
	Rainfall		
	Rain<=0.1mm (0.004 inches)	0.989	0.070
	Rain>0.1mm (0.004 inches)	1.175	0.023
	Rain>=1.8mm (0.071 inches)	0.853	0.084
	Rain>=4.6mm (0.181 inches)	Ref	Ref
	Mean Wind Speed		
	Mean Wind Speed<=7.2m/s (16.11 mph)	0.480	0.324
	Mean Wind Speed>7.2m/s (16.11 mph)	0.053	0.910
	Mean Wind Speed>=9.6m/s (21.48 mph)	0.630	0.181
	Mean Wind Speed>=12.6m/s (28.19 mph)	Ref	Ref
	Sunshine Hours		
	Sunshine Hours<=2.3 hours	0.106	0.822
	Sunshine Hours>2.3 hours	-0.731	0.110
	Sunshine Hours>=6.6 hours	-0.840	0.062
	Sunshine Hours>=9.4 hours	Ref	Ref
	-2log-likelihood convergences	115.889	
	N	182	
	Nagelkerke R2	0.094	
a. The reference category is: 2.00.			

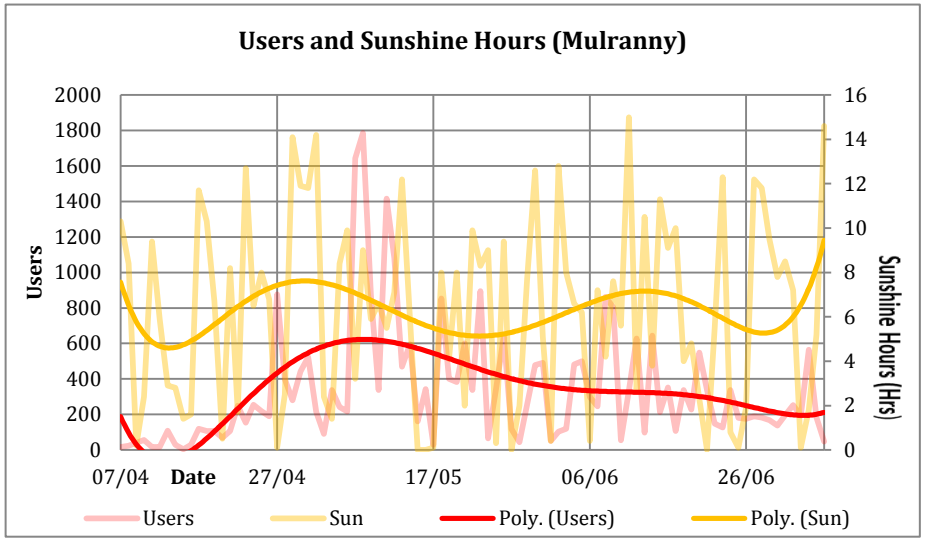
FIGURE 4 Graphs containing weather data and usage numbers




Users and Mean Wind (Achill)
Users
Wind Speed (Knots)
Date
07/04
27/04
17/05
06/06
26/06
Users
Wind
Poly. (Users)
Poly. (Wind)


Users and Wind (Mulranny)
Users
Wind Speed (Knots)
Date
07/04
27/04
17/05
06/06
26/06
Users
Wind
Poly. (Users)
Poly. (Wind)


Users and Sunshine Hours (Achill)
Users
Sunshine Hours (Hrs)
Date
07/04
27/04
17/05
06/06
26/06
Users
Sun
Poly. (Users)
Poly. (Sun)


Users and Sunshine Hours (Mulranny)
Users
Sunshine Hours (Hrs)
Date
07/04
27/04
17/05
06/06
26/06
Users
Sun
Poly. (Users)
Poly. (Sun)

CONCLUSION AND DISCUSSION

In Ireland, travel patterns to and from schools were becoming more and more dependent on the car between 1981 and 2002 (*4*). It is known that nationally, active travel accounts for 17% of all trips. It is known that cycling accounts for approximately 1% of trips undertaken and approximately 16% of trips undertaken are by means of walking (*5*). The low rates of active travel behaviour are believed to be a contributory factor in increased child obesity and air pollution. Providing infrastructure similar to the GWG throughout the country could prove to be important at reducing pollution, obesity and traffic congestion.

The school survey results indicate that up to 29.3% of school related trips are done so by means of cycling or walking. 22.9% of these use the GWG for the purpose of school related trips. Before the GWG, 67% of those who now use the greenway to get to school did so by means of the car. This indicates that up to 44 car trips are taken off the road on a day when the 22.9% of those surveyed, cycle. The survey results also indicated that over three quarters of students and staff use the GWG for recreational purposes. When the survey results are compared the census results for the surrounding wider area, it can be observed that the rates of commuting by bicycle and walking are higher in the areas immediately adjacent the GWG than areas without access to the GWG. The rate of commuting by bicycle and walking to school for the wider area is 11.15% whereas the survey results indicate that up to 29.3% do so in the areas immediately around the GWG.

The usage and weather data indicate certain relationships. Usage is higher when there is a combination of the following variables, temperature is above 13.15^{o}C and sunshine hours are between 2.3 and 9.4 hours. Wind was found not to be an overly important factor in the usage.

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Department of Transport, Tourist and Sport, Ireland
Failte Ireland

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