

Sustaining WPI's Off-Campus Living Students

An Interactive Qualifying Project submitted to the Faculty of WORCESTER POLYTECHNIC
INSTITUTE in partial fulfillment of the requirements for the degree of Bachelor of Science

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This report represents work of WPI undergraduate students submitted to the faculty as evidence of a degree requirement. WPI routinely publishes these reports on its web site without editorial or peer review. For more information about the projects program at WPI, see

<http://www.wpi.edu/Academics/Projects>.

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Abstract

In this IQP, we investigate the contribution of WPI students on the trash and recycling clutter in the streets surrounding WPI. Our conclusions were reached by tracking the trash in the streets through compiling images and surveying students who live off-campus. Our research has shown students are enthusiastic about maintaining the community, however, adequate information is not provided by the school. With our data and research, we believe that the recommendations made in this project are sufficient enough to increase awareness around campus.

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Chapter 1: Introduction

At WPI, the majority of students following their freshman year decide to live in private residences off-campus. In 2020, of the 4,892 students who attended WPI as undergraduates, 53% lived in off-campus apartments (US News, 2020). While WPI is a school that values sustainability greatly, and does much to make the students live the greenest lifestyle possible while at WPI, they do not take into account the massive WPI community off-campus, and the impact they have on WPI's overall sustainability. Litter is visible on almost every street surrounding campus, from Dunkin Donuts cups half filled with melted ice coffee to greasy pizza boxes. Since nearly 3,000 WPI undergraduate students live off campus in this community we began to wonder what contribution WPI students have towards this issue, and if there is anything we as a community can do to make the neighborhoods surrounding campus have less litter overall.

During this academic year, our group discussed the many possible options for an IQP topic. Littering is a global issue, but one that is also very visible on the day to day in Worcester. Our group, along with Professor LePage, conducted long discussions and documented the street garbage found in the streets that many students call home during the academic year, and observed exuberant amounts of litter surrounding off-campus apartments. For years, as residents of Worcester, we have observed the garbage, but it wasn't until the documenting process began that the severity of the issue became clear. Litter is visible on almost every street surrounding campus, from Dunkin Donuts cups half filled with melted ice coffee to greasy pizza boxes. Since nearly 3,000 WPI undergraduate students live off campus in this community we began to wonder

what contribution WPI students have towards this issue, and if there is anything we as a community can do to make the neighborhoods surrounding campus have less litter overall. Our goal with this IQP is to understand WPI's role in Worcester's litter, and to see what can be done to further support and encourage a sustainable off-campus community.

Chapter 2: Background

To understand the problem of littering in WPI's proximity, we had to research and identify is a human issue that we as a society have had to deal with for many centuries, and a plethora of studies related to littering behavior have been released in recent years. These studies go into both individual and environmental factors that may make one more or less likely to litter. WPI has also released studies and plans with sustainability as a main focus. The issue of street garbage hasn't been touched on fully by the sustainability plan; although, recycling and waste management from a student perspective are addressed.

Behavior observation is one of the most effective ways to gather data for social sciences, in addition to surveys and interviews. However, there are several factors in taking the survey questions, the actual conversation of the interview/survey, and how we analyze the results gathered. It is a fluid form of data collection, primarily qualitative, and, depending on the nature of the questions, it can reveal a lot or be pushed to fit a narrative. Organizations like Institutional Review Board (IRB) exist to protect the subject's rights to authenticity and informed consent to the study. In this chapter we will go over the relevant information relating to research processes applied in this IQP, and the information that was needed to complete our objectives.

2.1: Worcester and the Issue of Litter

Litter is defined as any unwanted objects in public spaces, most commonly single use products such as cigarettes, drinking containers, and food wrappers. Littering as an act is illegal and can be punished with a fine up to fifteen thousand dollars in the state of Massachusetts. It is

an issue the residents of Worcester take very seriously. It is cited as one of the main complaints to the city by the city council (Pelletier, 2021). As the fastest growing city in New England, it makes sense that waste management services struggle to keep up. Worcester also is also home to several colleges, and has a migratory group of residents who do not consider Worcester their full-time home. When looking at Worcester, it is important to look at its demographics when referring to its littering. Worcester, especially the streets surrounding WPI, have an array of families living in close proximity to students and younger people. These differences in lifestyles can cause some tension, especially when one group is more invested in the area than the other.

Many residents have created local organizations to clean the streets such as the Worcester Green Corps, a group of high schoolers who collect litter, and the ‘Adopt a Storm Drain’ program that works to keep our water systems free of large solid waste (Schwan, 2021). Those are two of the many of such groups (Pelletier, 2021). The community outcry and initiatives make sense from a residential perspective.

2.1.1: Understanding Littering and its Effects

The Broken Window Theory, first done by Philip Zimbardo and introduced by George Kelling and James Wilson, is a physiological theory that the presence of a broken window in a neighborhood causes more crime, and thus more ‘broken windows.’ This theory implies that a broken window or something else visually unappealing like trash may lead to more violent or dangerous crimes (Simply Psychology, 2008). While there are some issues with this study, specifically if the correlation is causation, it’s a theory worth noting when accounting for the potential impacts of street garbage.

Littering isn't isolated to Worcester, it is a national issue. Annually, the US government spends eleven billion dollars a year on street clean-ups. Studies have been observing litter and the behaviors linked to it since the 1960s, and still are to this day.

Sage Publications conducted research in 2013 studying behaviors in littering and found that the most defining factors of whether you as an individual would litter were age and smoking status. Cigarettes being one of the most commonly littered items put smokers at a higher risk of littering. People from age 18 to 29 have a 26% percent chance of littering; the average overall of all age groups was 15%. (Wesley, Schultz, Bator, Brown Large, Bruni, Tabanico, 2013) Other factors that could affect littering is the presence of a friend or person while on the sidewalk. Although, when littering, the environment seems to matter more than the actual person. In this study, they put participants in different situations with or without litter or garbage containers present. Results showed that the presence of a trash can reduces the likelihood of littering by 17%. (Wesley, Schultz, Bator, Brown Large, Bruni, Tabanico, 2013)

In a 1973 study, 272 participants were given hot dogs in wrappers and had their behavior observed in environments with and without litter. In the cleaner street, only 14% of individuals littered, but with street trash that amount increased to 33% (Wesley, Schultz, Bator, Brown Large, Bruni, Tabanico, 2013).

The garbage in Worcester has had a lot of public outcry for some time now. Residents have spoken out on the decline in 'curb appeal' caused by the garbage and the emotional and psychological problems that it creates. However, littering has many effects on the surrounding community other than the aesthetics of the neighborhood (Schwan, 2021). Garbage, especially food waste, can attract roaches, rats, mice, and other pests. Litter can also host an array of bacteria and disease that can spread to the community through animals, the air, and other ways

(Global Conservation Force 2013). They can also further perpetuate the issue by tearing trash bags while rummaging for food. Some of the most commonly littered items, according to the Global Conservation Source, are cigarette butts, cardboard, beverage containers, and food waste. As stated before, studies have shown that the environment contributes to the likelihood of additional litter.

Not all of the garbage is intentional street litter though. Wind, especially when someone's recycling isn't secure, can cause a lot of garbage to dislodge and blow across the street. Once it is litter, the chances of being picked up vary greatly on where you are. If not picked up it has a good chance of ending up in Salisbury Pond or another nearby body of water. Many catch basins surrounding WPI's campus run directly into the pond without any treatment other than the catch basin. As our group has noticed from recording the trash in the adjacent streets, many of these catch basins are overflowing with trash and sediment. Since there are no other treatment processes that the storm water goes through before it arrives at the pond, it typically takes the sediment with it.

This issue has not gone unnoticed by the City of Worcester. In a study conducted by Weston & Sampson Engineers, they found that, since the pond was created (it was dammed up by a nearby wire factory to serve as a power source), the average depth has decreased from twelve feet to three feet (Kotsopoulos 2013). This massive deposition of sediment in the pond has severely deprived the value of the pond to the community and has little use to Worcester other than serving as a reminder of the poor water treatment processes. While it may not seem like a major concern, sediments in the storm water are devastating to aquatic life. When sediments and dirt are brought into the pond, it makes the water extremely murky, which inhibits many photosynthetic processes and therefore suffocates the aquatic animals that depend on these

plants to breathe. Mass deposits of sediments oftentimes can lead to algal blooms as well. These blooms very commonly decrease the amount of oxygen in the water and become very toxic to organisms that depend on the water in the pond (Stormwater - Issues & Impacts). Ultimately, while Salisbury Pond could be a location where recreational activities such as swimming, kayaking, and canoeing takes place, the pollution, caused by years of unmonitored deposition of solid waste, has deprived the pond of its potential community value.

2.1.2: What Worcester has Done

Worcester has not ignored the accumulation of trash in the street and has jumpstarted many programs in order to combat this issue. As of 2021, Worcester introduced the “Clean Worcester Program,” which improves waste management via the inclusion of new lidded recycling bins, standardized bulk recycling costs, and streamlining the garbage process to encourage garbage drop off as opposed to littering. Services are now available for a flat fee to pick up and dispose of large items.

The new bins (as seen in Figure 1) that are being introduced will be distributed based on zip code, with each resident receiving the first for free. Each bin will feature a QR code that will depict what can and cannot be recycled in Worcester. The bins are being paid for by the increase in the cost of yellow city trash bags. Residents have also been forming local ‘neighbor groups’ to regularly patrol neighborhoods and collect litter, these include organizations such as: 50 central mass, Mothers Out Front, Walk Bike Worcester, and the Worcester Green Corps. Another unique initiative was the Adopt an Island Project, where Worcester residents would adopt a grass, concrete, or asphalt island and provide basic care. These good Samaritans would be

responsible for gardening, cleaning up waste, and even putting in free mulch provided by the Worcester DPW. In order to show appreciation from the city, residents who adopt an island will receive a plaque with their name on it displayed on the island, as well as a letter of appreciation (City of Worcester 2022).



Figure 1: Image of Worcester Issued bins with Accepted and not Accepted Materials

In a fundraising program for the Worcester DPW, Worcester implemented the Yellow Trash Bag Program. This program made it so that in order for your trash to be collected you must use a yellow trash bag, which are sold in supermarkets across Worcester. An issue that the city has raised in the past couple years was, people putting out the trash a day or a couple days early and with sharp or hazardous waste. When residents put their trash bags in the street earlier than they are supposed to, it gives animals, people, and mother nature more time to cause damage to the integrity of the bag. Once the bag is ripped open, it is not long until the wind or rain gets hold of it and carries it across the street and into roads, driveways, and, in many cases, bodies of water. By reminding residents to keep their trash inside until the night before or the morning of trash clean up, it significantly decreases the risk of the trash ending up as pollution.

Worcester put \$25,000 aside in their 2022 budget for a grant program for neighborhood cleanup initiatives. Different groups in Worcester can apply for grants (each grant would be around \$100 to \$150) to pay for supplies or snacks during any cleanups. This is a great initiative to get people outside and cleaning their streets. Overwhelmingly, it has shown that community engagement is the most effective offense to combat clutter in streets.

2.1.3: Catch Basins Their Role in Street Litter



Figure 2: Image of Catch Basin with Litter

These loose garbage items also pose health and integrity risks to nearby bodies of water. Catch basins, such as seen in Figure 2, are a simple yet mostly efficient method of separating solids, oils, and other articles of garbage from the storm drains. When contaminants fall into a catch basin, usually due to rain, the heavier solid materials sink to the bottom, and the lighter liquids and solids float to the top. Between the top and bottom layer is a mostly uncontaminated section of water which is able to safely flow onto a nearby pond or water treatment facility. Unfortunately, catch basins have their limitations and flaws. During periods of heavy rainfall, the

water and contaminants which are carried into the catch basin do not have adequate time to separate due to the large inflow of water. Therefore, the outlet carries the oil, sediment, and other street litter with it into its final destination. In many cases, large flows of water will even pick up previously settled contaminants and take them all to the body of water or treatment facility.

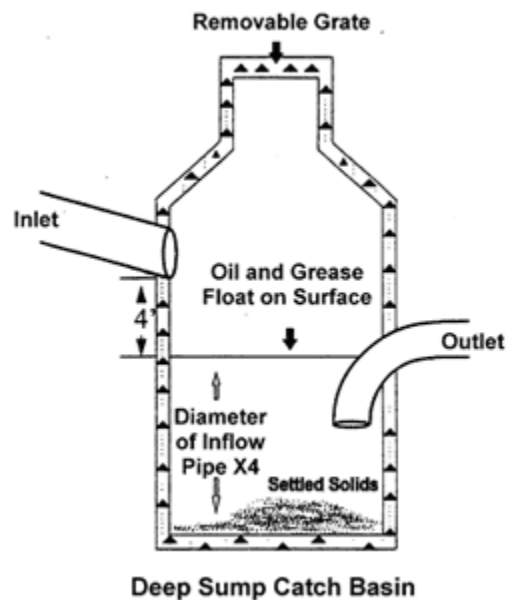


Figure 3: Section View of a Deep Sump Basin (Massachusetts Clean Water Toolkit, (n.d.))

2.2: WPI and Worcester

In August of 2021, the USNews listed Worcester, Massachusetts as one of the top fifteen cities on the East Coast to live in. Worcester's high annual salary and overall lower crime rates have made it a highly sought after area for living. (Thorsby, 2021) Through their innovations and various community outreach initiatives, WPI has also added to the appeal of Worcester since its founding in 1865. WPI students have shown in the past several years that they have a strong commitment to improving the surrounding community and increasing sustainability through IQP projects. One of these projects, which was initiated by WPI students, was called the *Elm Park*

Conservancy Project. In this project, three students, with the help of faculty advisors and the university, were able to increase the sustainability of Elm and Salisbury parks by creating funding and increasing volunteers to help clean the parks. This IQP team worked in collaboration with a group called The Park Spirit of Worcester, which shared the common goal of improving and protecting Worcester's parks (Htet, Alshahrani, Navickis, & Suriner, 2017). There are even more examples of projects and initiatives on campus to further Worcester's growth.

2.2.1: Sustainability Plan

One of WPI's main focuses has always been sustainability, and in furthering that goal, a sustainability plan was introduced in 2014 to set clear goals and intentions going forward. In this plan, sustainability is defined by environmental impact, social justice, and economic security. New sustainability plans come out every few years to update the school's progress and address new issues. WPI created its first Sustainability Plan in 2014. Over the past six years it has worked to create realistic and productive goals for WPI's environmental footprint. In the 2020 WPI Sustainability Plan, there are four clear goals to be accomplished by the end of the year 2025. The first goal is to increase the understanding of sustainability through Academic Programs and Initiatives. This will put sustainability at the forefront of academics and will hopefully be carried over to the career path a student takes. The second goal is to have sustainability be a leading guideline for operations and academic research conducted on campus. This starts in the classroom, by introducing important topics of sustainability. The third goal is to direct research and scholarship efforts conducted at WPI towards developing a sustainable

community locally and globally. The fourth and final goal of the plan is to increase engagement at WPI through events, community service, and education to reach a greener future.

2.2.2: Students Off Campus

The majority of WPI students, following their freshman year, decide to live in private residences off-campus. In 2020, of the 4,892 students who attended WPI as undergraduates, 2,593 lived in off-campus apartments. (US News, 2020) Unfortunately, the sustainability plan does not take into account the off-campus community and the impact they have. To limit the impact students have in the surrounding communities, WPI should consider directing more efforts towards educating off-campus residents about trash and recycling procedures.

2.2.2.1: WPI Off-Campus Resource Website

WPI has an off-campus living page for students looking for resources before their move to an off-campus apartment. When one enters the webpage, the first thing they would see is a statement from WPI Residential services stating that this page is acting as a courtesy and not meant to be taken as WPI sponsoring or endorsing any products or services. In this blurb on the page, it also states a Worcester city ordinance that it is illegal for more than three unrelated people to be listed on a single lease without proper permitting. (WPI Residential Services) There are some apartments surrounding WPI that by this definition are technically illegal, so WPI provides this information to protect students' rights as a renter. The website has other legal tools

such as links to rental agreements, renter's insurance, termination/eviction information, and resources from the Massachusetts state website. (WPI Residential Services) (See Figure 4)

... → THE STUDENT EXPERIENCE → HOUSING & DINING → LIVING OFF CAMPUS

HOUSING & DINING

Living Off Campus

The Residential Services Office provides information to WPI students as a courtesy service. WPI is not responsible for leases or other contracts between students and landlords or for the consequences of any off-campus student housing arrangement. WPI will not be involved in any negotiations between you (the leaseholder) and any landlord, property owner, student, prospective student or realtor before, during or after any agreement. In addition, WPI does not endorse or sponsor, nor does it investigate or verify, any of the agencies, information, services, advertisements, properties, or landlords included in this website.

Please be advised that apartments are listed to rent for three or less individuals. (This limitation is not intended to restrict occupancy by more than three persons who are related family members.) The reason we are taking this approach is that the City of Worcester has been enforcing a "lodging house" ordinance that prohibits more than three unrelated people from living together. It has been the City of Worcester's position that if you have more than three unrelated people AND the land owner does not have a "lodging house" license (most do not have the license) you are living in an illegal apartment and subject to Worcester Code Enforcement action. The City has cited a number of area property owners and have issued cease and desist orders that require individuals to move out of cited apartments.

WPI Residential Services does not endorse or support any specific landlord or rental agency. There are a variety of websites and posting areas where you can find off-campus apartments for rent.

← Housing & Dining

Living Off Campus

Tips & Planning Guides

Figure 4: WPI's Living Off-Campus Page

... → THE STUDENT EXPERIENCE → HOUSING & DINING → LIVING OFF CAMPUS

Communicating with Your Landlord

Access [samples of various documents](#) that may come in handy when communicating with your landlord.

Other Resources for Renters

- [Checklist for Finding Off-Campus Housing \(PDF\)](#)
- [Rental Agreements or Leases \(PDF\)](#)
- [Lease Terminations & Evictions \(PDF\)](#)
- [Model Sublease Agreement \(PDF\)](#)
- [Contacts for Additional Information \(PDF\)](#)
- [Security Deposits \(PDF\)](#)
- [Maintenance, Repairs & Housing Codes \(PDF\)](#)
- [Utilities \(PDF\)](#)
- [Fire Safety \(PDF\)](#)
- [Renters Insurance For College Students](#)
- [Tenant Screening Services](#)
- [Massachusetts State Resources](#)
- Visit <https://www.inmyarea.com/> for information on the best providers for Utilities, Home Security, Cable TV and Internet available in the area.

Figure 5: WPI's Living Off-Campus Page, Helpful Links

Following this is a list of places to look for apartments (Craigslist, Zillow, exc...) and then several links to relevant codes and documents. Fire code, utilities, state resources, subletting information, and cable are all available as PDFs. (See Figure 5)

At the very bottom of the website is a quick list of things to keep an eye out for such as scams happening in the area and recycling blowing away. Other than that short comment on the bottom the street trash, and the extent to its problem, is not emphasized on the site.

Also on this site is a “Living in Worcester” page the viewer can go to that is a short page vaguely encouraging students to be involved in Worcester along with the addition of some fun facts and a short video showing some of the city’s best views. There are three subpages on this page, “Vibrant College Town,” “Getting Around and Visiting,” and “Innovation and Opportunity.” The “Vibrant College Town” page lists activities in the city that students would enjoy, along with links to more updated Worcester event pages.

The “Getting Around and Visiting” page lists transportation resources very simply as a mix of links and explanations. The “Innovation and Opportunity” page is meant to showcase Worcester as a research hub and up and coming city. New articles about innovations are featured there.

There also is a “Tips and Planning Guide” page on the site with information on how to be a good neighbor. It suggests introducing yourself to the people living around you and being aware of your volume at night. Along with the advice there are more links available for accessing trash disposal information, the electric grid, internet, cable, SNAP transportation services, and parking.

2.2.2.2: Green.WPI Webpage

WPI has a student-run group called the Green Team that puts together environmental) In the Welcome tab, the group explains what they are, what they do and when they meet. After that, they list the main goals of their group along with a list of their officers. There are two links on the bottom of the page, one for their bike share program and the other called Constitution, which is where they agree to the rules set forth by the school. The Event page lists out their planned events for the year by term, but it does not include exact dates of the events. On the next tab, one can find images from their events and gatherings in the Gallery tab. (Green Team, 2022) The last tab to be mentioned is the Green Guide tab, and includes a calculator that calculates the rate of recycling based on weight. They have a bulleted list of different forms of transportation that a student can use, as well as a calculator that calculates the amount of CO₂ produced by a person's car based on the car's MPG. For the tips on food, the Green Team has some on food choices, some on containers and food waste. Water usage is listed next and has tips on cutting down on a person's water usage, there is also a shower water usage calculator based on the time spent in the shower. Finally, there are tips for handling the amount of electricity used by the students and a calculator for light bulbs to compare their energy consumption. (Green Team, 2022)

2.3: Standard Data Collection

Data collection is a systematic process where information on areas of interest is gathered through qualitative and quantitative methods. Data collection is used as a way to prove an absence of understanding in many sciences. Data is later utilized to either prove a resolution or

provoke more research. Ingenuity and validity are essential when conducting any academic study. In order for data to be recognized all data must be found properly; therefore, *(Responsible Conduct in Data Management)* quality assurance exists as a precautionary measure so that no misconduct happens. This is all done before the actual collection period begins. Some examples of quality assurance are having protocols in the methodology, looking for any possible systematic errors in the study/experiment, and documenting the entire process. Quality control comes after the study, and is a tool for analyzing and recognizing data to be faulty or not. *(Responsible Conduct in Data Management)*

2.3.1: Institutional Review Board (IRB)

Whenever doing a study involving any living subjects, preliminary steps must be taken to ensure their wellbeing and agency throughout the process. An organization called the Institutional Review Board (IRB) was created in 1974 in response to the Human Research Act to regulate any experiments or studies involving humans. This act was a massive step forward in patient and human rights and introduces the concepts of informed consent.

Before interacting with any test subjects, all methodology and justifications relating to the study/experiment must be sent to the IRB for approval. Most academic organizations have their own IRB offices, so in the cases of university studies the school's IRB office would be approving.

The IRB at WPI promotes and supports efforts to conduct innovative research at WPI while also helping researchers understand and comply with the ethical guidelines and regulatory requirements for research involving human subjects. (U.S. Food and Drug Administration) It is

federally mandated that the IRB review and approve any research that involves human subjects. This is found not only at WPI but throughout colleges in the USA. (U.S. Food and Drug Administration) The process is simple, the research group is required to fill out an online form outlining the project's objectives and planned methods, along with a copy of any interview/survey questions that the group plans to give out or ask. It also asks questions that define what that study entails. It is all submitted once the information is filled in. Once submitted, the submittal is brought forth to the IRB and they decide if it is suitable or not. (WPI, 2022) Any issues with the application can be addressed if there is an issue and resubmitted.

2.3.2: Visual Surveying

Visual surveying is an essential tool in observational science. The purpose of visual surveying is to characterize an environment through several images over a period of time. It can also be done in the form of an inspection. Image surveying systems became popular around the 1990s. A company called Anton Nelessen and Associates created a method called the “Visual Preference Survey” (VPS) as a way to get public feedback about city planning, though it has been applied to many facets of research. (CivicWell)

In visual surveying, establishing scale is very important. In a study done about stormwater in 2018, a scale system from A to D was established; A having no litter and D having an extreme amount. They also wanted to establish in their assessment that they were only considering litter that could have moved or can be moved through a water storm drain. Large pieces of garbage like tires or furniture were not considered due to their inability to be moved by stormwater.

Other observation and data collection-based visual surveys also are useful. They are utilized in water treatment, biology, and many other industries. The most effective visual surveys have a set of parameters so that there is a scale or level of severity of some kind. Without one, it can be hard to evaluate images. Other than evaluating the images, observations can be made from them about the setting that can be useful for research purposes. They then did a visual survey with photography over time to establish and map “problem areas” where there is a qualitatively larger amount of trash, identify timing with trash, and begin an action plan.(BASMAA, 2018)

The length of visual surveys varies depending on what is being demonstrated. For studies where change over time is trying to be shown, like a survey demonstrating wetland loss with satellite images, longer periods of time spanning years or even decades are more effective. There are many things that can be demonstrated in shorter amounts of time though, like a visual survey of sunburns throughout the healing process. The photographs generated in visual surveys can act as very useful data for both evidence of a point and progression over time.

2.3.3: Traditional Surveys

Traditional question-based surveys are effective for gathering information on a given population. Surveys are one of the most common forms of data collection because it is generally cheap to run surveys and they tend to get to get relatively quick responses. (Qualtrics) A survey can exist in many forms, but the most common are face to face, phone, written, and digital surveys. Face to face surveys and phone surveys both are driven by an interviewer, when written/digital surveys can be conducted individually by the participant. This is useful for

surveys with larger time windows where one wants more participation. There are qualitative and quantitative approaches to surveys, but before writing questions one has to understand the motivation of their questions. (Qualtrics)

2.3.3.1: Types of Questions and Writing the Survey

Once one understands the reason they are conducting the survey, they can begin the writing process. What is the goal the study is trying to achieve? What information needs to be collected? (Qualtrics) One has to keep all of that in mind when constructing the survey, and also the goal of making sure the participant completes every question. Survey fatigue, a phenomenon where people start then do not finish surveys due to boredom or other reasons, can be common, so avoiding unnecessary questions and keeping surveys relatively short can help response numbers. Having diversity in question types also can help with that, though certain questions can be more useful in some situations. (Sarah Fisher 2020)

All questions should be written very directly. Abstract ideas should be avoided as opposed to clear ideas and statements. Simple questions like “Agree or Disagree” or “True or False” are useful as quick questions. (Pew Research Center) If the study requires something more detailed than a “yes or no,” a multiple-choice format is useful. Bias still needs to be considered when constructing multiple-choice questions. This means only providing necessary information and scaling responses to paint a clearer picture (e.g avoiding ultimatums like agree/disagree or true/false). The ordering of answer options can also influence respondents’ decisions. To address this, it’s beneficial to have answers randomly shuffled through the survey

medium. However, the randomization method should not be used when questions have an answer scale (ex: great, good, meh, bad, horrible). Four to five options for multiple choice questions have been shown to be the most effective, as too many can cause fatigue in the subject. People also have been proven to struggle keeping more than five choices in mind. (Pew Research Center)

Clear and concise language is important regardless of the question type. While one would assume the person taking the survey is literate in the language it is presented in, avoiding complicated words is still important. It is also important to avoid question with bias. Bias is an undisclosed inclination or prejudice towards an opinion. In surveys, one should want all data to be uninfluenced by the people running it. (Qualtrics) Also being aware if a question is open or close ended is important. An example of an open-ended question would be a question where the participant is entering a text submission instead of selecting from predetermined answers.

2.3.3.2: Administering Surveys

The survey should be tested before being sent to or completed by study participants. The Pew Research Center uses focus groups, cognitive interviews, and/or pre-testing when testing out questions for surveys. Sarah Fisher suggests getting at least five friends to take the survey to iron out any wrinkles found in the formatting of the questions and in the overall survey (Sarah Fisher 2020.) Survey takers are less likely to finish a long survey, meaning that they won't finish a survey that jumps from topic to topic. When doing surveys digitally they can be distributed in a plethora of ways such as social media, email, or through QR codes. Data also can be stored and analyzed easily, especially if done through a surveying software.

Using incentives is another way to attract people to a survey. These incentives can range from free candy, money, or gift card giveaways. It is important to remember the demographic the study is catering to when selecting the item.(Sarah Fisher 2020) Offering an incentive can draw in people who are only answering the survey to get the incentive, so targeting certain demographics with the prizes can work at times.

2.3.4: Interviews

Interviews are another useful method of qualitative research and social science. They are important for many reasons, but mainly what they reveal about the subject's motivations, views, and opinions. In social sciences, personal accounts are some of the most valuable data one can collect. Interviews are more personal than questionnaires due to the conversation-like feel they have, and much information can be gained due to them. The less structured and formal the interview is, the more causal and candid it can become. They are interesting due to the dynamics they introduce that aren't present in a survey; the interviewer's physical presence and the power dynamics the research form causes.

Many things must be considered when conducting and preparing for an interview, from the structure to the phrasing and many other small elements. Understanding who you are researching, what knowledge they have, or what you want them to have before the interview is essential.

(Gill, 2008)

2.3.4.1: Types of Interviews

There are three main types of interviews: structured, semi-structured, and unstructured. Structured interviews are heavily scripted and are essentially an interviewer reading aloud a survey or questionnaire. These are useful for situations where one doesn't want lengthy or more scoped-out answers. They are also useful for situations where there may be a language barrier or another reason to make communication difficult between you and the subject. Having a constant and clear script also allows the data to be analyzed more objectively than other surveying methods; although, when writing it, one has to be clear. However, the inability to ask follow-up questions can be difficult in some instances, and other methods reflect the need for more nuance in some interviews.

Semi-structured interviews consist of some clear guiding questions that allow the subject to open up and go into more detail. The interviewee is allowed to "go off of script" and ask related questions they think of as the interview goes on. The flexibility of this method makes it very common, especially in health care. (Gill, 2008) Unstructured interviews are very similar, though they do not have any preconceived theories or themes given away in structured questions. This interview style is the most time-consuming and often lasts many hours. Some subjects find the lack of predetermined interview questions unhelpful because they do not know what to say, but this style works well in journalism or other cases where the interviewee knows what they want to say beforehand. (Gill, 2008)

2.3.4.2: Creating the Interview

Creating the interview questions and understanding the goal of the research is often the first step in the process. Open-ended questions work best. It is also important to keep a neutral tone as to not sway the person and to start with easier questions and then progress to more complex or difficult ones. This progression will feel more natural and allow the participant to feel more relaxed before opening up. Conversation builds confidence for both the interviewer and interviewee. (Gill, 2008)

Choosing where the interview will be is also important. Locations with little to no distractions like coffee shops or rooms designated for data collection are preferred. Phone interviews work well when both participants are in quiet rooms and can clearly understand each other. During the actual interview, the first thing before any interview or survey is to give the subject any and all relevant information so that they may give their informed consent. Both parties should have a clear understanding of the interview and what is expected before the interview starts. (Gill, 2008) During the interview, treating the participant with respect is crucial, which includes not interrupting them and listening intently. Having another person there to take notes helps keep the interviewer engaged in the conversation.

Chapter 3: Methodology

Our group established that our goal was to improve sustainability off-campus, and to do that primarily through spreading information to students. To do that we set a clear set of objectives similarly to the Sustainability Plan. The first objective was to gain a better understanding of what information students off-campus have about living in Worcester, and what improvements can be made. Surveys were given to off-campus students about trash, recycling, and generally living in Worcester. Landlords were also interviewed about how WPI students are as residents and what information is given to students from them or the housing company.

Our second objective was to document the accumulation of garbage in the community around Worcester. It was decided a visual survey conducted by group members would work, so a selection of streets were photographed over the course of three weeks. These photos then were analyzed for information about what litter is most commonly discarded, where litter is found most frequently, along with other observations.

Our last objective was to develop ideas for improving students' access to off campus information. The main resource found from WPI is the "Off-Campus" page, but our group saw many areas where information could be added or consolidated. Making students aware of the page's existence is also key. Our group met with members of the WPI staff and researched what other colleges provide to see what others have found useful.

3.1: Objective 1: Understanding Information WPI Students Have on Living Off-Campus

We created a survey for off-campus students at WPI that addressed litter, recycling, and other aspects of living in Worcester. The survey was created using the online platform Qualtrics. In this survey, we asked if residents know what items can and can't be recycled, along with other questions about Worcester. Qualtrics is an online platform that allows people to take surveys on smartphones and computers. We used multiple choice because it lists answers that the survey takers have to select between. Short answer questions were used for any extra details a student may have on a topic, which provided us with more insight. We formulated our survey using the knowledge from "Designing a litter tracking method for Worcester MA," which stated that in mobile surveys multiple choice questions were the easiest and best question type to format. (See Appendix A: Student Off-Campus Survey)

Each one of our group members sent out the survey to friends, or peers who are in a similar clubs or sports. One potential issue for skewed data was sending it to individual organizations who will likely all have the same answers. When sending the survey to an organization such as the basketball team, many members of that team live in the same apartment complex, therefore their understanding and perception of the trash system in WPI is likely almost exactly the same. In order to combat this, also included several random survey participants. Our group accomplished this by taking turns sitting in the WPI campus center and requesting volunteers to take the survey. Another issue that our group faced was Greek life. Whether or not fraternities or sororities are actually considered off campus was a gray area. While they are considered by the school to be an on-campus residency, many of the fraternities live a

considerable distance from the school. During the collection of images, many group members also noticed that Greek life apartments contribute to the pollution in the street, whether it's leftover trash from parties, or the trash carried away by the natural elements.

To encourage people to take the survey, participants were given the opportunity to enter a raffle for a selection of gift cards to local restaurants. After all of the data was collected, 3 survey participants were selected and received the cards through a raffle.

Our group also interviewed a landlord who rents in the area surrounding WPI's campus. The goal of the interview was to see who they primarily rent to, what information they provide to students, and how WPI students are overall as Worcester residents. The landlord was kept anonymous and was not recorded during the interview process to promote honesty during the conversation. (See Appendix C: Landlord Interview Consent and Questions)

The interview itself was semi-structured to allow for a more conversational feel. This also allowed for them to more comfortably interject with any information or anecdotes that were relevant, but were not covered in our questions. During the interview, we inquired as to how long they had been a landlord and what drew them to the profession. This was to get an idea of their intentions as a landlord. We then asked if they were from Worcester, the number of apartment units they own in total, and the amount owned in the Worcester area. The goals of these questions were to see if they knew much about Worcester and if they had their focus as a landlord outside of Worcester as well. Following that, we wanted to know the general area of their owned units and the primary group of tenants they rented to. This was to see if the information they were giving us pertained to the research on WPI students we were after. After those questions, we asked about how often they visit their properties each month and what information they give tenants pertaining to living in the area. The final set of questions inquired whether they rent to

other college students, if so, which schools they attend, and how WPI students are as tenants. We wanted to know their input on how WPI students were. The landlords were also asked how the students were with the garbage collection system. If the landlord rented to other students from a different school, we would have asked the same questions pertaining to WPI renters about those colleges.

The information collected from this interview was compared to our survey results to better understand what information WPI student's still need when living off campus, as well as any other improvements to be made to the WPI off-campus website.

3.2: Objective 2: Collect Images To Track The Accumulation of Trash In The Streets.

In the collecting and analysis of the photos, we wanted to see many things. Our photos were taken Monday, Tuesday, Wednesday, and Friday every afternoon. This acted as a visual timeline of the streets through the city's garbage cycle. We were able to observe behaviors relating to recycling like what containers people were using, what was already spilling or being blown out, and if there were any non-recyclable items that we saw in the bins. Our group wanted to track and see the areas that most constantly have litter, and what pieces of litter stay on the street over the course of several weeks. We also wanted to see the density of street garbage, see what areas tend to be heavier and what differences there are on a street block to block.

First, we began to record the accumulation of trash over the course of the term. Our group decided the best way to do this was to document three individual streets surrounding WPI's campus. These streets were selected due to their different demographics. Wachusett, since it is nearly entirely student housing, is a great isolated sample to study the student contribution to

trash and recycling. Bowdoin Street has a larger population of permanent residents, and therefore was an effective subject to focus on the local contribution to trash. Finally, Dix Street was chosen because it is a fairly even mix between both students and permanent residents and we were able to study the relationship both groups have, and how it impacts the conditions of the street.

Over a three-week span, the group was each assigned a road in the surrounding community of WPI. During this time the group photographed the streets from the same relative spots to record the amount of litter on the streets. We were looking for litter caused by off-campus residency as well as litter attributed to permanent residents of Worcester. We were able to analyze trends and make educated conclusions about the severity of the trash issue among WPI students. We organized our pictures into three separate slide presentations, one for each street. Each slide is for a different day and includes three to four pictures of similar places. This allowed us to easily compare each street day by day with the pictures being side by side to each other. (See Appendix F)

3.3: Learn What Information Other Colleges Provide Their Off-Campus Living Students

We researched a number of colleges in the Worcester area as well as colleges not located in Worcester. The colleges researched were Holy Cross, Clark, Assumption, Texas University Austin, Skidmore, Tulane, and Massachusetts Institute of Technology. This was to get a general sense of what resources other schools give their off-campus living students. After going through the schools' information we were able to use our findings to suggest changes to WPI's webpage. Every school was researched in the same way. We would go to a school's website and try to find the information by clicking through the tabs and links listed by the schools. We then searched for

information by using the search bars provided on the websites. Finally, after the information had been recorded, we would do a general Google search. What this did was see if the information was easy to find by navigating the website, if you could find the information through the provided search bar, and if you could find information through a Google search.

3.4: Improve WPI's Off-Campus Living Page

Our group met with a member of the residential office in order to streamline the off-campus website. The meeting occurred on Thursday the 17th of April at 12pm. We asked them about the process of making changes to the WPI webpage, how often the website is maintained, how much they work with off-campus students, ways to get information out to students and anything else they wanted to add to the conversation. Another objective of this meeting was to learn the capabilities of the website design software in order to incorporate some new ideas that group members had.

Our group also wanted to consolidate the information on the Green Team's website and the "Off-Campus Residents" page, so there is an easier way to access the knowledge of being a sustainable Worcester resident. We recommended changes on the off-campus page on the WPI website so it's focused more on recycling, with a clear guide of what Worcester does and doesn't accept. This website could be shared via QR code on the WPI Twitter so it can appear on TV across campus and be seen semi-regularly by students. We also asked residential services to see if RA's can spread this information to residents who may be planning on moving off-campus. We will track the progress of this by first understanding what is missing and then being able to successfully add information which will inform more people about the ways they can improve Worcester's sustainability.

Chapter 4: Results

In order to determine what action must be taken to improve the quality of Worcester's neighborhoods, extensive data was compiled by our group in order to correctly analyze the condition. Maintaining the quality of Worcester's neighborhoods should be something that WPI encourages and recognizes among its students.

While keeping our objectives in mind, our group compiled all of our data of street images and student surveys and assessed the severity of the issue. In order to accomplish our goals, WPI needs to increase its activism towards our adjacent neighborhoods. The lack of information available has caused the stigma that WPI is separate from the Worcester community. In reality, the majority of students during their time at WPI will live off campus. By not teaching the valuable lessons of community maintenance, WPI is doing an injustice to their students and the community. By making more information about cleaning and maintaining their community available to WPI students, the quality of the neighborhoods of Worcester and wherever students move will improve.

4.1: Student Survey Results

After spending time disseminating the survey to off campus students, we began to notice trends. There were 130 responses and of those responses 115 were students who live off-campus. After Over 50% of the people recorded stated that they lived in the state of Massachusetts, which

has a fairly uniform trash collection process. Even though the majority of survey students were from the same state, over 90% noticed that there was an unresolved trash issue around Worcester. Even more interesting was in Figure 6, data records that nearly 50% percent of survey takers stated that the condition of the streets were much worse than the streets of their hometown.

Q9 - How would you compare the cleanliness of the streets around WPI to your per...

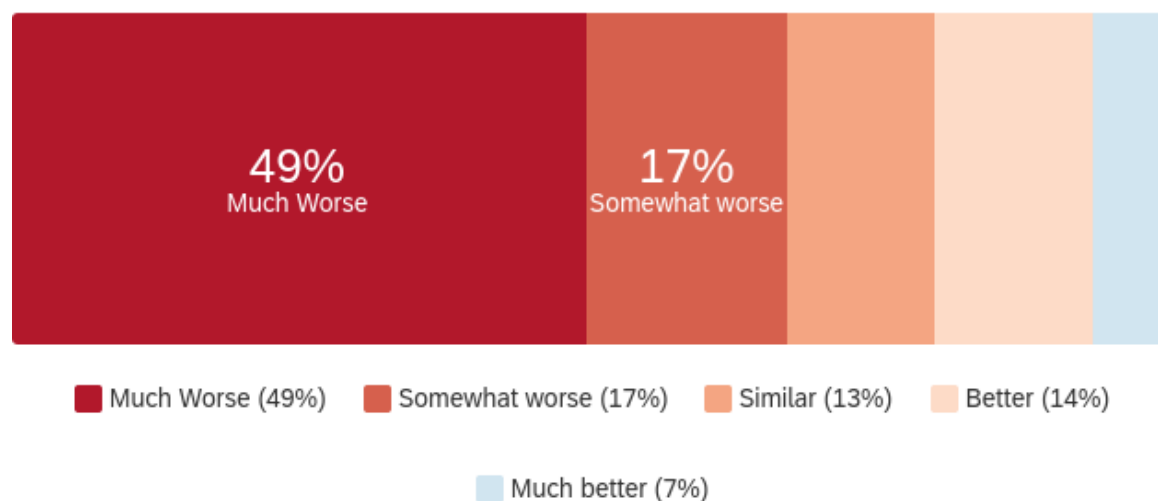


Figure 6: Graph representing students comparing cleanliness of the hometown to Worcester.

Although a high percentage of people agreed that there was a trash issue in the Worcester area, surprisingly just over 20% of survey takers considered the trash issue was much better or somewhat better than their hometown. The most shocking information that our group found was how many people expected at least some of their recycling to end up as garbage in the streets. An astounding 82% believed this would be the case. Although the majority of students who have taken the survey agree that there is a serious trash problem in the streets, many admit that they are unwilling to do anything about it. 44% percent of students who took the survey admitted that they were unlikely to pick up any trash or recycling on the street whether it was theirs or not. The

Figure 7 below shows students react to trash on the street, and how students are almost just as likely to pick up trash as they are to leave it.

Q12 - How likely are you to clean up your recycling if you see it in the street?

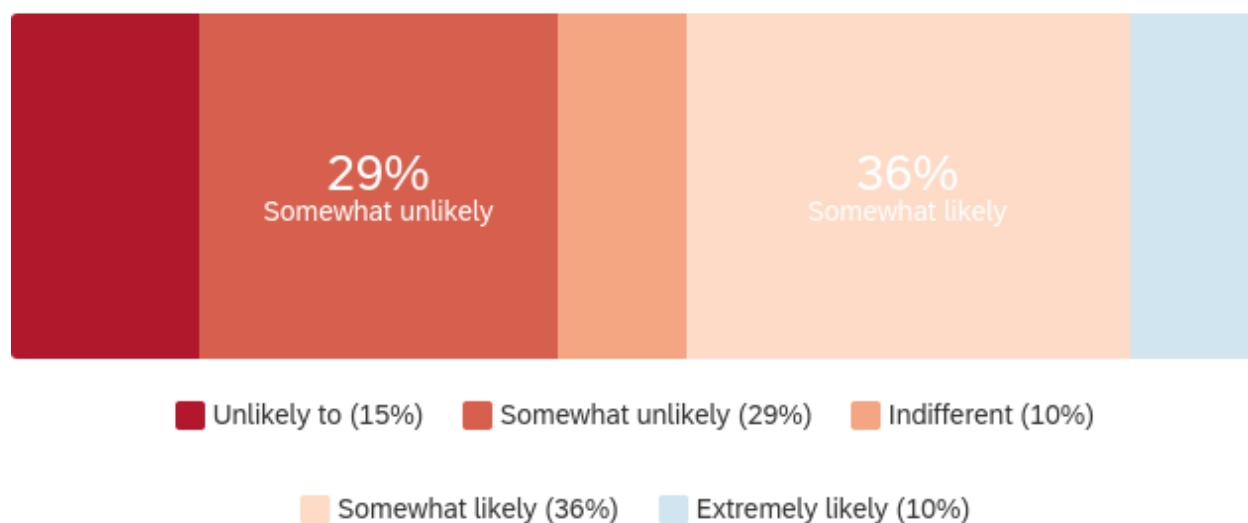


Figure 7: Data showing likely students are to pick up trash off the street.

We found that a Discord and Twitter feed regarding off-campus sustainability were not popular options sitting at 60% and 51 % unlikely to utilize them as resources. However, many survey takers, 64%, claimed that they would be interested in following an Instagram which covers trash, recycling, and other Worcester resources.

4.2: Landlord Interview

The anonymous landlord that we chose to interview is from Worcester and has been leasing out his properties for around 30 years. They became a landlord for investment purposes. The landlord revealed that they own six apartment and target WPI students as tenants. The information that they provided to their tenants is on the lease. The lease does not mention the

trash and recycling process, it only mentions rules for living on the property. They said that WPI students are pretty good tenants, some are clean and some are messy, but they did not notice any consistencies. When specifically asked about trash they said that most tenants understand how the system works, but in the past there have been some who have had issues with putting trash out correctly. They sat down with the tenants to educate them on proper times to place their trash on the curb. According to the landlord, they visit their properties twice a month, and will go more than that if there are needed repairs. Finally, they do not like when students leave stuff behind when moving out at the end of their leases. It appeared that in conclusion of this interview that the landlord did not have a strong motivation for improving the community but instead was solely motivated on maintaining his property.

4.3: Visual Surveying

Each member of our group came to very unique conclusions after three weeks of collecting images and comparing results. Throughout the three-week period each street had its own fairly consistent quantity of trash. The same piece of garbage also could be seen multiple days in a row in many cases. The trash each week was the worst the day after trash was collected, Wednesday. On Wednesdays, all of the trash and recycling which was left behind from the collection day was scattered along the sidewalks and street. Recycling and yellow trash bags that were put out too late also are left to be damaged by weather or animals. (See Figure 8) As the week went on, the quantity remained fairly consistent, however, many articles of trash began to congregate at the catch basins and along fences. Our group observed many trends in the three streets we observed with the types of litter and other behavior. These results were compiled into

three sections: the trends we saw, problems this causes, and the contributing factors that further perpetuate the litter.



Figure 8: Image of Wachusett Street 3/7/2022

4.3.1: Trends

During our survey, the most commonly seen items littered were food/drinking containers such as beer cans and pizza boxes, cigarette butts, plastic, and vapes. Among those were also needles, broken glass, and other hazardous waste. The majority of garbage recorded though seemed to be garbage blown away from bins, not intentionally dropped trash.

A common observation among the streets surveyed that had excessive street trash was that they often didn't have access to city recycling bins. The migratory population of college students makes keeping the city bins with the apartment difficult, as renters may take them with them when they move. Because of that, in lieu of recycling bins, many people used paper bags or loose shopping bags. Although it served the basic purpose of grouping the recycling together, in

many situations the contents of the bags were tossed by the wind and all ended up scattered in the street. Once the garbage is blown away, it is then very unlikely to be picked up by the resident.

Residents may not be picking up said trash for many reasons. If the other students around them are not, it would make sense for students 'not to see the point' due to the garbage that will already be there from other residents.

Another trend that contributes to the clutter along the streets is whether or not residents and the public works employees will take the effort to collect stray litter that is not in bins. Some residences and businesses obviously put out more of an effort towards cleaning up their area. Whether it is motivated by business reasons, or just by having a healthier neighborhood for their kids to play, these small acts of sanitation drastically increase the conditions of the street. As seen below in Figure 9, the image on the left is clearly a tenant who has taken the time to clean their yard whereas the image on the right appears to be a less considerate resident. The DPW and private contractors which are tasked with cleaning up the clutter left in the street most often are understaffed. It already can be difficult collecting trash from all the homes in the time frame, adding time for individually picking up litter seems unrealistic within their resources. That leaves most of the responsibility to the resident to clean the yard and sidewalk in front of their yard.



Figure 9: Trash Found in Yards

Areas which are most susceptible to large accumulation of trash and loose recycling are catch basins, fences, and complexes with large unlocked dumpster bins. Weather seems to be what pushes garbage and sediment to the edges of the streets where basins and fences are located. Catch basins are particularly vulnerable to light plastic and cardboard which can be picked up by the rain or wind and carried along the street. In the Figure 10 you can see how trash and other object will accumulate over time on a manhole cover. Fences are vulnerable for similar reasons. This problem was no different in any of the adjacent streets to WPI. Figure 11, shows how fences serve as a net that pickup any light material caught in the wind. In the streets recorded, every single street's catch basis had visible rubbish



Figure 10: Trash found on Dix Street 4/6/22

Another trend we have seen is large apartment complexes or businesses often have non-affiliated residents using their waste disposal instead of using the city bags. These bins are often left with garbage overflowing, or bags haphazardly tossed on the side. It has been observed that the elements and scavengers rip through them, and the result is more clutter in the street.



Figure 11: Trash Stuck on a Fence

4.3.2: Problems Caused By the Litter

The visual surveying has displayed to the team how vulnerable that catch basins are to loose litter and recycling. The runaway trash which is often picked up by wind or scavengers, is carried by rain downhill towards the curb and onto catch basins. During the weeks of observation there was a consistent coat of clutter covering the catch basin week after week. Furthermore, after a heavy rain, or a strong wind, the catch basins noticeably gained new articles of trash to add to the collection. Another noticeable issue that a group member brought up was the depth of the catch basin. The catch basins which were observed by team members had an accumulation of

trash, sediment, liquid, and oils which caused the level of the liquid to nearly reach the level of the road.

Another issue caused by the litter is the presence of hazardous materials on the ground. E-Vapes are one of the most commonly seen littered items, and their bright colors could make them seem like toys to children. Other hazardous items include needles, broken glass, and partially filled bottles of alcohol. The demographic of this area is not only students, it is families with children who are exposed to and live around this litter.

4.3.1: Contributing Factors

There are several factors that further contribute to this issue. During our data collection, torn trash bags were observed. Animals, people looking through bags, or just being moved around can cause bags to tear. The litter on the street also may contribute as sediment or sharp garbage can cause damage to the thin plastic. The areas where yellow trash bags are supposed to go, the curbs, are where there is the most accumulation of litter tends to be. (see Figure 12)



Figure 12: Trash Bags On the Sidewalk on Bowdoin Street 3/29

There also seems to be a visible gap in information regarding how trash collection works. We have observed garbage being put out late, too early, or on the wrong day multiple times in our 3-week survey. This can come from many things, confusion about the garbage cycle, forgetting, or not caring. Lack of access of a recycling bin also contributes to the issue. Without a uniform bin, it can hard for residents to find containers suitable for recycling. Using bags can be risky for wind unless something is weighing it down. Such as the image seen below in Figure 13. These loose plastic and paper bags are not heavy enough to withstand the wind, and therefore they tip over and their contents spill all over the street.



Figure 13: Image of Dix Street 3/29/22

4.4: College Comparison

We wanted to see how WPI compares to other schools with supplying their off-campus living students with information. To do this we researched three other colleges in the city of Worcester as well as four colleges that are not in Worcester. We specifically looked into the information these colleges provide on their websites for students that live off-campus while attending. The information we were looking for was split into two tables, the first covering the total student population, the percentage of students who live off-campus (as of 2020), searching for apartments, searching for roommates, and landlords. The second table covers provided regulatory information, selecting utilities, trash/recycling and helpful links. By making the table we were able to see which schools provided their students with the most helpful information.

Table 1: College's Provided Resources

School, Population & % living off campus	Apartment Search	Roommate Search	Landlords
WPI 6,920 53%	-List of websites with apartment listings - Checklist for finding housing	-Nothing directly stated for off-campus students	-No information on landlords; only a statement that WPI is not responsible for negotiations between students and Landlords
Holy Cross 2,997 10%	-Nothing to help find physical properties -Eligibility process is laid out	-Nothing for off-campus living students.	-Link to Massachusetts tenant rights
Clark 3,425 47%	-Uses the service, JumpOffCampus, for their house listings.	-Nothing for off-campus living students.	-Nothing

Assumption 2,420 15%	-Nothing	-Nothing for off-campus living students.	Nothing
UTexas Austin 50,476 92%	-Has a third-party system for apartment listings and a search guide	-Guide on finding a roommate -Has a system and Facebook groups for finding roommates	-Has a link to go to for problems with landlords
Skidmore 2,582 32%	-Nothing, encourages students to work directly with res services	-Nothing	-Nothing
Tulane 13,090 53%	-Timeline for finding a place -Inspecting the property -List of websites to find apartment listings in the area -Budget planner	-Information and links to websites that help find roommates -Self-reflection form to know what you want from a roommate	-How to Call and meet landlords
MIT 11,254 80%	-Webpage for off campus housing with listings	-Information on finding roommates	-Nothing directly said

Table 2: Regulatory Information, Utilities, Trash/Recycling, Helpful Links

School	Regulatory Information	Utilities	Trash/Recycling	Helpful Links
WPI	-Link to Worcester's webpage for parking -Information on repairs and house codes	-Links to websites listing utility services -Links and phone numbers for prominent local companies	-Warns students about being aware when putting trash out, it mentions strong winds	-Numerous links covering all categories listed in the last 2 tables
Holy Cross	-Off-campus living policy guide	-Nothing	-Briefly mentioned that students are	-3 links that lead to: the Massachusetts

			responsible for keeping properties clean and trash free -no direct link to Worcester's trash policies	Attorney General's Guide to Tenant Rights, MA Attorney General's Student Renters Guide and Off-Campus Living Policy
Clark	-Nothing	-Nothing	-Nothing	-Link to site with listings called JumpOffCampus
Assumption	-Nothing	-Nothing	-Nothing	-Commodities on-campus for commuters
UTexas Austin	-Tips with leases - Link to City of Austin Renters resources -Info on being safe in the Austin area	-No listing of providers or where to go to find them	-Nothing	-Weekly meal planner, multiple checklists, apartment repairs
Skidmore	-Eligibility to live off campus	-Nothing	-Nothing	-Guides for eligibility process and off-campus living policy
Tulane	-Lease terminology/key information -Multiple links informing people on their rights when leasing	-Links, numbers and addresses listed for electric & gas, and water. -Internet options	-Nothing	-Storage and moving, appliance and furniture rental, college student insurance
MIT	-Has office for off-campus living, lease examples	-Has information listed for students	-Nothing	-The entire webpage is intended to help

				with off-campus living -Most information can only be seen with a MIT account
--	--	--	--	---

After looking through the data collected in the table, we are able to see that WPI and Tulane supply their students with the most information.

When compared with what other schools do, WPI does a good job of listing places to find house listings, finding utilities, having links directly to the city's website resources, and giving a little bit of information on recycling. WPI has more information than other schools, but that does not make it perfect. Some things we noticed were that the information is hard for those to find who do not know the website exists. They also do not provide any resources for students looking for roommates to live off-campus with.

There are some things that other schools have that WPI could implement to improve their website. Similar to the University of Texas at Austin, WPI could add either a guide or a link to one of the Facebook groups for WPI students looking for off-campus living and or roommates. MIT does a good job of making their off-campus information easy to find and all in the same place. If WPI could do this, it would benefit the off-campus living students of WPI.

4.5: Results of Interview With Residential Services:

This interview with the residential services representative was very insightful towards how WPI handles off-campus issues. To begin with, residential services at WPI are experiencing a lack of staff members, so non-essential projects have been pushed off while accommodating housing for the following years and more pressing matters are settled. This unfortunately means that the off-campus website has not been updated, or adequately filled with information for off-campus students. The potential resource of having the off-campus website is not being utilized enough by students. At the same time, they said there is a weird gray area for residential services when it comes to putting out new information on off-campus living. The gray area is due to their role in promoting living on-campus and promoting WPI living. The problem with that is that WPI does not have enough space to house all of its students. On top of that, in the last few years, WPI has begun to increase the size of incoming classes. They encourage juniors and seniors to look for off-campus housing because the school does not guarantee them housing. They said that if residential services can't help all on-campus students, then there is no way they can handle dealing with off-campus issues. We asked about what methods Residential Services uses to send information out to students. They answered by saying, through Instagram, because most people at WPI have accounts. (See Appendix E for full meeting notes)

Chapter 5: Conclusions/Recommendations

In our analysis of the litter through our various surveying methods we wanted to look at the many trends we saw, and what implications they have. Problems like clogged storm drains and hazardous waste can be dangerous to both individuals and their environment. A lot of this project was researching and understanding this problem so that we can provide some recommendations for the community.

5.1: What Portion of Street Litter is Intentional?

One distinction we began to make within our results was the intentional and the unintentional litter. Intentional litter was defined by us as litter disposed of knowingly, like a cigarette butt. Also a common theme that was apparent from both the visual surveys and the student survey was students' lack of responsibility or care towards the condition of the streets. This lack of effort takes many forms, most being non-malicious. In our reconnaissance of the streets during the days leading up to trash collection day, such as Monday or Sunday, we found many people had already placed their trash on the curb. This demonstrated to our group a lack of concern for their trash and whether or not it even made it to the recycling or trash collection plants. It also could be due to a lack of understanding of the trash system or not understanding how their actions further add to the problem. Placing the trash out on the days before Tuesday gives scavengers and the natural elements much more time to get hold of the trash and recyclables and spread them around the community. Figure 14 which is shown below shows multiple residents who placed their trash

almost 24 hours before the trash collection day. Our survey did show the students did see litter and trash as an issue, but did not address how they may be contributing to it.



Figure 14: Image of Wachusett Street on 3/21/2022

Another issue is the trash that is directly thrown on the street by other residents. These people understand that the clutter they leave behind will likely not get picked up and will instead join the pile of trash accumulating on the street side. This mainly is due to the litter already being on the street. The main concern with these residents is that the majority of trash is usually hazardous waste. Whether it is glass bottles that are thrown on the street and shattered, needles left haphazardly on the curb, or e-cigarettes or cigarette butts, these items can pose serious health risks to members of the community. An example of hazardous waste is seen below in Figure 15.



Figure 15: Image of Needle found on Dix Street on 4/25/2022

5.1.1 Recommendation For Action For Intentional Litter

The residents in the community who are placing the garbage out days early likely do not understand the ramifications of their actions. In order to combat this issue, WPI and Worcester in general need to publicize more information about the impacts of runaway garbage and recycling. By decreasing the time that garbage has on the curbside, there is less of a chance that it is scattered on the streets and more likely to make its way to its final destination at the trash or recycling plant.

The issue of intentional litter of hazardous waste is of greater concern. These people are aware that their actions are a detriment to the condition of the community and littered regardless. We recommend the publication of metal street signs reminding residents of the fines which will be payable if they are caught littering. Also looking further into public trash cans and how they could possibly be implanted could prove helpful. In a fairly recent initiative taken on by Worcester,

called *Keep Worcester Clean Program*, it gives members of the community ideas for how they can help clean up the neighborhoods, in whatever capacity they choose. For example, some of the helpful tasks that Worcester is asking residents contribute with are, waiting until the day off trash collection to put out your trash and recycling (around 6:30 or 7:00 am), report incidents where property has been vandalized, inform the police when street signs have been stolen, and also use the trash receptacles in local parks to maintain their integrity. There are many other simple measures to take as a resident in order to keep Worcester clean. (City of Worcester, 2022). If you are interested in helping the community visit their website at <https://www.worcesterma.gov/trash-recycling/keep-worcester-clean>.

5.2: What Portion of the Street Litter is Unintentional?

Fortunately, in the conclusion of the student surveys, which were conducted on campus, there appears to be an enthusiasm for cleaning up the community. Most students were aware of the problem litter presented, and wanted in theory for it to be improved. Many participants in our group's survey also reported that they are interested in learning more about sustainability, but the issue is their access to information. After group members noticed this trend, the first question our group would ask is, “are you aware that there is an off campus living page for WPI students?” We did not find a single person who was aware of this page. Finding ways to spread information on this page could help alleviate this issue. This can be done in several ways, including providing a link on the WPI twitter page or the residential services Instagram. We believe that this a primarily a problem of miscommunication, and general un-motivation due to the already litter filled environment. Cleaning the areas and providing resources could show some shifts in the behavior.

5.2.1 Recommendations For Action For Unintentional Street Litter?

Unintentional litter caused by people who do not understand the impacts of their actions should be significantly easier to solve than people who are aware, yet choose to do it anyway. As part of our methods, our group developed a document filled with information to update WPI's off-campus website. The implementation of this information will make this website much more valuable. By having more organized and a larger quantity of information, we hope that the off-campus website will gain some more online foot traffic. We hope that when WPI students are learning about the rules and tips for trash and recycling before moving in, the misconceptions about what day trash is collected will be removed. In the conclusion of the survey, many people had never used or did not even know there was a website for off campus students. Our group decided the best method of improving the information would be to send the information that is missing to residential services so they can use our work to update the website. We believe that improving the information available and emphasizing how WPI is a member of the Worcester community will increase the responsibility that off-campus students feel towards keeping the neighborhoods clean.

The document represented in Figures 16 through 20, displays the edits that we recommended to Residential Services. A main focus of our work was not to completely redesign the website and create more work for the staff, but to reorganize the information already available and add in missing elements. Hopefully, in the near future, residential services will be able to look over our proposal and implement as many changes as they see fit. The off-campus website page is

a potential asset for WPI freshman and other students who are moving off-campus, and it is important that it is updated and accurate so that it can be properly utilized. (See Figures 16-20)

WELCOME TO THE WORCESTER COMMUNITY

Off Campus Residents PSA:

WPI students are members of the Worcester community. For this reason, all students should take on the responsibility of doing their part to keep the community clean. Although the majority of nearby housing is allocated towards students, there are still families that share the community. These neighborhoods are a shared space and WPI students should try to be respectful of families and the children who are nearby. Be careful with hazardous waste, such as e cigarettes and glass bottles, as they can pose serious health risks to children and other residents. Finally, take the responsibility and ensure that your trash from your residency does not end up scattered in the street. Clean up after your trash and recycling if it is blown from the rubbish bins, leave the neighborhoods cleaner than when you arrived!

Liability Release:

In Worcester it is only legal to have three tenants on a lease. Some Landlords who are aware of this, will sign a lease to only three people, leaving one member out of it. Therefore if complications arise

Communication and Legal Help with Landlord:

<https://www.masslegalhelp.org/housing/self-help-forms>

Figure 16: Page 1 of Suggested Edits to WPI Off-Campus Website

Helpful Resources to Help In Your Apartment Search:

Telegram.com
Zillow.com
Apartments.com
Rent.com
Craigslist.com
jumpoffcampus.com
Bulletin Boards at local businesses

Before You Move:

Recycling Bins: (must bring proof of residency)

Located at:

76 East Worcester Street

Hours:

Monday to Friday

7:30am - 5:00pm

1. If not provided by your landlord then you are able to receive your first recycling bin as a new resident for free.
2. If lost or stolen you are able to receive a new bin for only \$5.
3. If damaged you are able to receive a new one.

Helpful Things to Have in the Apartment:

Figure 17: Page 2 of Suggested Edits to WPI Off-Campus Website

After You Move in:

Tips and Tricks for Recycling and Trash: More information can be found at <https://www.worcesterma.gov/trash-recycling/trash-disposal>

1. When putting out trash to the side of the curb, be sure to place it a safe distance from the edge of the sidewalk so that it is not accidentally knocked into the road.
2. When loading your recycling bin try to load the heavier items on top so that the top articles of recycling do not blow away.
3. Worcester DPW will ONLY collect trash if it is in a yellow Worcester city trash bag.
4. Yellow trash bags are available at Shaws, Price Chopper, Stop and Save, Big Y, Market 32 and ANY OTHER NEARBY PLACES?
 - a. In your use Insta Cart you can add these yellow trash bags by Requesting "City Ordinance Bags"
5. Only put the trash out if possible the morning of trash collection. Try to refrain from putting trash out the night before to prevent it being spread by animals, people, or the natural elements.
6. Do not place broken glass in with recycling or trash, it can cause injury to the DPW employees and also rip open the trash container.
7. If supplied, cover your recycling bin with a cover in order to prevent the recycling from scattering in the street.
8. You can find updates to the trash schedule or if there are any parking bans in place in the link here:
 - a. <https://public.coderedweb.com/CNE/en-US/BFC691572170>
9. ADD IN as many as you can think of
10. You DO NOT need to separate your recycling

Figure 18: Page 3 of Suggested Edits to WPI Off-Campus Website

What CAN be recycled:

- Plastic Cups
- Cardboard Boxes
- Glass Bottles
- Paper
- Metal cans

What CANNOT be recycled:

- Soiled paper
- Plastic bags
- Egg cartons
- Styrofoam
- Plastic toys
- Small Pieces of metal & wood
- Pizza Boxes (place under yellow bag)
- Dishes
- Glasses
- Pyrex
- Broken glass (wrapped in newspaper)
- Window/auto glass
- Flower pots
- Buckets
- Pails
- Paint & aerosol cans (empty)
- Motor oil containers (empty)

Other Resources:

Maintain the same links that are provided on the website:

Figure 19: Page 4 of Suggested Edits to WPI Off-Campus Website

Enjoying the Beautiful City of Worcester:

Worcester Art Museum:

<https://www.worcesterart.org/>

Green Hill Park:

- Golf
- Walking in the park
- Farm animals
- Recreational Sports
 - Baseball/Softball
 - Soccer
 - Football
 - Skate Park

<https://www.worcesterma.gov/city-parks/green-hill-park>

Figure 20: Page 5 of Suggested Edits to WPI Off-Campus Website

5.3 Lack of Responsibility Among Students

An issue that our group unveiled in the visual surveys was a common lack of responsibility from residents once the trash was placed on the curb. Once the recycling and trash are left on the curbside, it may be torn apart by animals, rummaged through by humans, or even forgotten by the trash crew. Most of the time, the trash is not collected and is left on the curb to be pushed around Worcester by the rain or wind. Based on many comments received from the survey, students felt this concern was less of a WPI issue and more of a Worcester concern. Our group concluded that this lack of responsibility for WPI students' contributions to trash is going to be an obstacle to

overcome. The survey has revealed that students do not feel as if they are members of the Worcester community and, because of this, are not responsible for the trash issues off WPI's campus. WPI students who live off campus need to feel more responsible for the trash and recycling. Another interesting observation that our group made was how 45% of students were unwilling to pick up the clutter that was left on the curbside or on the street. This again demonstrates that WPI students do not feel obligated to help maintain the health and well-being of the community. The lack of responsibility to the community leads to a situation similar to the broken window theory. If there is trash in the street already people will be less willing to feel guilty about adding to the street pollution.

5.3.1: Recommendations For Lack of Responsibility Among Students

It is a WPI issue that students do not feel a part of the Worcester community. There are many actions that WPI can take in order to combat this mindset, such as hosting more cleanups in surrounding Worcester neighborhoods with students in order to increase their appeal. Not only will this improve the condition of Worcester's parks and recreational activities, but it will also increase the likelihood that WPI students pay these locations a visit and immerse themselves in the community. As stated in chapter 2.1.1, which discusses the broken window theory, the same applies to our streets. If WPI encourages street cleanups adjacent to the campus, then students and locals are more likely to maintain their community.

5.4: Further Steps and Research

Our group was fortunate to have seven weeks of preparation and planning in PQP and an additional six this term to execute our project. Still, while analyzing our data and formulation our conclusions, we saw gaps that could be addressed in further research. One of the main ones was how we considered Greek houses not as off-campus residents. Further research we have done in other schools and WPI has shown they are mostly considered off-campus. We also have considered it, and have now realized the impact Greek houses, and their parties, have on the neighborhood around them. Further surveys could address this, and also include more questions about personal responsibility and “laziness.” Once more information about trash is spread it will be interesting to see if the behavior changes.

Another thing we further want to research is the impact of litter on our water system and children. What we observed about the storm drains in Section 2.1.3 was concerning, and we worry that the excess garbage is making the settling tanks obsolete under high water flow. Other IQP’s or research could see if this contributes to more bacteria and microplastics entering our water. Litter also may affect children who live around it. The hazardous waste poses a threat to them in theory, but we don’t really know how children interact with litter. In our IQP we assumed they might pick up some, especially more colorful things like E-Vapes, but looking more into littering and the affects it has on the children who grow up around it could be revealing.

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Appendix

Appendix A: Student Off Campus Survey

Student Survey Consent: WE are a group of wpi students that are looking into how much off-campus students know about living in Worcester. The answers to these questions will help our group understand what people know. This understanding will allow us to fix and or add ways for off-campus students to find information. Your participation is completely optional, you may stop at any point and you do not have to answer all questions. Your name will not be recorded, and any personal information will be kept anonymous and not tied to any particular response. By submitting a survey you agree to participate and you understand what has been stated here. If there are any questions while filling out the survey you can ask in-person or by email gr-sustaining2022@wpi.edu

Class year: _____

Do you live on the WPI campus?: Yes No

Address (just street and house number): _____

Are you from the state of Massachusetts: Yes No

Are you from the city of Worcester, MA: Yes No

Have you noticed an increase of trash in the streets in recent weeks: Yes No

How would you compare the cleanliness of the streets in Worcester to your permanent residence?

Much Worse	Worse	Similar	Better	Much Better
------------	-------	---------	--------	-------------

What day of the week is garbage picked up on your street (not sure if we should ask for their district)?

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
--------	--------	---------	-----------	----------	--------	----------

In your opinion, how likely is your recycling going to blow away after putting it out

Very Likely	Somewhat Likely	Indifferent	Moderately Likely	Unlikely To
-------------	-----------------	-------------	-------------------	-------------

How likely are you to clean up your recycling if it is blown onto the street?

Very Likely	Somewhat Likely	Indifferent	Moderately Likely	Unlikely To
-------------	-----------------	-------------	-------------------	-------------

Is this Recyclable at your college residence:

Pizza Boxes: Yes No

Paper Cups: Yes No

Broken Glass: Yes No

Styrofoam: Yes No

Paint & Aerosol Cans: Yes No

Egg Cartons: Yes No

Paper: Yes No

Used Paper Plates: Yes No

Cardboard Boxes: Yes No

Do you think your street has a garbage problem?

Very much so	Somewhat	No opinion	A bit of one	Not at all
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How much does street litter on the street you live on bother you:

Very Much	Somewhat Bothered	Indifferent	Moderately Bothered	Unbothered
-----------	-------------------	-------------	---------------------	------------

Before moving off campus...

did you visit any WPI off-campus websites:

live on your own previously?:

What do you wish you knew before moving off-campus?: (Short answer)

If there were an off-campus community platform to share Worcester news what would you like to see in it?

LIST SOME FUNCTIONS

How likely are you to use a discord server for off-campus WPI students?

Very Likely	Somewhat Likely	Indifferent	Moderately Likely	Unlikely To
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How likely are you to follow a Twitter account for off-campus WPI students?

Very Likely	Somewhat Likely	Indifferent	Moderately Likely	Unlikely To
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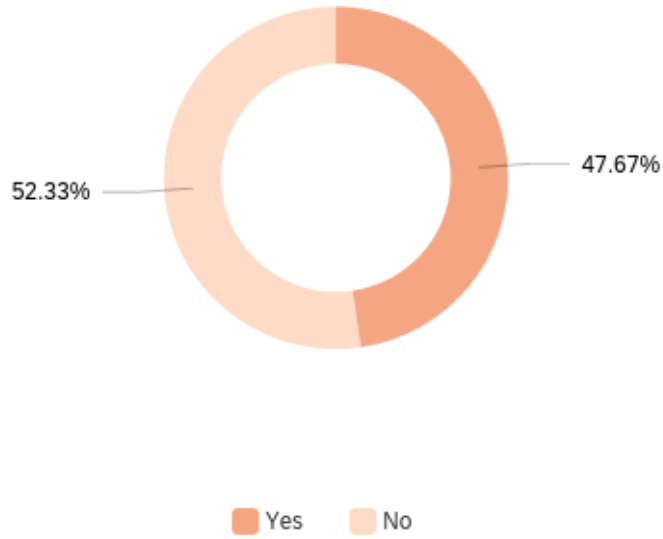
How likely are you to follow an Instagram account for off-campus WPI students?

Very Likely	Somewhat Likely	Indifferent	Moderately Likely	Unlikely To
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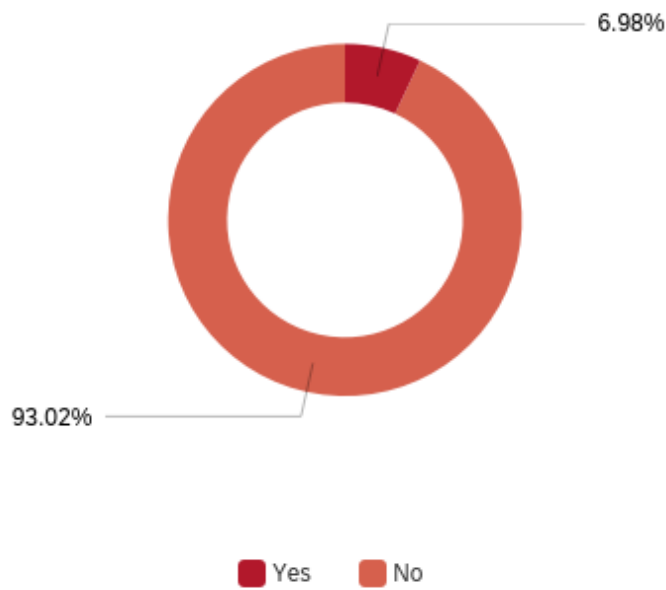
Is there anything specifically you'd like to share pertaining to any questions in the survey?
(Short Answer)

Appendix B: Data from Student Survey

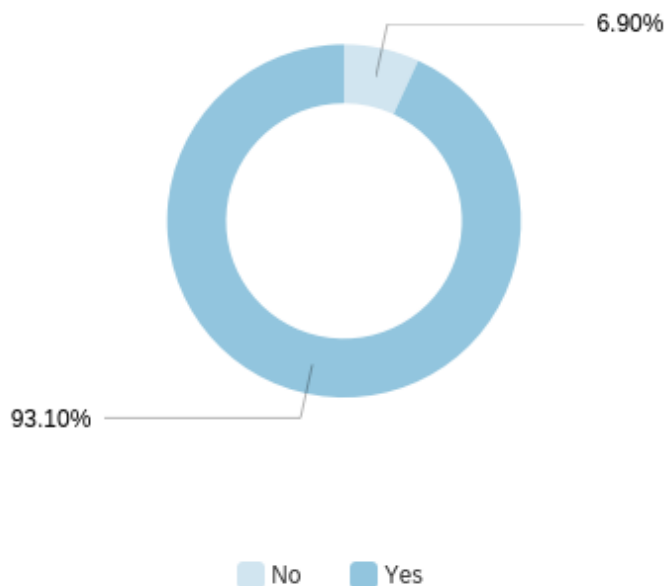
Q6 - Are you from the state of Massachusetts?



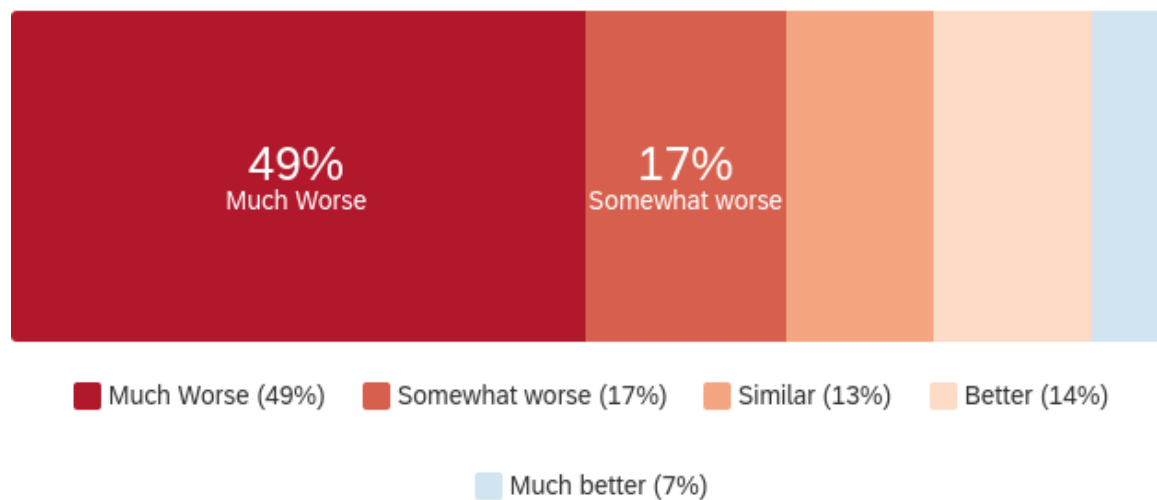
Q7 - Are you from Worcester, MA?



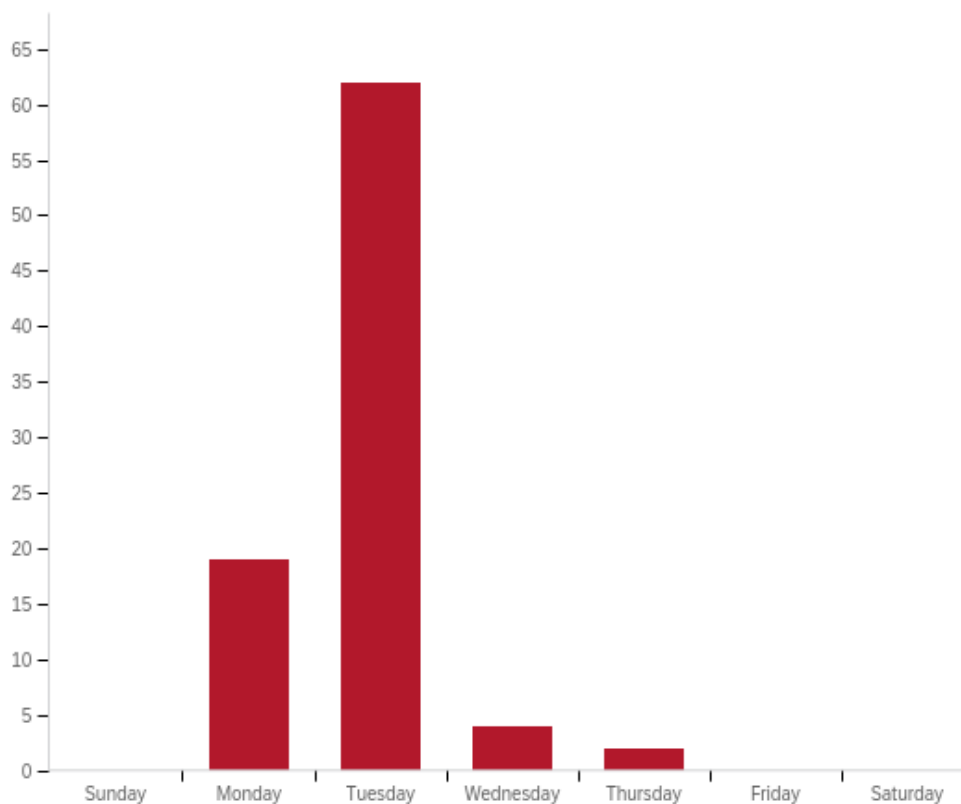
Q8 - Have you noticed trash on streets near your apartment?



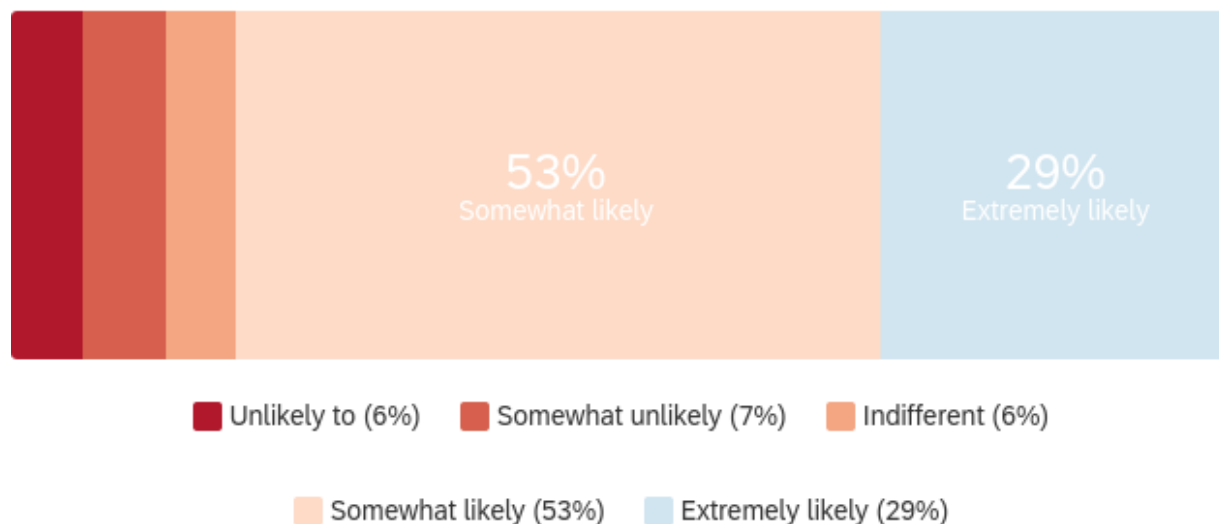
Q9 - How would you compare the cleanliness of the streets around WPI to your per...



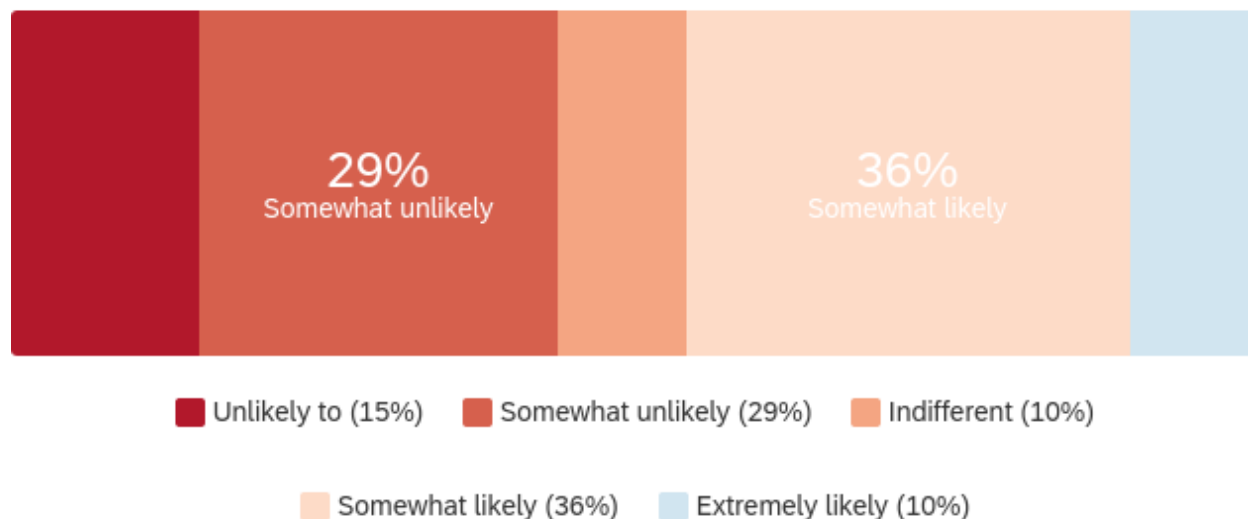
Q10 - What day of the week is garbage picked up on your street?



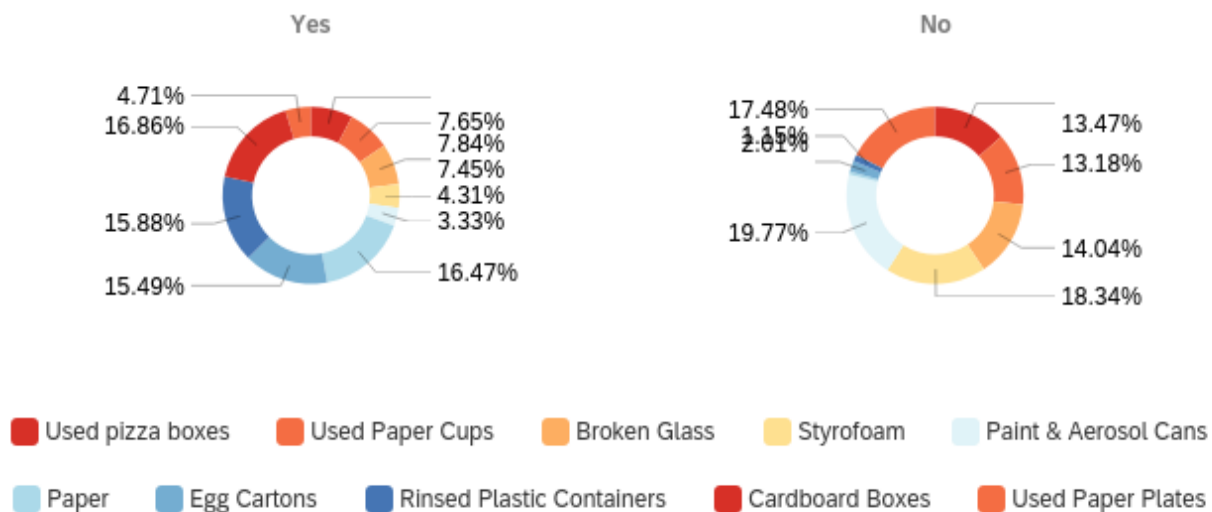
Q11 - In your opinion, how likely is your some of your recycling to end up as str...

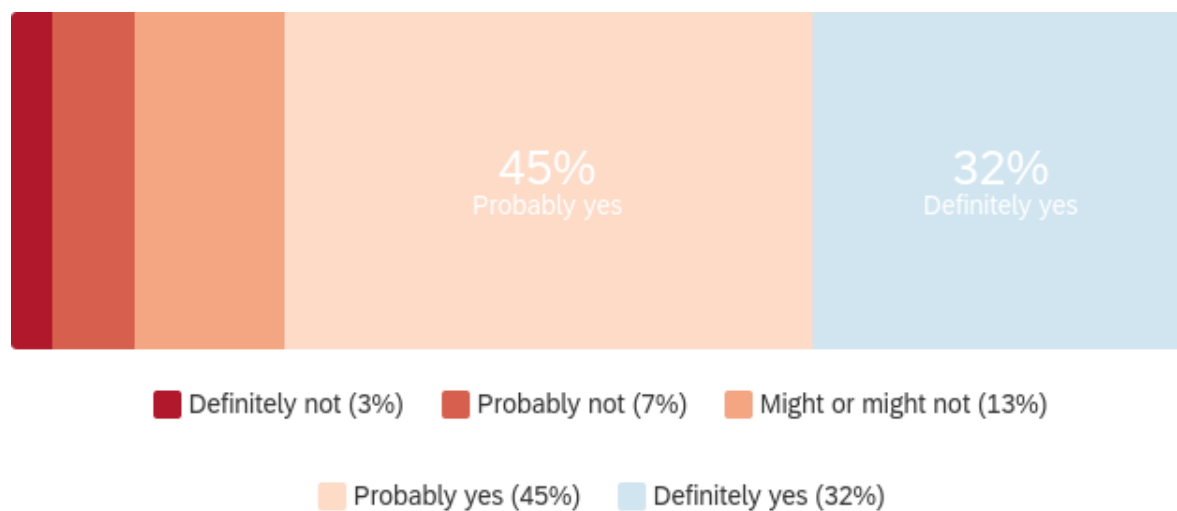


Q12 - How likely are you to clean up your recycling if you see it in the street?

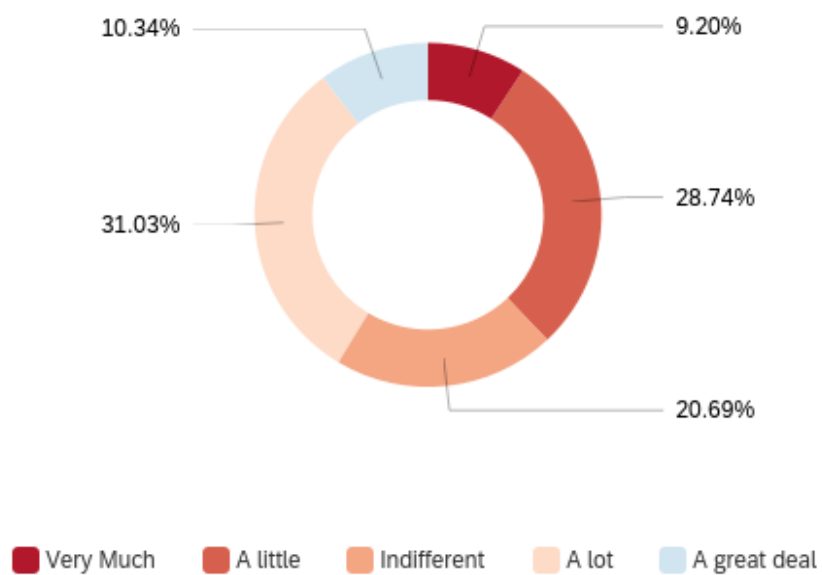


Q13 - Indicate which of the following items are recyclable in Worcester:

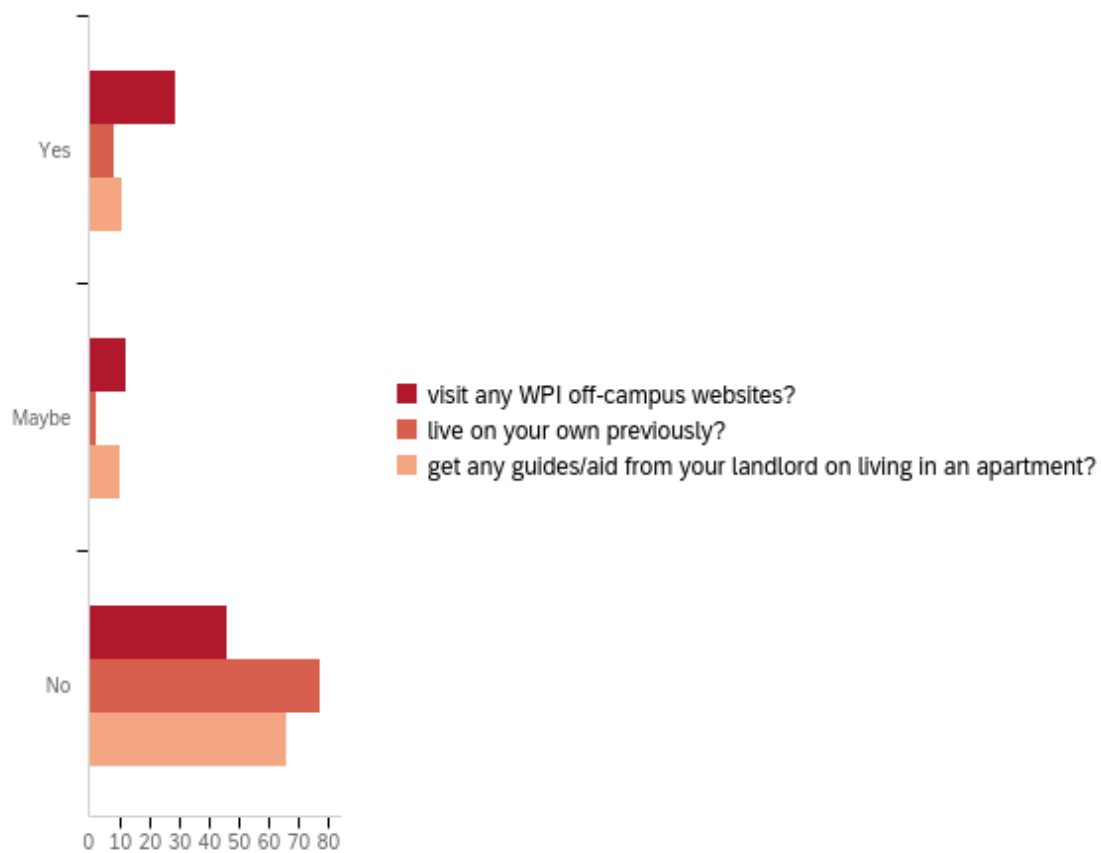




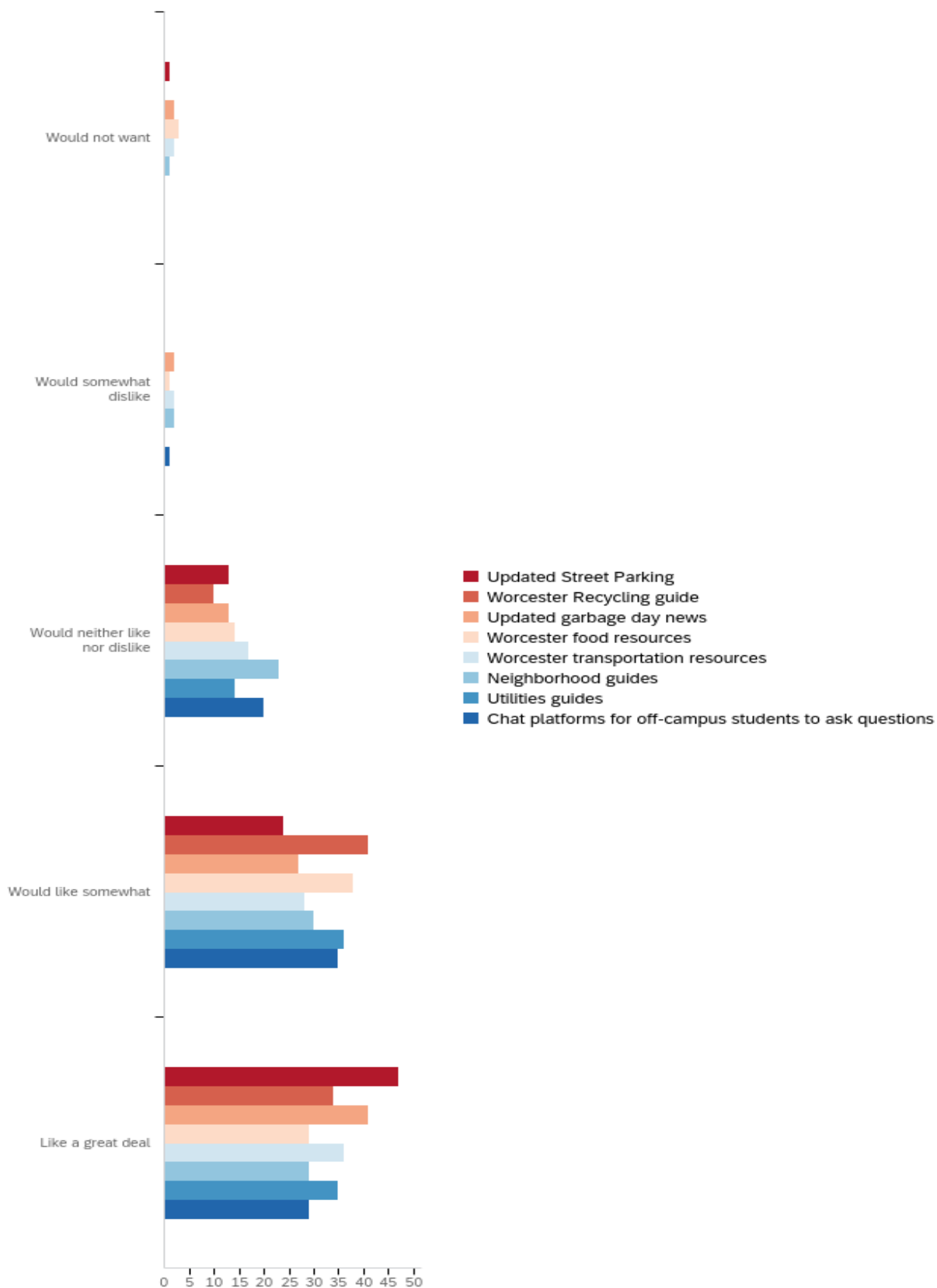
Q15 - How much does street litter on the street you live on bother you?



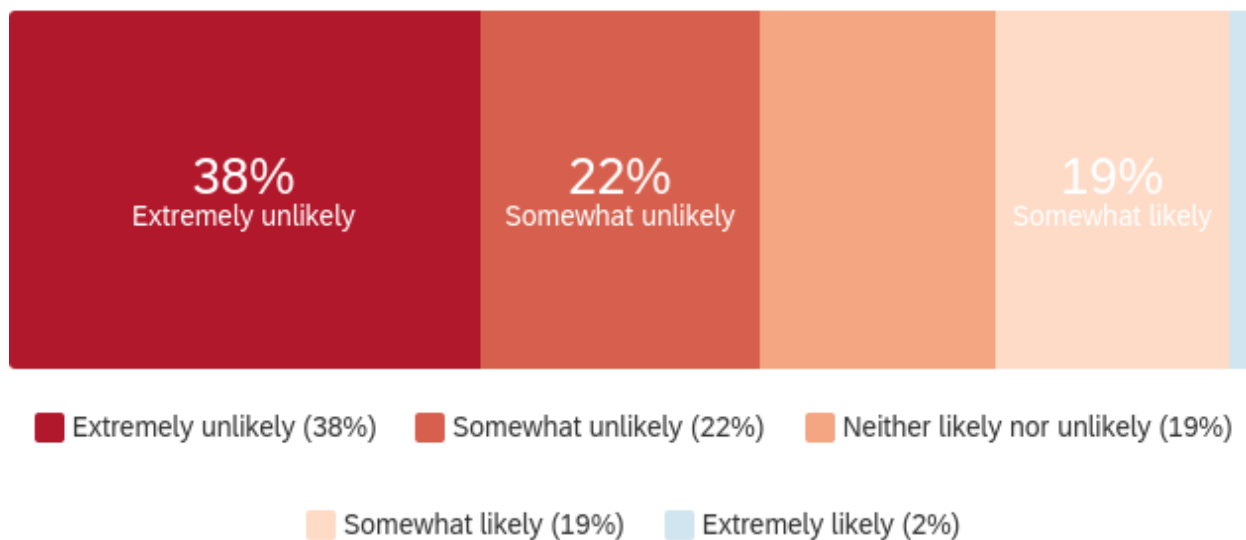
Q16 - Before moving off campus did you....?



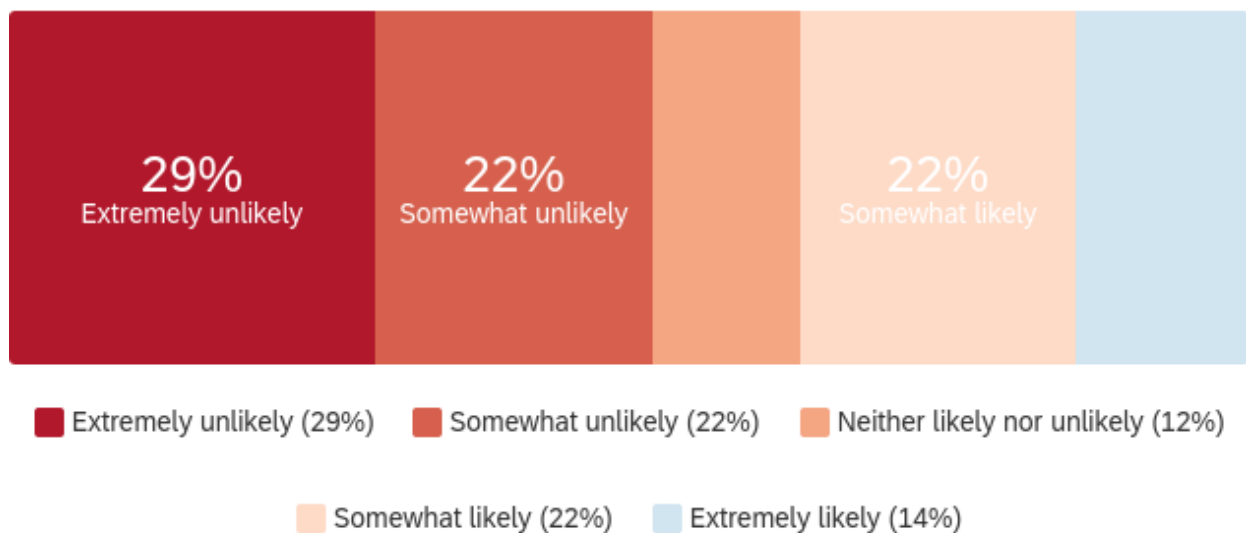
Q17 - If there were an off-campus community platform to share information about L...



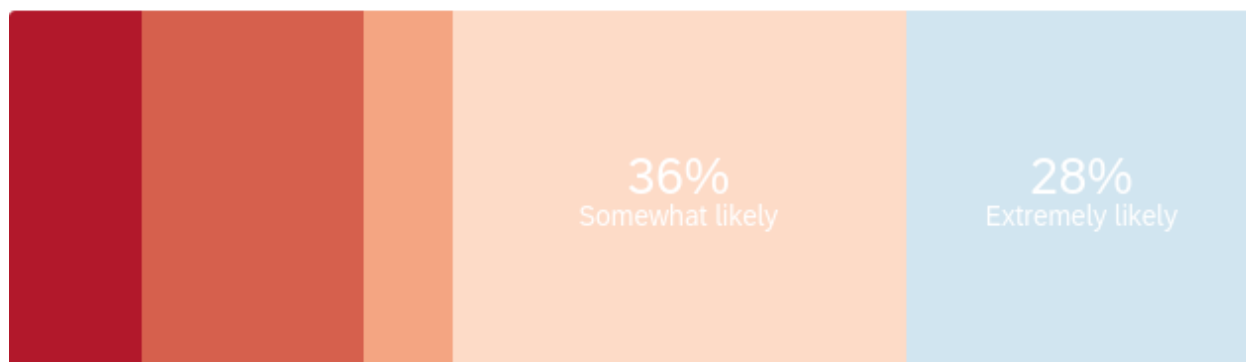
Q18 - How likely are you to use a discord server for off-campus WPI students?



Q19 - How likely are you to follow a Twitter account for off-campus WPI students?



Q20 - How likely are you to follow an Instagram account for off-campus WPI studen...



Extremely unlikely (11%) Somewhat unlikely (18%) Neither likely nor unlikely (7%)

Somewhat likely (36%) Extremely likely (28%)

Appendix C: Landlord Interview Consent and Questions

Interview Questions:

Verbal Consent: Hello, we are interviewing you today to understand how WPI students who live off-campus are in the surrounding community. Participating in the interview is completely voluntary and you may stop at any time. All responses will be kept anonymous in our final report. If you have any questions please ask.

Verbal Recording consent: Do you mind if we record this interview? It will only be used to help type notes on the interview and it will not be published or shared.

Thank you for doing this interview, this should take around 30-40 minutes. *Introduce ourselves briefly.* Our group is focusing our end of year project on the trash and recycling clutter around the streets off campus. We all live on off campus apartments, and Morgan and John both live on Dix street and have noticed a trash build up that has accumulated over this year. We have specifically focused on what the WPI off campus students have contributed to this epidemic. We were hoping that you would be able to give us a better understanding of what needs to change.

Some interview question ideas:

Tell us about yourself; how long have you been a landlord/why did you decide to be one? Are you from Worcester, MA?

Are you from Worcester MA?

How many apartment units do you have?

How many apartment units do you have in Worcester?

In what area generally are your apartment units?

Who is the primary group you rent to?

What information do you give to your tenants before they move in?

Do you rent to many college students? What colleges?

Do you think WPI students tend to be good tenants?

What have you noticed about WPI students as tenants?

How often do you visit your properties?

Appendix D: Write up/Summarization from Landlord Interview**Landlord interview:****1: How long have you been a landlord, Why did you become one?**

A: 30 years, did it for investment purposes

2: Are you from Worcester MA

A: Yes

3: How many Apartment Units do you own

A: 6

4:How many Apartment Units do you own in Worcester?

A: 6

5: What general area are your units

A: WPI Area

6: Primary Group rented to

A: WPI Grad and undergrad students

7: What information do you give tenants before moving in?

A: Only information is located in the lease and pertains to living conditions inside the apartment.

8: Do you rent to many college students? If so, what colleges?

A: yes, WPI

9: How are WPI students as Tenants?

A: pretty good, Some are messy, some are clean,

(Question then reworded, Have you noticed anything specifically pertaining to trash and recycling)

A: Most people understand the trash, some didn't though and slowly learned through the landlord explaining stuff to them. They talked to them about the times at which they should be putting their garbage out.

10: Is there anything else you notice about wpi students as tenants?

A: nope, Doesn't like when students leave behind stuff when moving out.

11: How often do you visit your properties

A: 2 times a month unless repairs need to be made.

Summarization:

Landlord # is from Worcester and has been a landlord for around 30 years. They became a landlord for investment purposes. Landlord # owns six apartment units, all located in the WPI area. The tenants that they rent to are WPI Grad students but they also rent to undergrad students. The information they provide tenants is located in the lease and only pertains to living conditions inside the apartment. Landlord # said that WPI students are pretty good tenants, some are clean and some are messy. When specifically asked about trash they said that most tenants understand how the system works, but in the past there have been some that did not understand. To handle the situation, the Landlord had a discussion with the tenants, telling them about proper times to put out their garbage. They go to their properties at least twice a month, and will go more than that if repairs need to be made. They do not like when students leave stuff behind when moving out.

Appendix E: Write up of Topics to Cover in Residential Services Meeting

Quick Introduction of our project and the situation:

Our group is currently working on our IQP on off campus trash and recycling issues. We are not sure if you are local to Worcester but in this past academic year we have noticed a significant issue with the trash and recycling litter in the streets. Our main goal of the project is to gain an understanding of what is understood by the WPI student community of this issue, and what steps can we take in order to increase the understanding about how trash and recycling is collected in Worcester. One of our objectives in this was to conduct a survey in the campus center testing off campus residents about their understanding of the collection process. When we passed around the survey in CC a lot of people did not use the residential services website as a resource, and many didn't even know it was available. We were just hoping to increase participation on the website. Students moving off campus have a greater understanding of recycling methods and procedures in worcester.

Some things/features we would like to see on the website (we understand some may already be on it, but we want it to be more centralized)

- Utilities Guide
- Link to Worcester News site
- Garbage Map/Schedule
 - Phone number you can sign up for with city of Worcester for garbage updates
- Worcester Recycling Guide
 - Tips for keeping it from blowing away

- Be aware of wind
 - Put heavy items on top
 - If available use a lid
 - You are responsible for your recycling until it is in the truck! If you see it is blown away, clean it!
-
- Worcester Food Resources
 - Links to platform our IQP creates
 - Worcester Transportation resources
 - Neighborhood guides
 - How to be a good neighbor

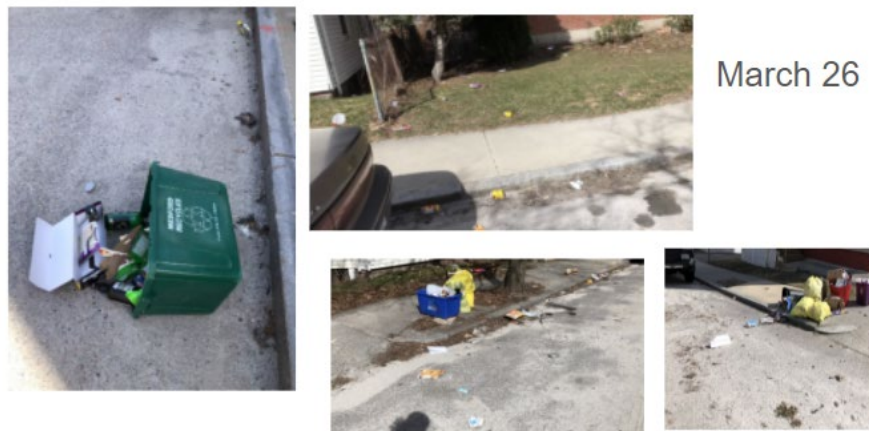
Appendix F: Steet Images from Visual Survey

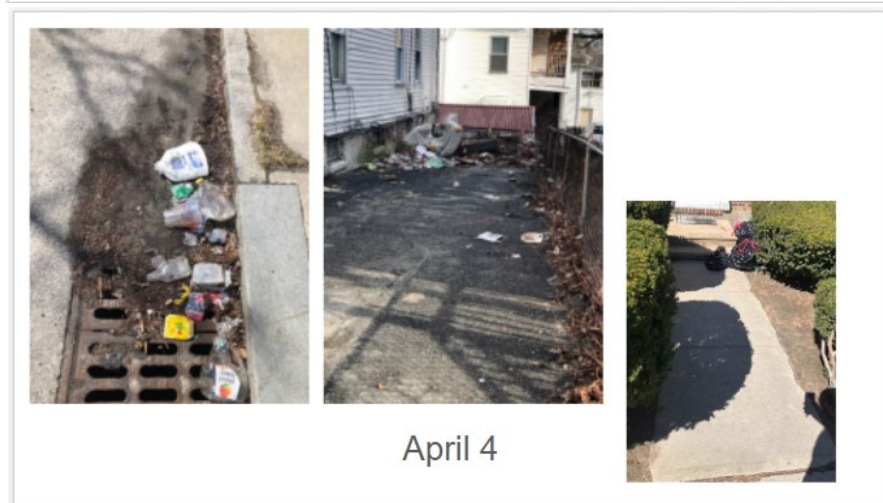
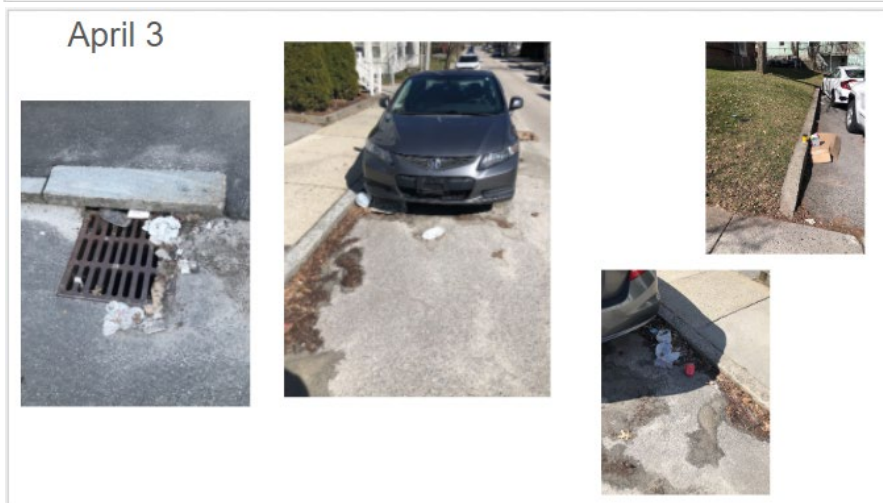
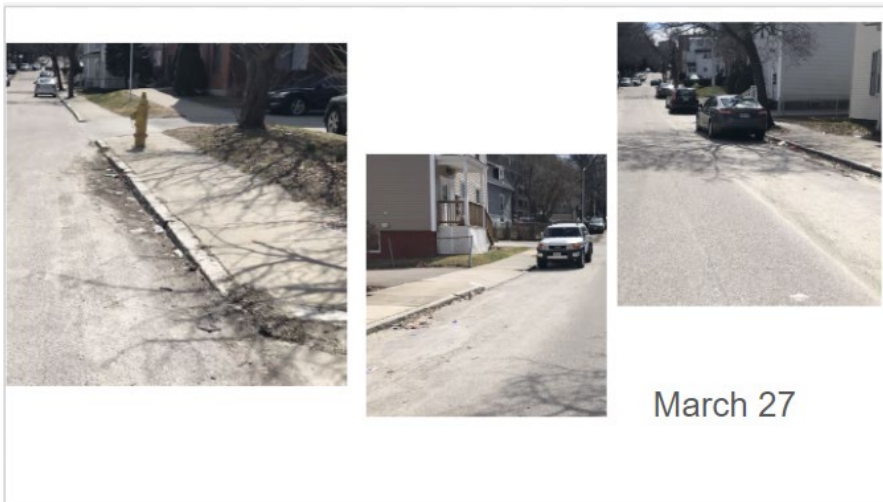
Wachusett

March 25



March 26







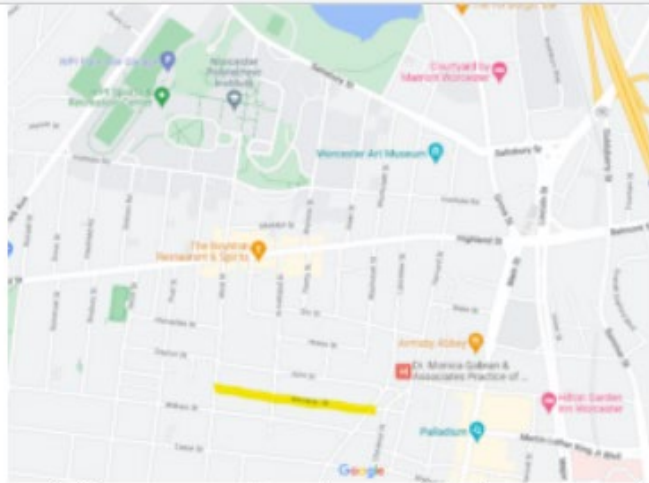
Catch Basins



Personal Residencies



Bowdoin Street



Bowdoin Street

1		2
3	<p>On each page:</p> <ul style="list-style-type: none">- Each picture goes in order from 1 to 4- 1 is the beginning of the route, 4 being the end of the route	4







4/1/22



4/4/22



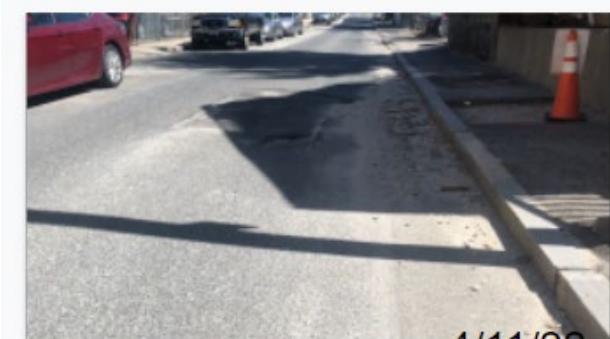


4/5/22



4/6/22







4/12/22



4/13/22





4/15/22



Dix Street:



3/29/22 1/4



3/29/22 2/4



3/29/22 3/4



3/29/22 4/4



3/30/22 1/4



3/30/22 2/4



3/30/22 3/4



3/30/22 4/4

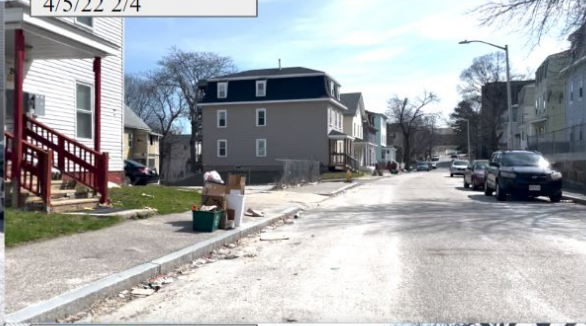




4/5/22 1/4



4/5/22 2/4



4/5/22 3/4



4/5/22 4/4



4/6/22 1/4



4/6/22 2/4



4/6/22 3/4



4/6/22 4/4





4/15/22 1/4



4/15/22 2/4



4/15/22 3/4



4/15/22 4/4



4/16/22 1/4



4/16/22 2/4



4/16/22 3/4



4/16/22 4/4



4/18/22 1/4



4/18/22 2/4



4/18/22 3/4



4/18/22 4/4



3/30/22



4/6/22



4/6/22



4/6/22

