

# Team 1 | CS506 | Final Deliverable

Team 1: Anton Barash, Henry Liu, Himanshu Patil, Animikh Aich

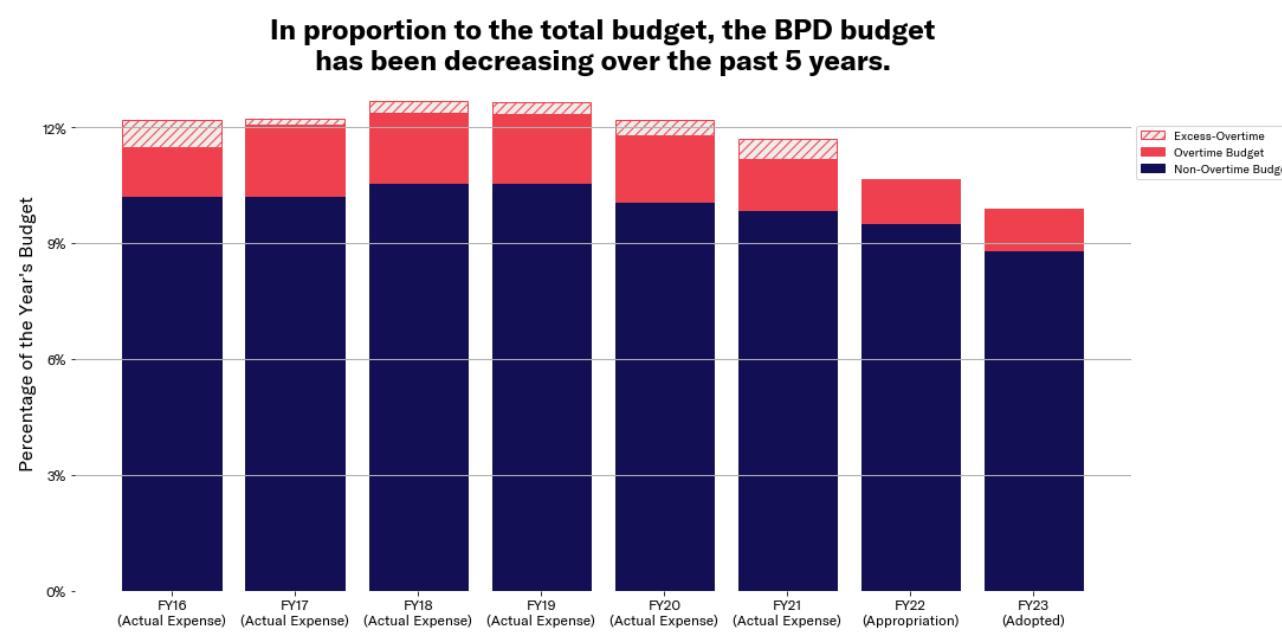
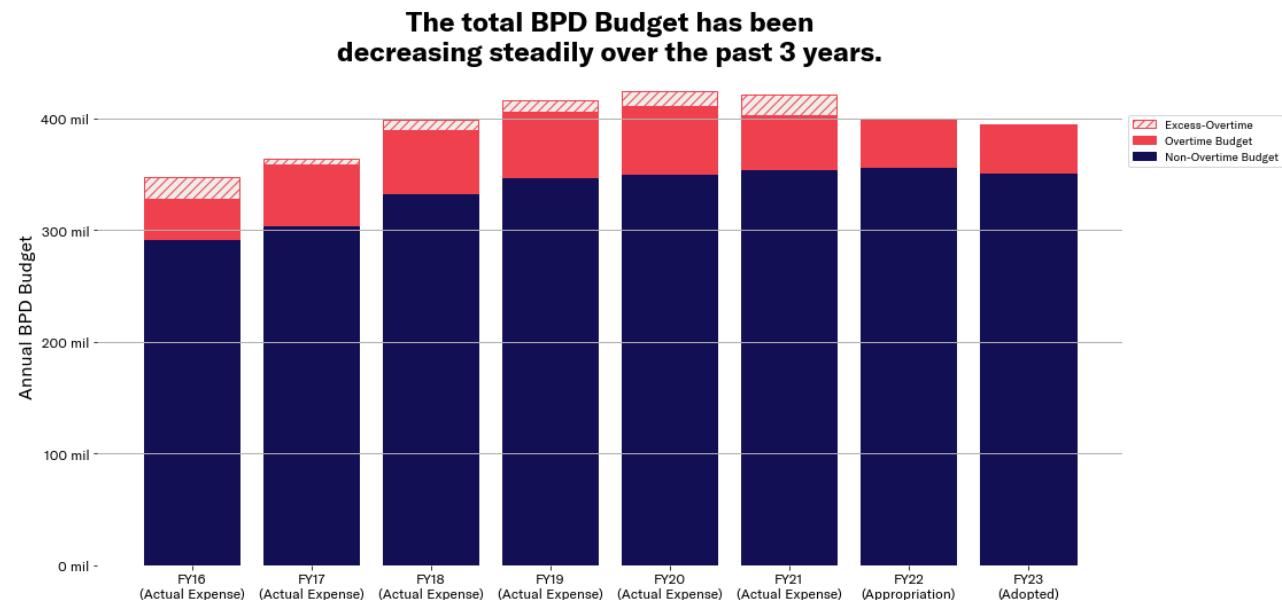
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Team Lead: Himanshu Patil

December 16, 2022

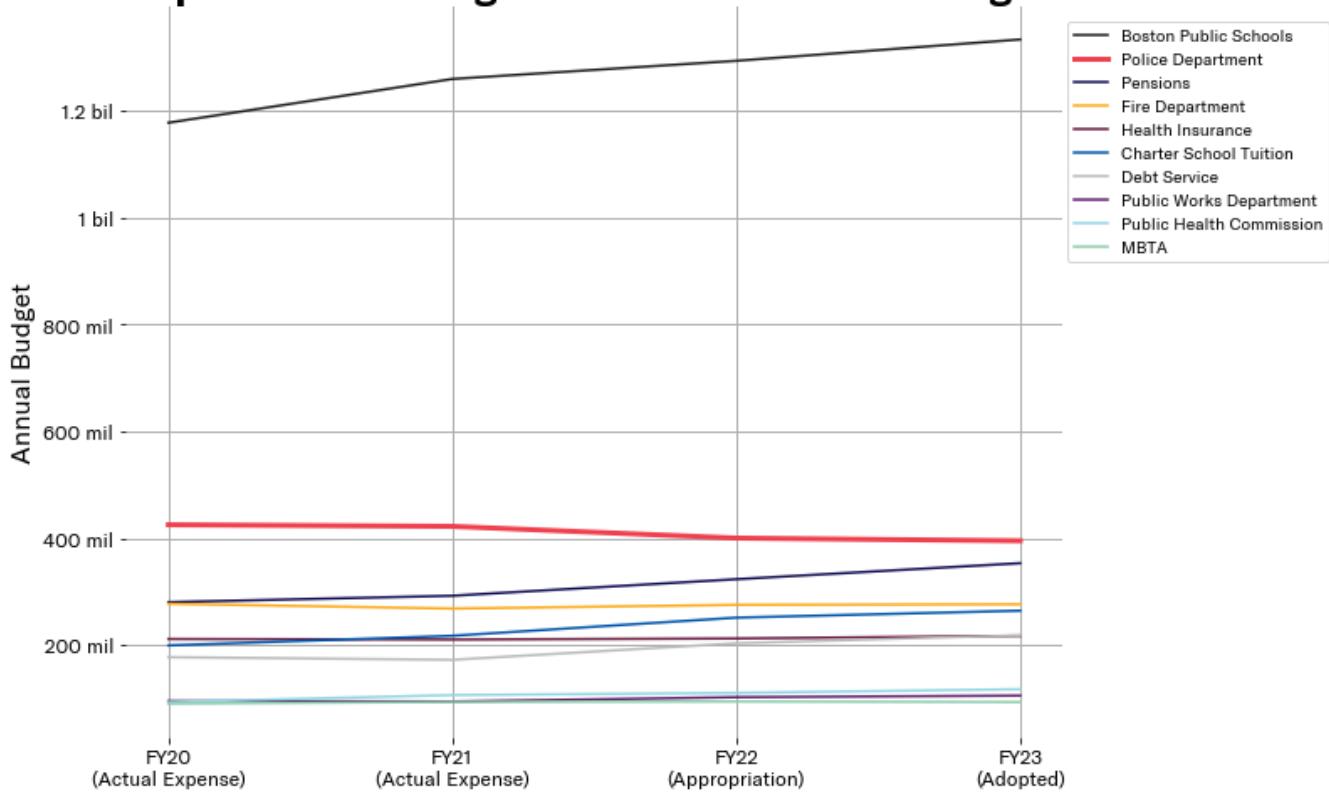
## Base Project

### 1. Total BPD Budget vs. previous year

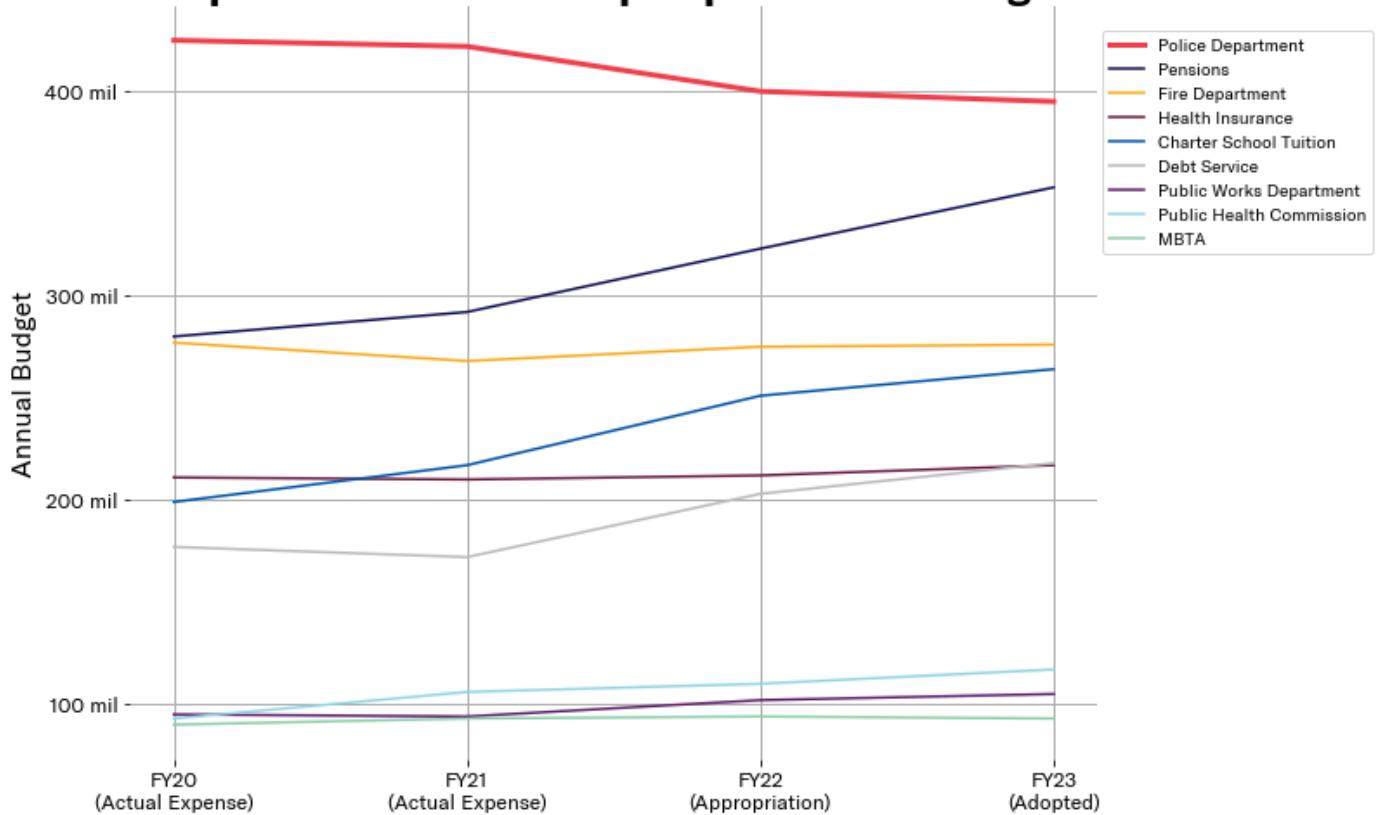


## 2. BPD Budget vs. other departments budgets + change over time

**The BPD ranks second within the top 10 departments that get allocated the most budget.**

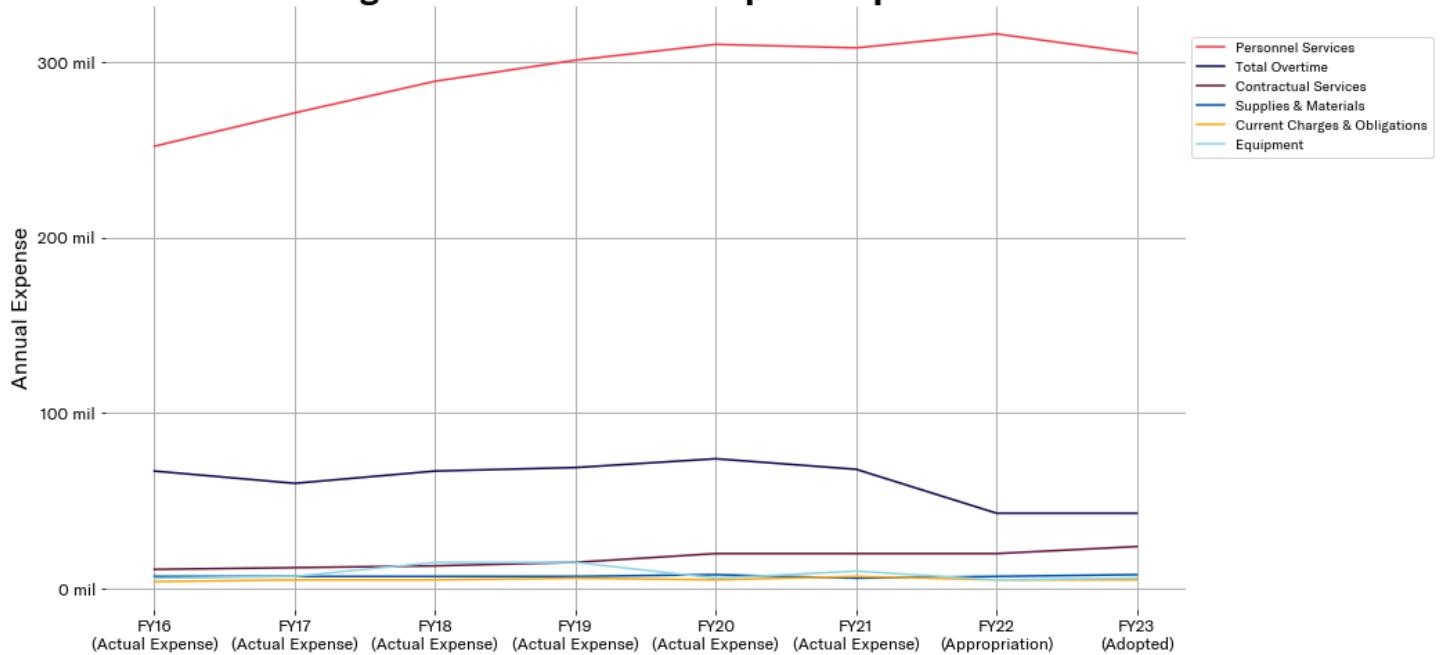


**The BPD gets allocated almost double the amount compared to the other top departments' budgets.**

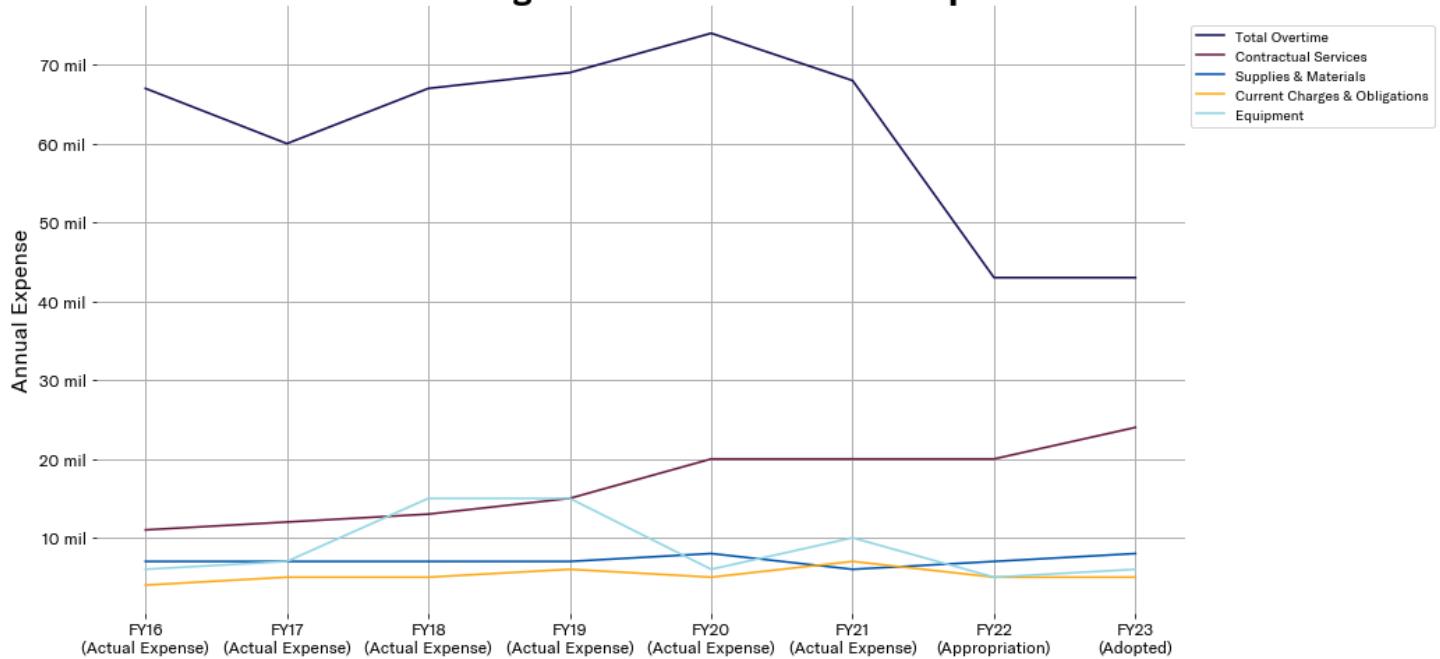


### 3. BPD Budget spend categories + change over time

**Most of the budget allocated to BPD is spent on personnel services.**

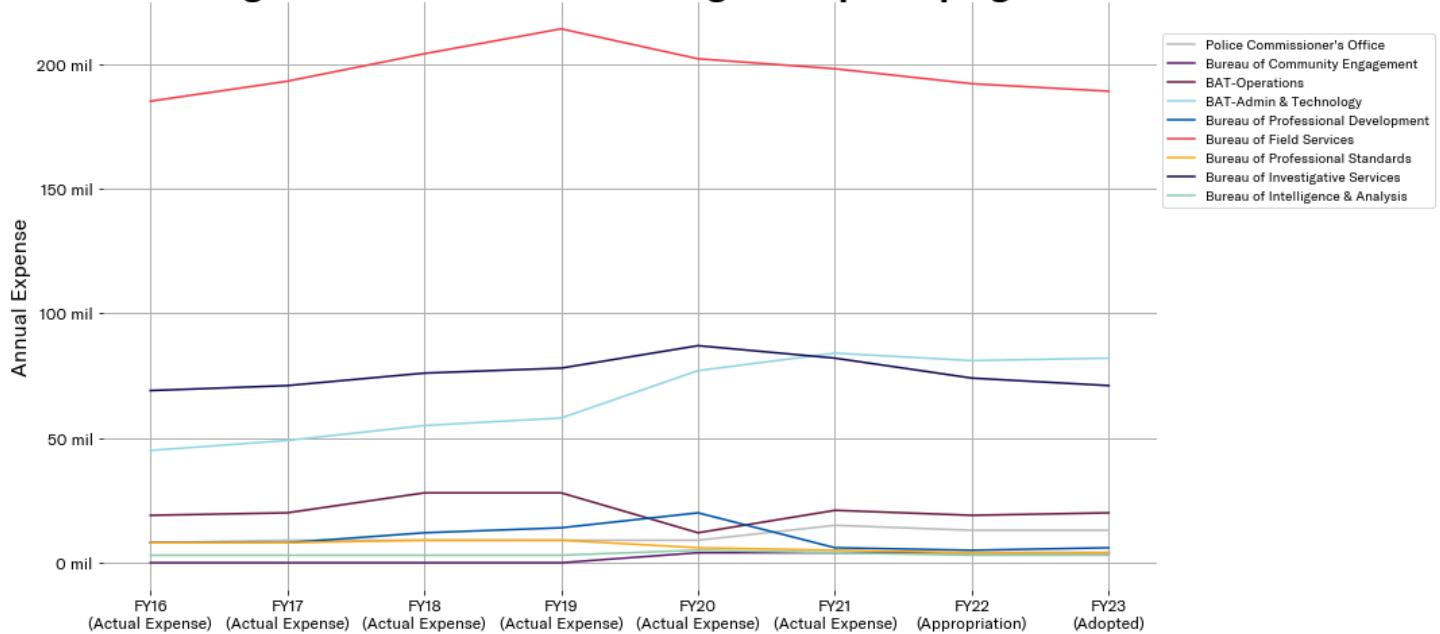


**Overtime is the next highest expenditure for the BPD. The rest of the categories are minuscule in comparison.**



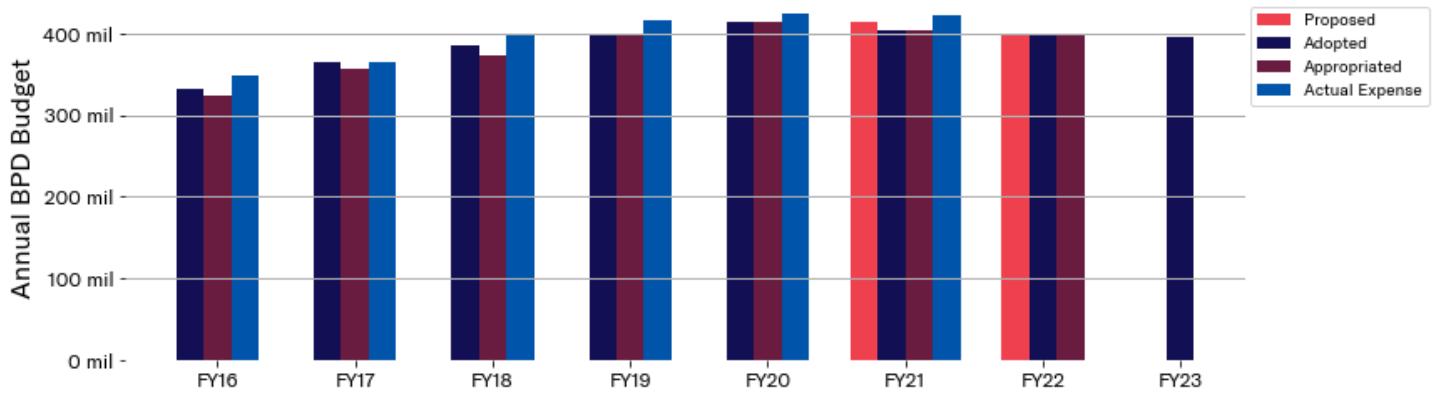
### 3.5 BPD Budget spendings per program + change over time

**The Bureau of Field Services spends a majority of the BPD budget, using twice as much as the next highest expense program.**



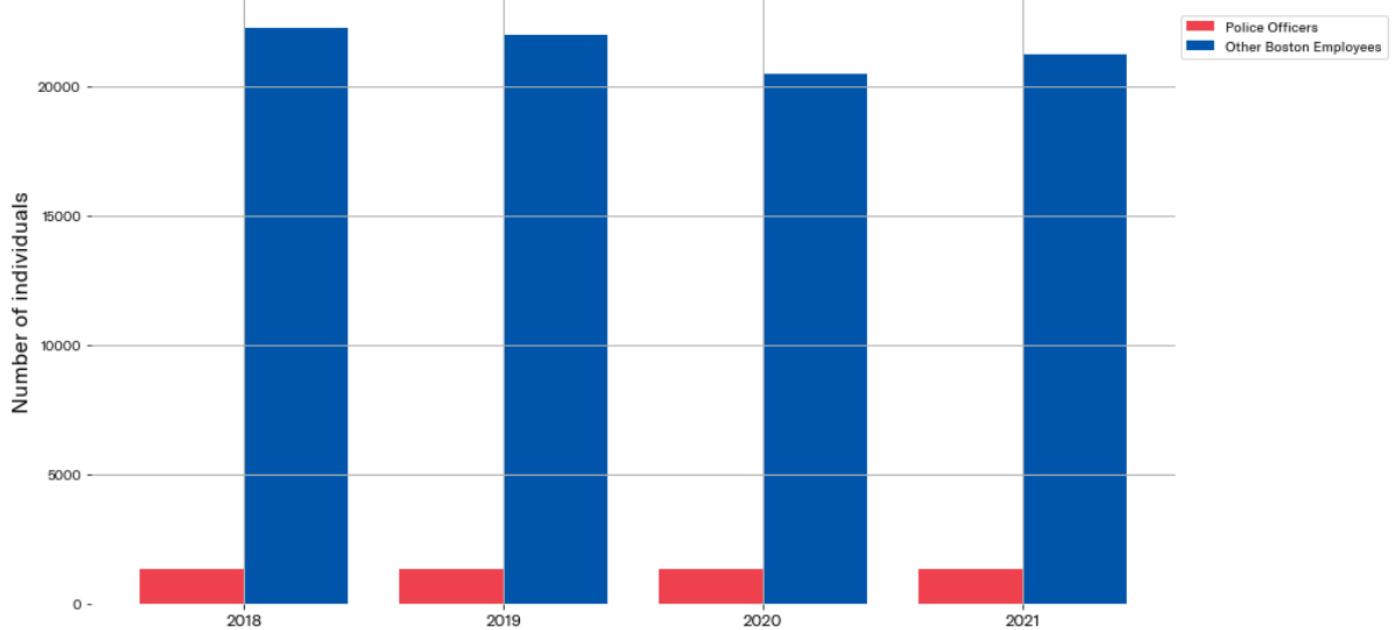
### 4. BPD adopted vs proposed budget

**The adopted FY23 budget is similar to the proposed and appropriated expense of the past few years.**

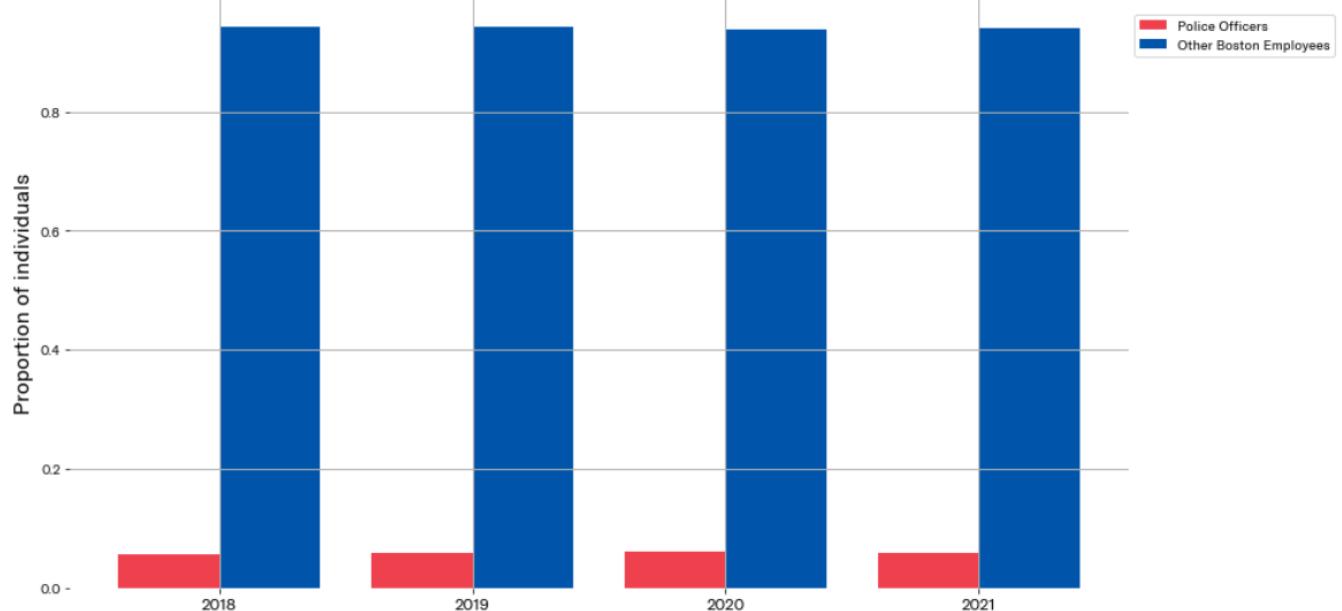


## 5. Number of police officers (compared to other Boston employees)

**The number of police officers compared to the other Boston employees has stayed pretty stagnant throughout the years 2018-2021.**

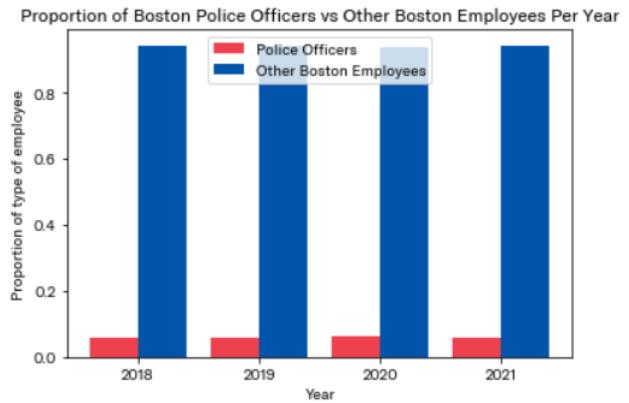
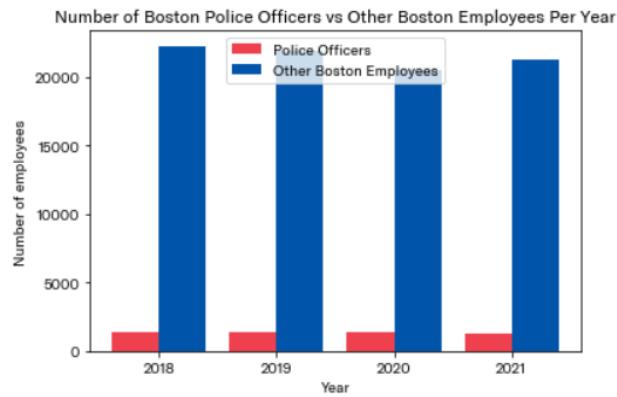


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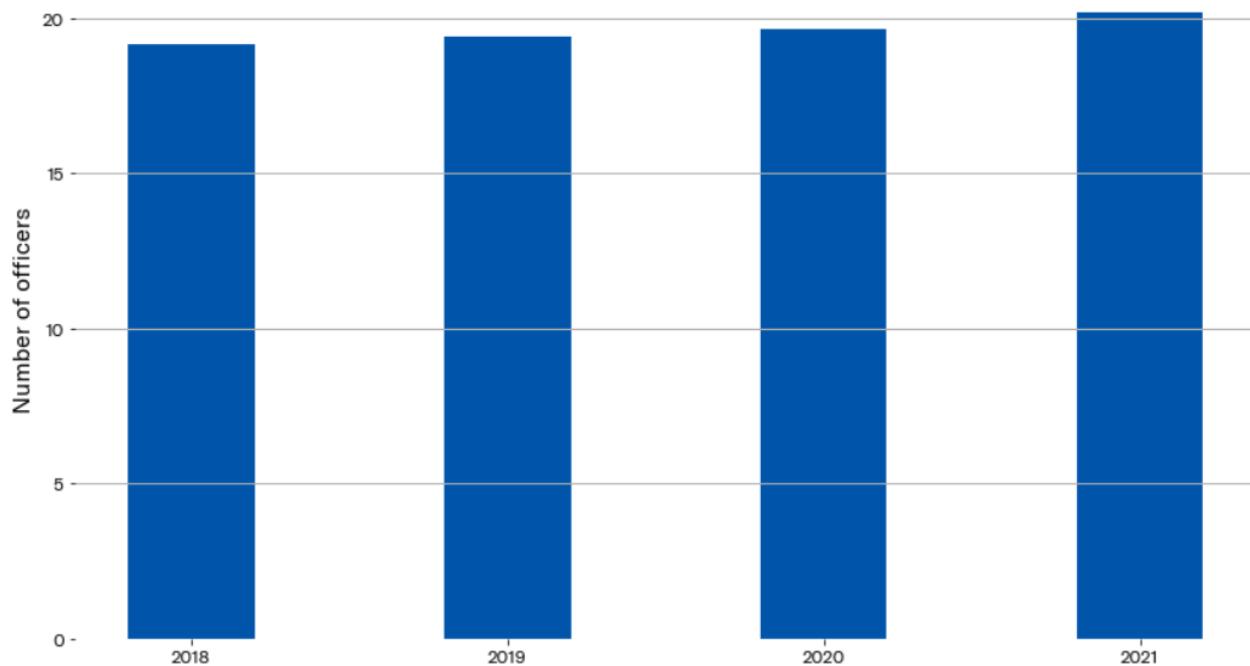
**DELETE THIS:**

The number of police officers compared to the other Boston employees has stayed pretty stagnant throughout the years 2018-2021.



## 6. Number of police officers per 10,000 residents

**The number of police officers per 10000 Boston Residents has steadily increased from 2018-2021.**

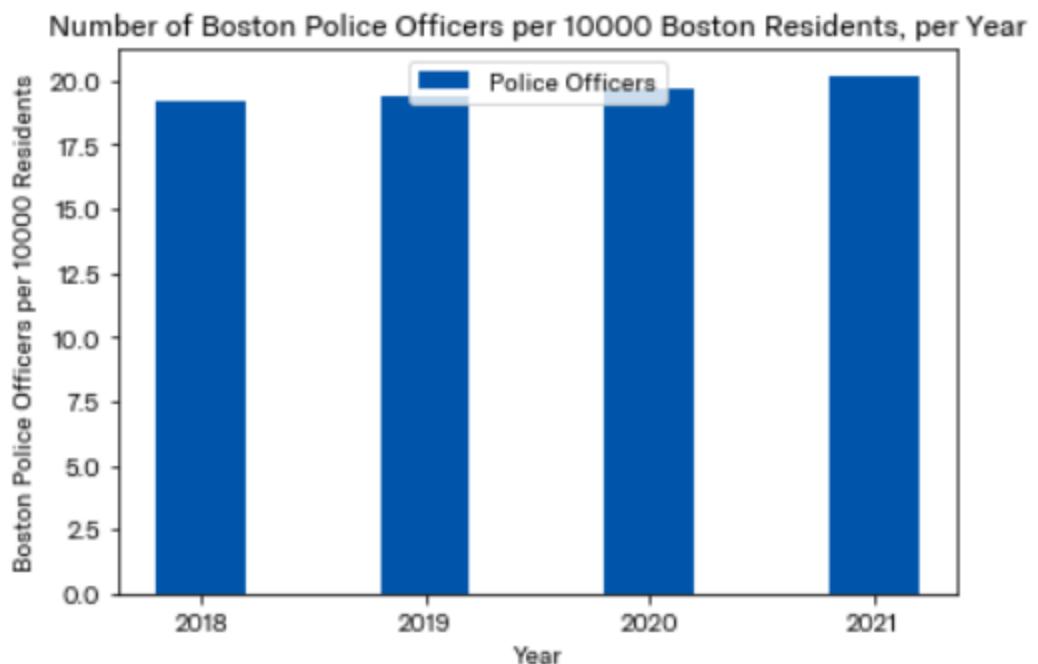


Source for census data:

<https://data.census.gov>

Specifically using the American Community Survey numbers for each year in the government census database

The number of police officers per 10000 Boston Residents steadily increased from 2018-2020 until 2020, and then went down for 2021.

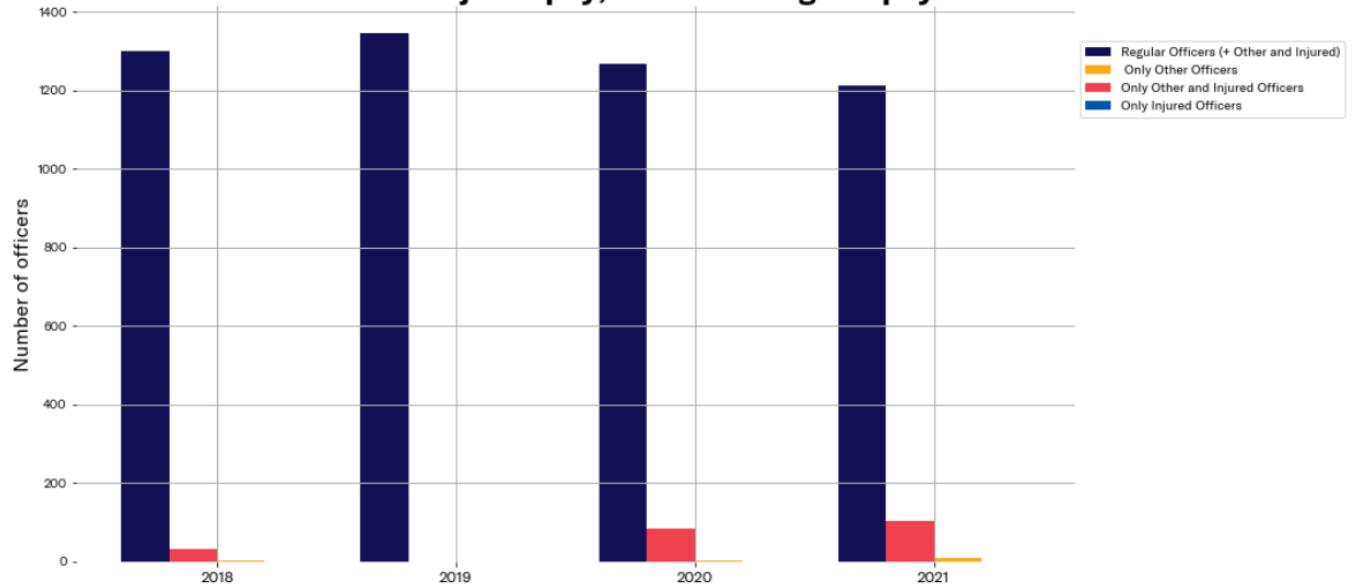


**7. Number of police officers active, medical leave, etc.**

The number of other and injured officers went up in 2020 and then further up in 2021. Also, there are no officers who are only collecting injured pay, as all officers at least collect Other + Injured pay, or collect Regular pay.

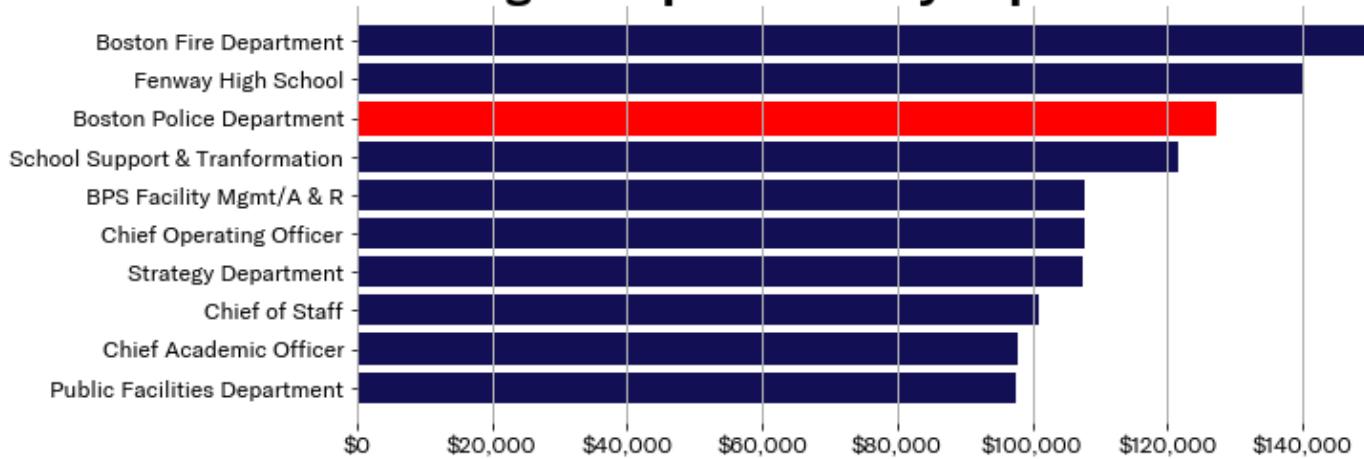
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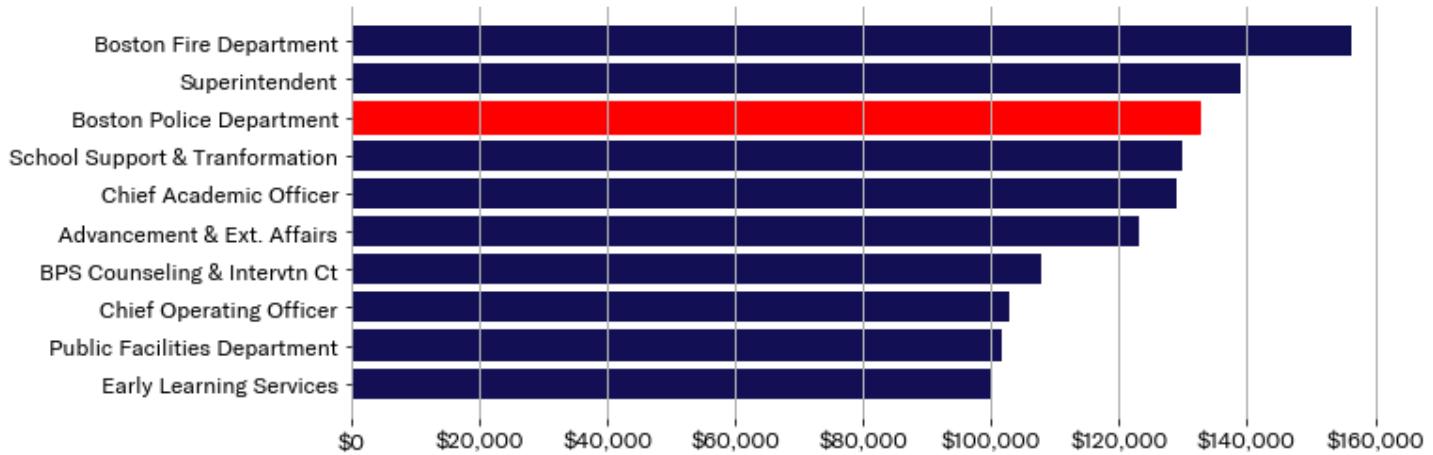


**8. Employee compensation comparison to non-BPD employees**

**The BPD is ranked third for average compensation by department in 2019.**



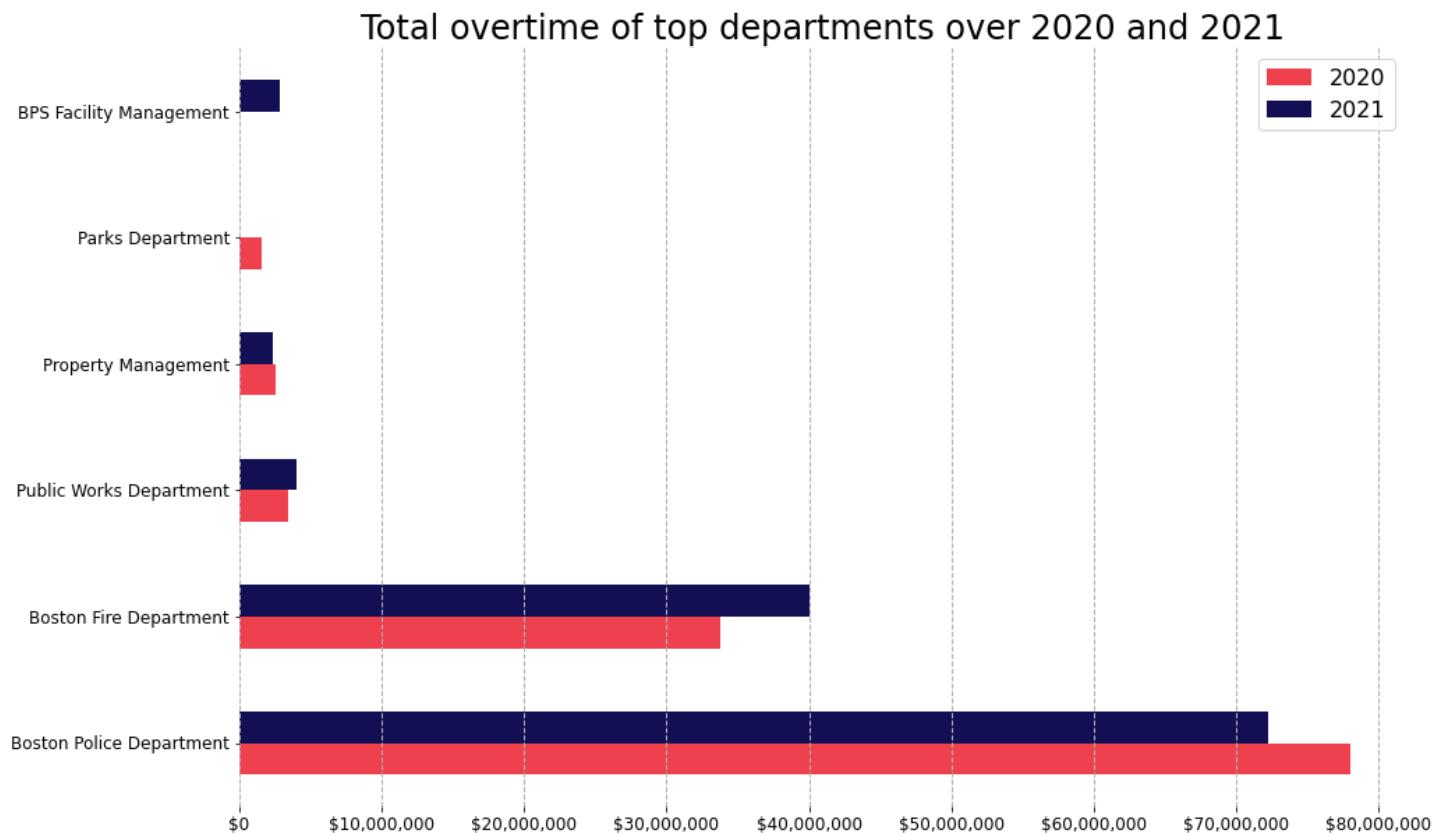
**The BPD remains third rank in 2020 as well.**



## 9. Total overtime of top departments + over time

From the graph it can be observed that Boston Police Department has the highest total overtime spends among all departments, and is nearly double that of Boston Fire Department, which comes second.

However, we also observe that the total overtime compensation for Boston PD has reduced between 2020 and 2021.

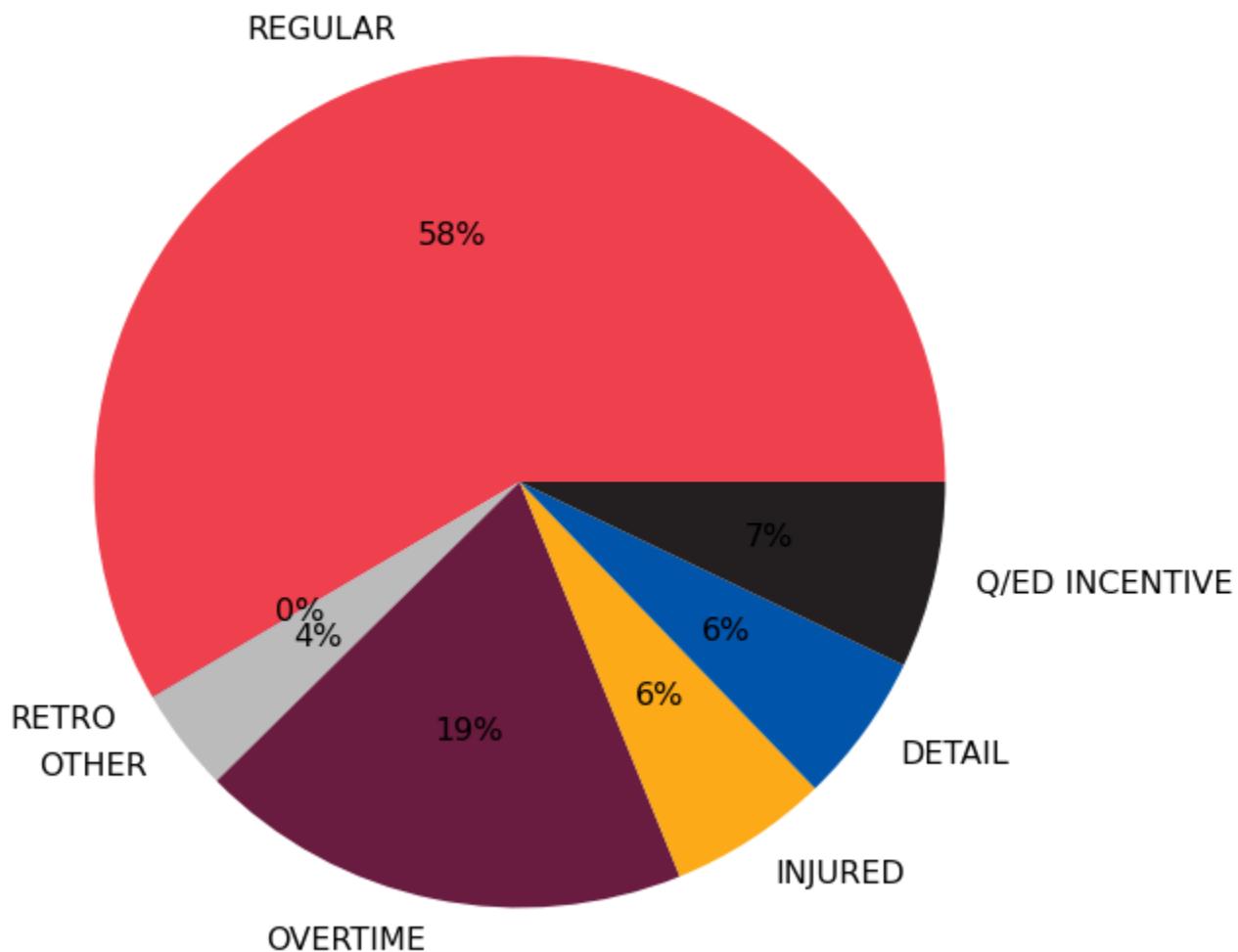




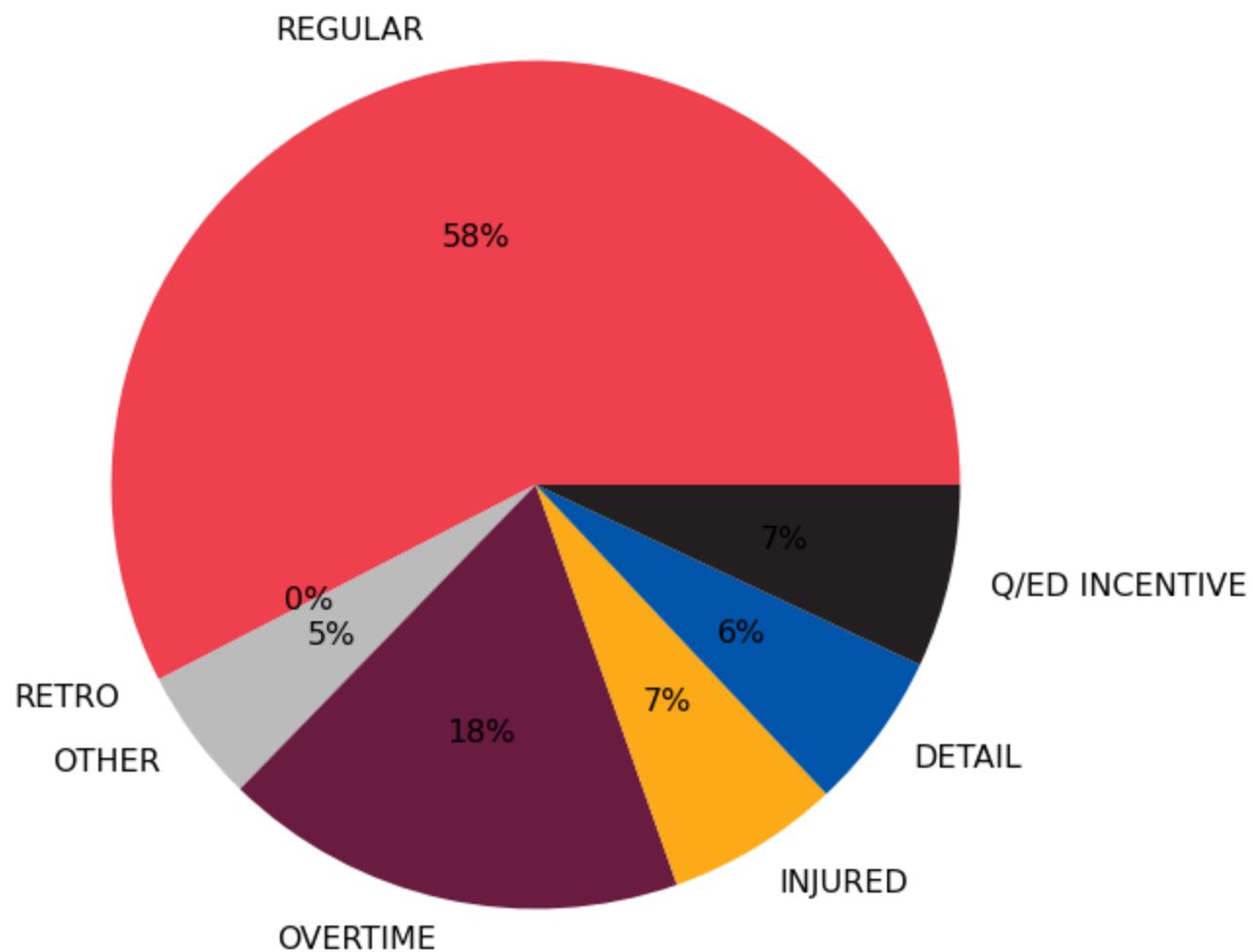
## 10. Payroll distribution over time (base, overtime, retro, detail, etc.)

From the charts we can conclude that the payroll distribution has remained consistent over the year with a slight decrease in overtime percentage in 2021 as compared to 2020.

Payroll Distribution for 2020



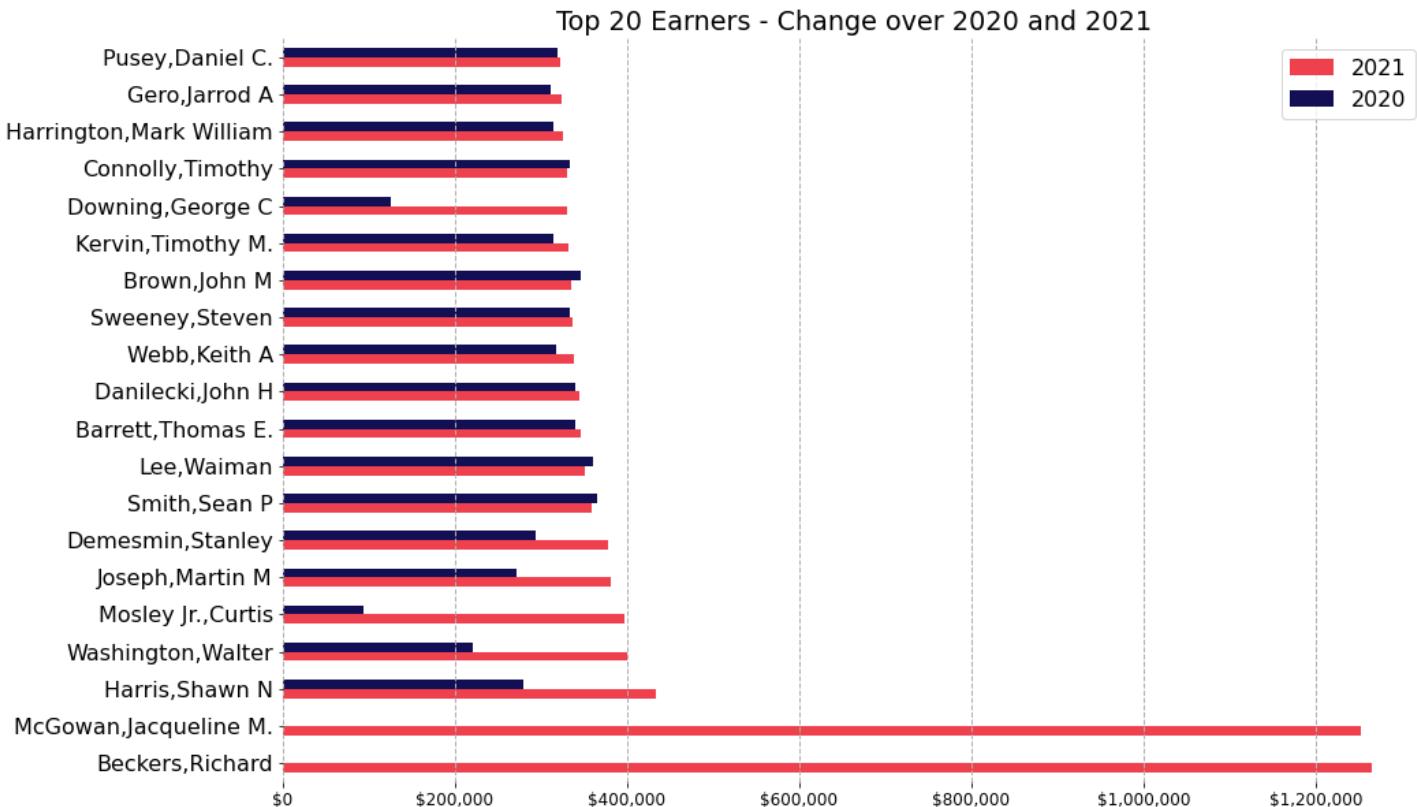
## Payroll Distribution for 2021



## 11. Top 20 Earners (change from previous year)

From the graphs The top two earners are earning significantly higher than the others.

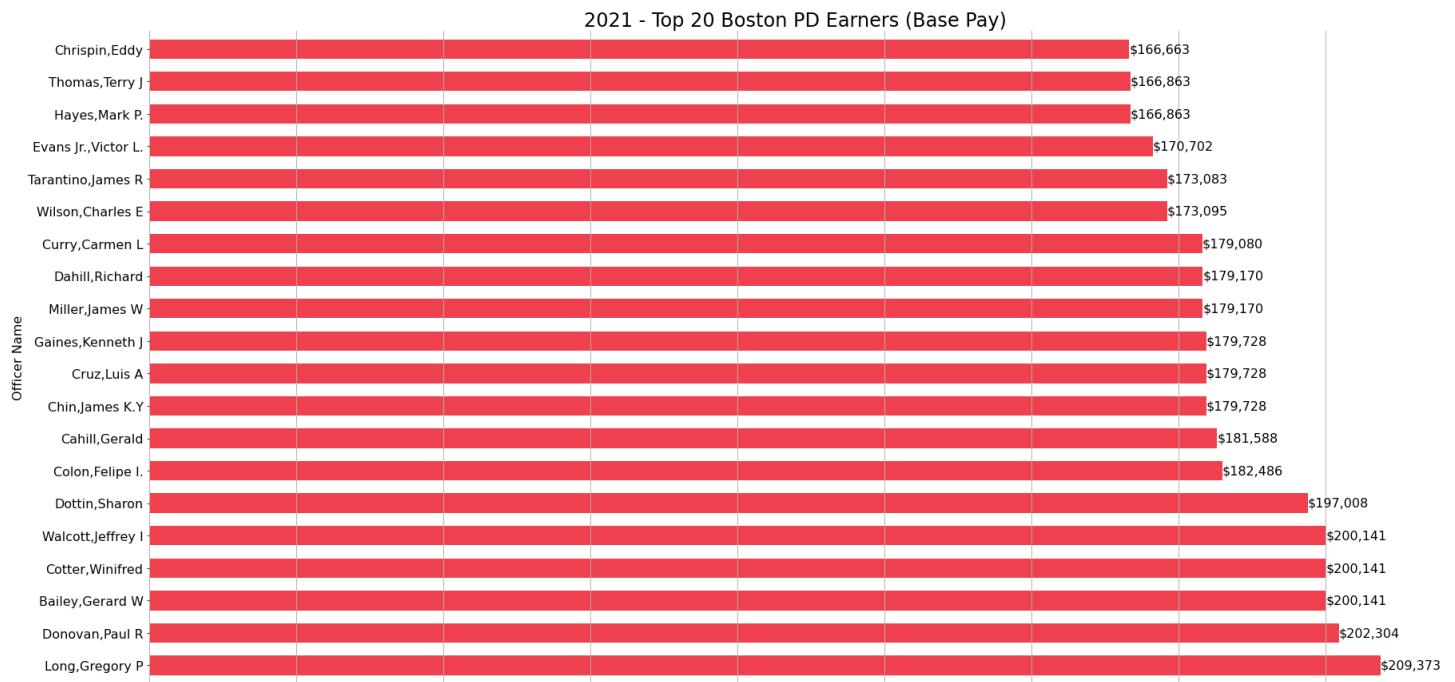
Additionally, we also observe that the third to fifth top earners has had significant pay raise (gross salary) as compared to the previous year.



## 12. Top 20 Earners (OT, Base, Other)

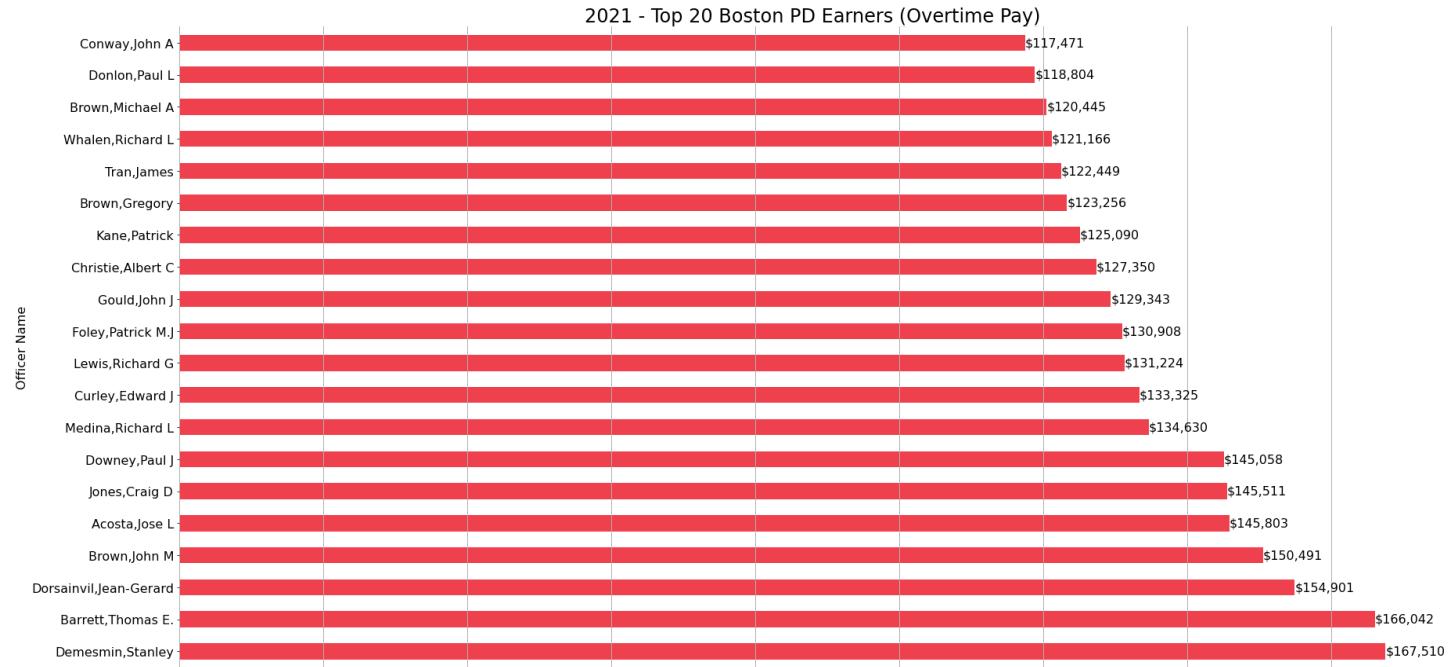
The top 20 earners have related/similar pay scales and there does not seem to be any apparent pay disparity among them.

The base pay seems to be similar for officers with the same rank/experience



Based on the graph we can see a clear difference between the top earner and the top 20th earner in terms of Overtime Pay. This may be due to higher overtime hours or higher overtime rate, or both.

Further analysis can be done by comparing the overtime pay with overtime hours.



There is a clear pay disparity between the officers in the “other” category, where the top two officers get paid over a million USD, where the third highest officer gets paid around 200K USD.

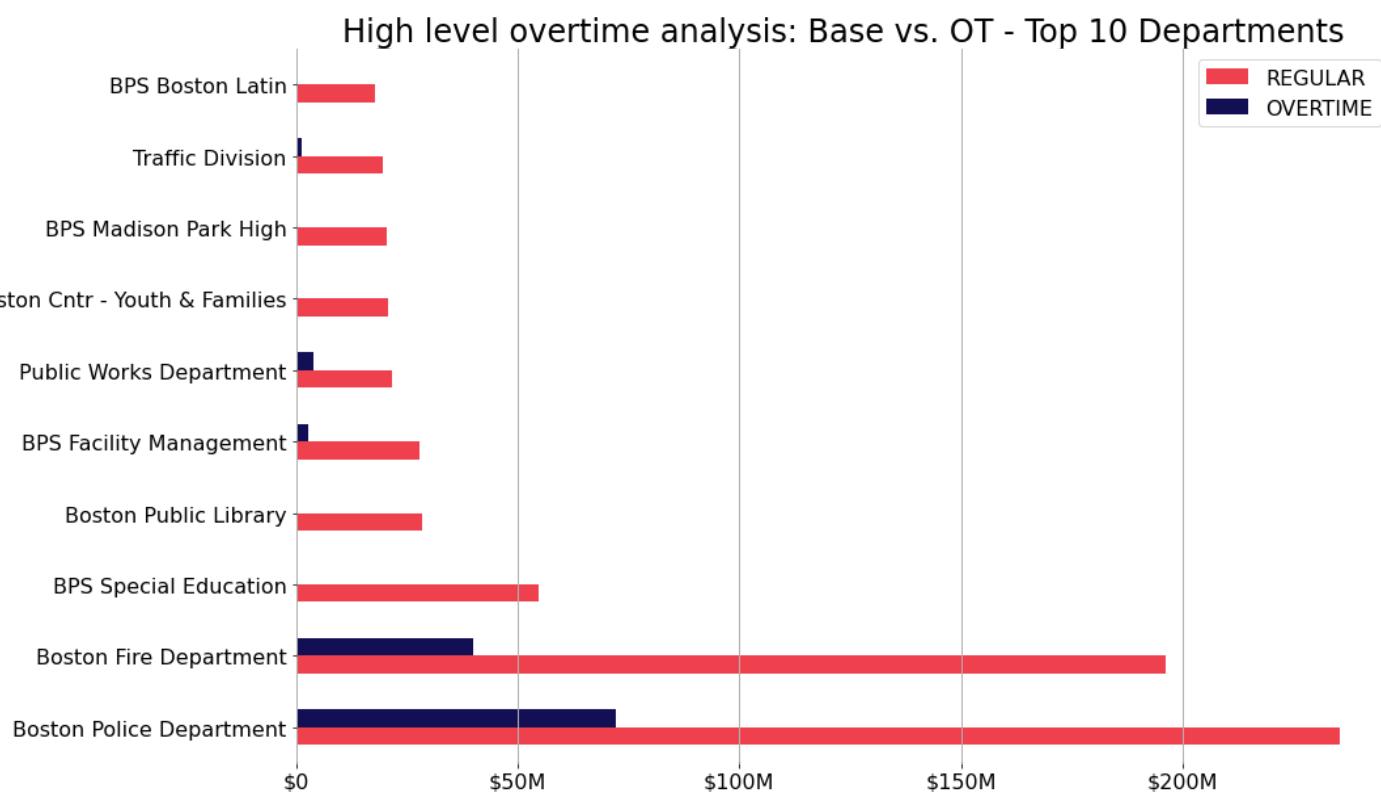


### 13. High level overtime analysis (base salary vs. overtime vs. other departments)

Among the top 5 departments in terms of Base Pay, Boston Police Department has the highest total compensation in terms of base pay and overtime pay.

It is comparable only to Boston Fire Department, which is second in the list.

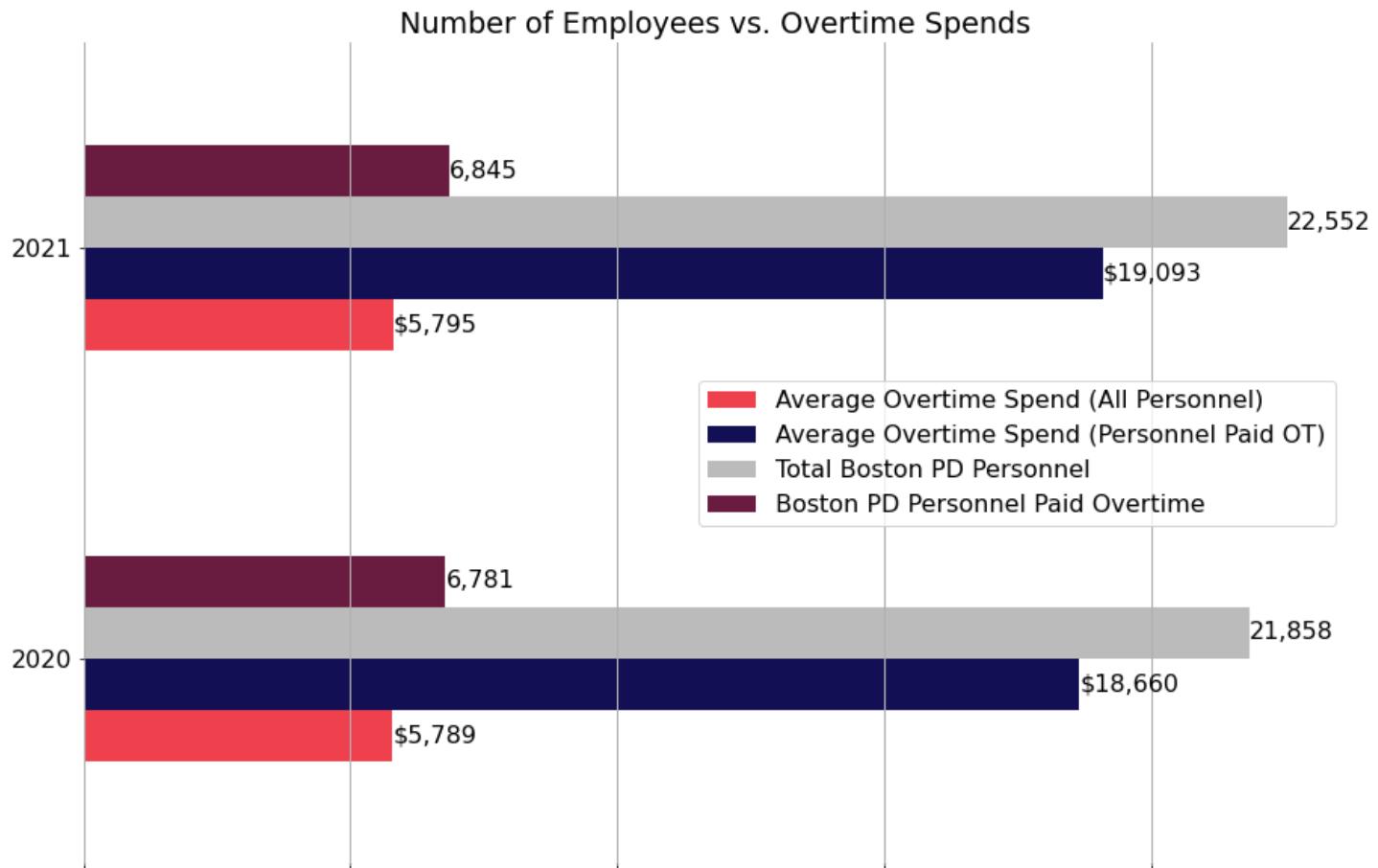
The other departments have several times lower compensation in comparison.



#### 14. # of employees vs. OT spend

From the graph we can see that the total number of Boston PD personnel who are paid overtime is less than half of the total number of personnel in the department.

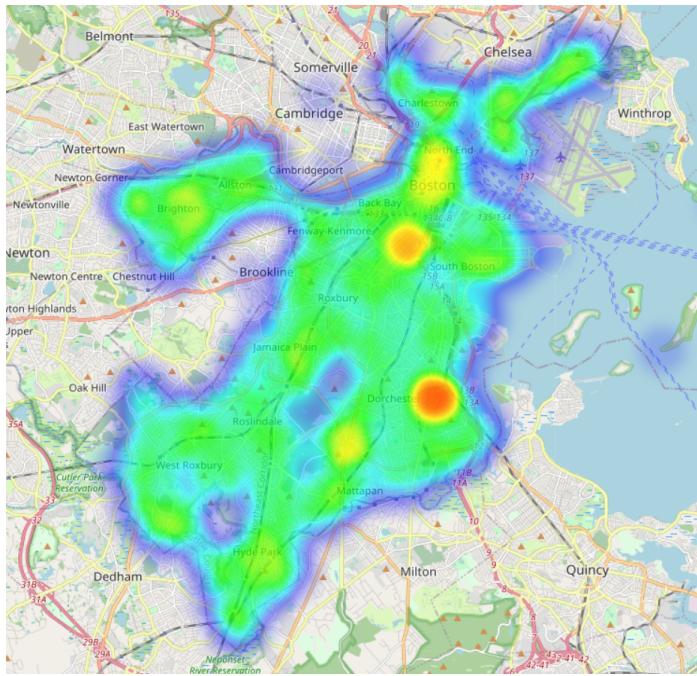
The distribution of overtime compensation and personnel has not changed much between 2020 and 2021.



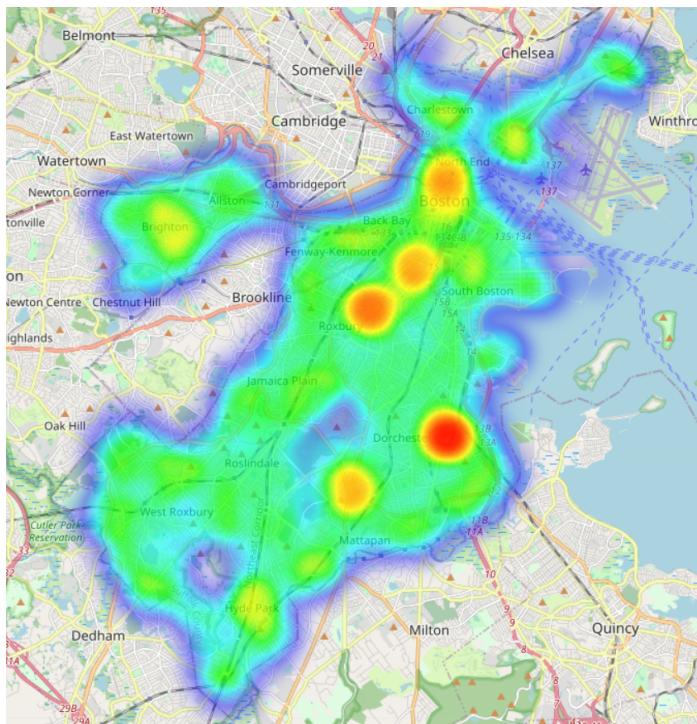
# Extension Project

## 1. Crime Incident Reports Heat Maps over Time

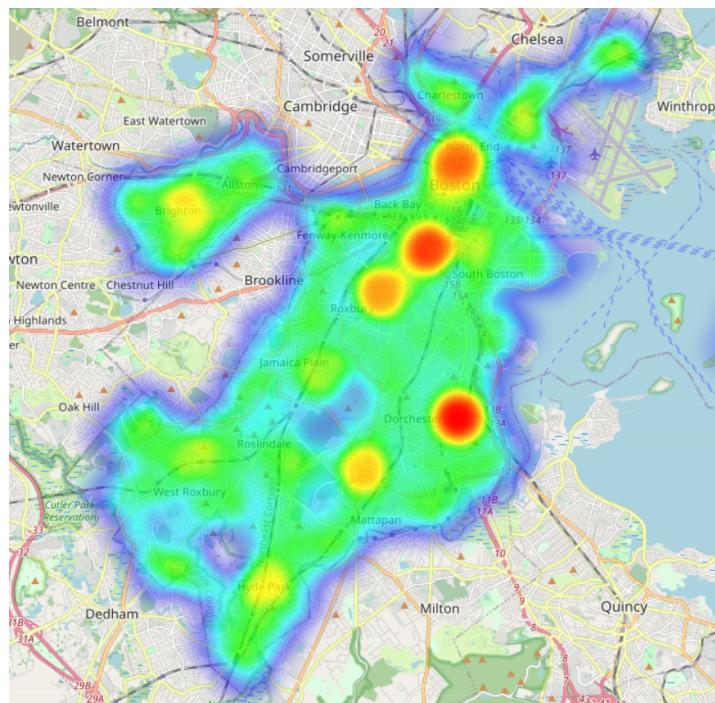
2022:



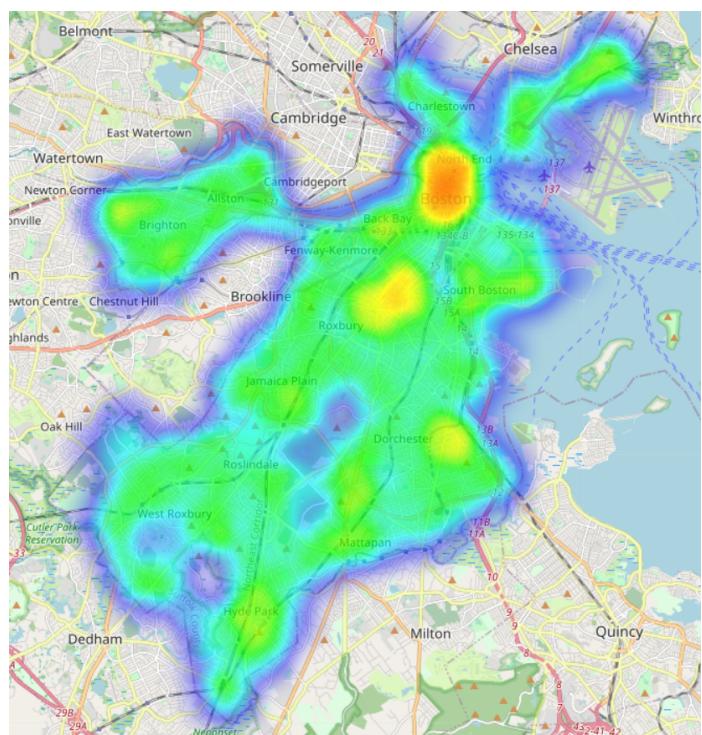
2021:



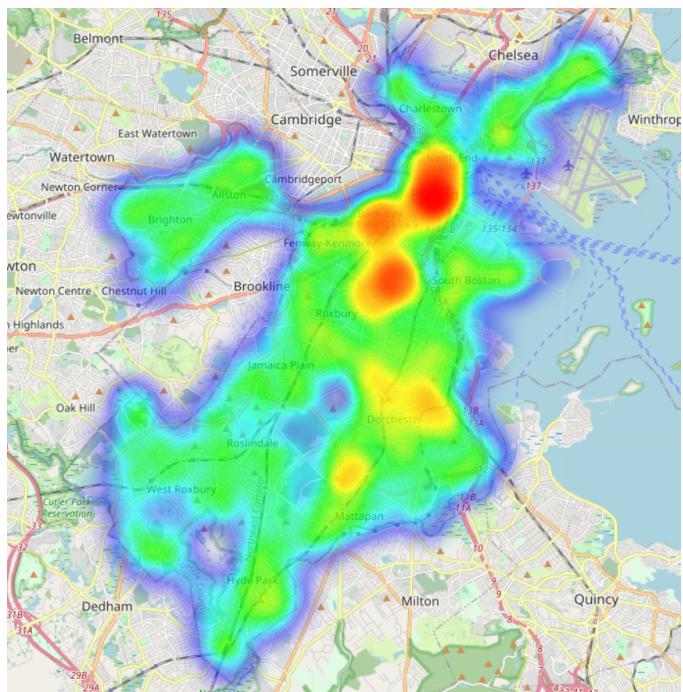
2020:



2019:



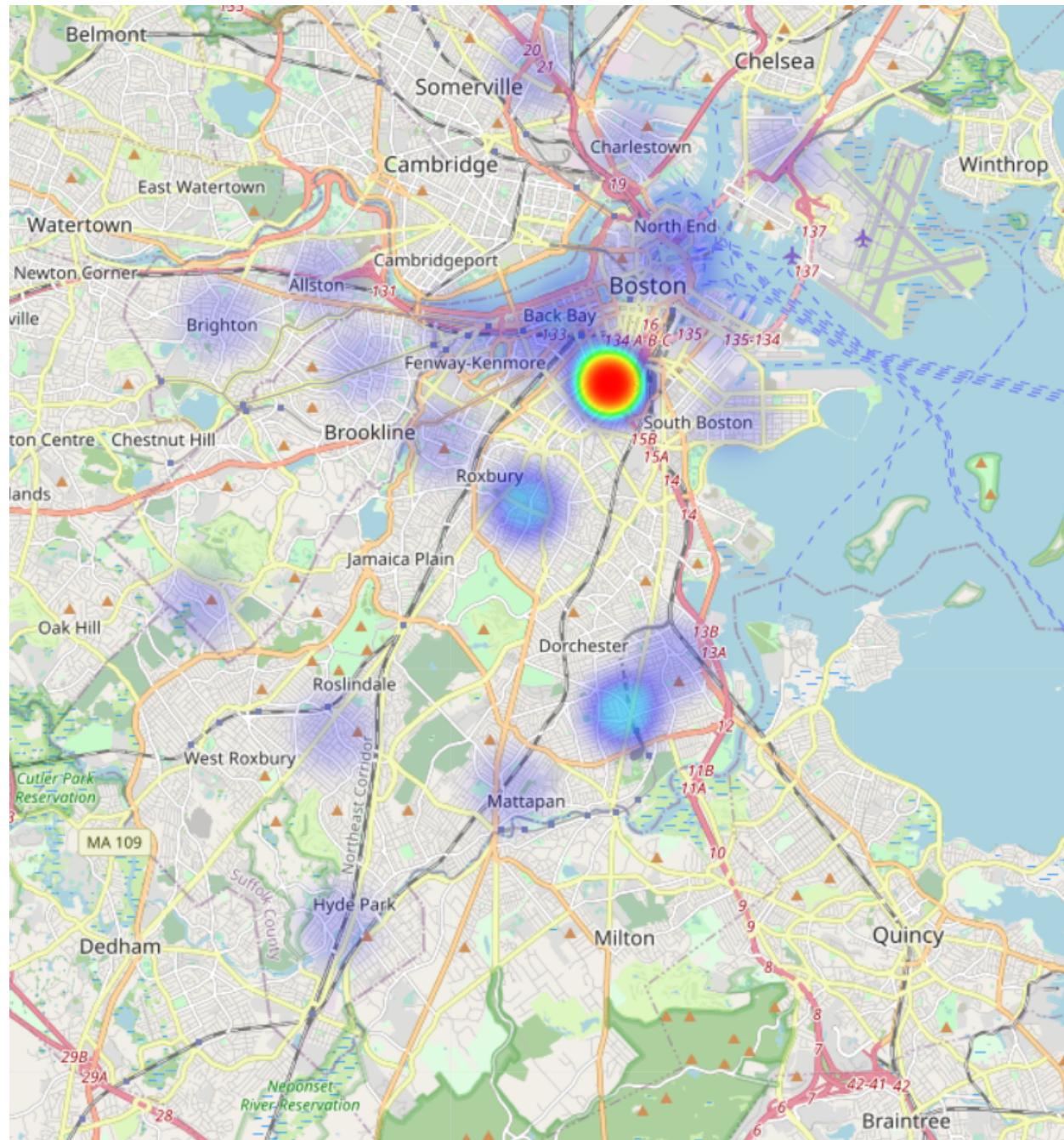
2018:



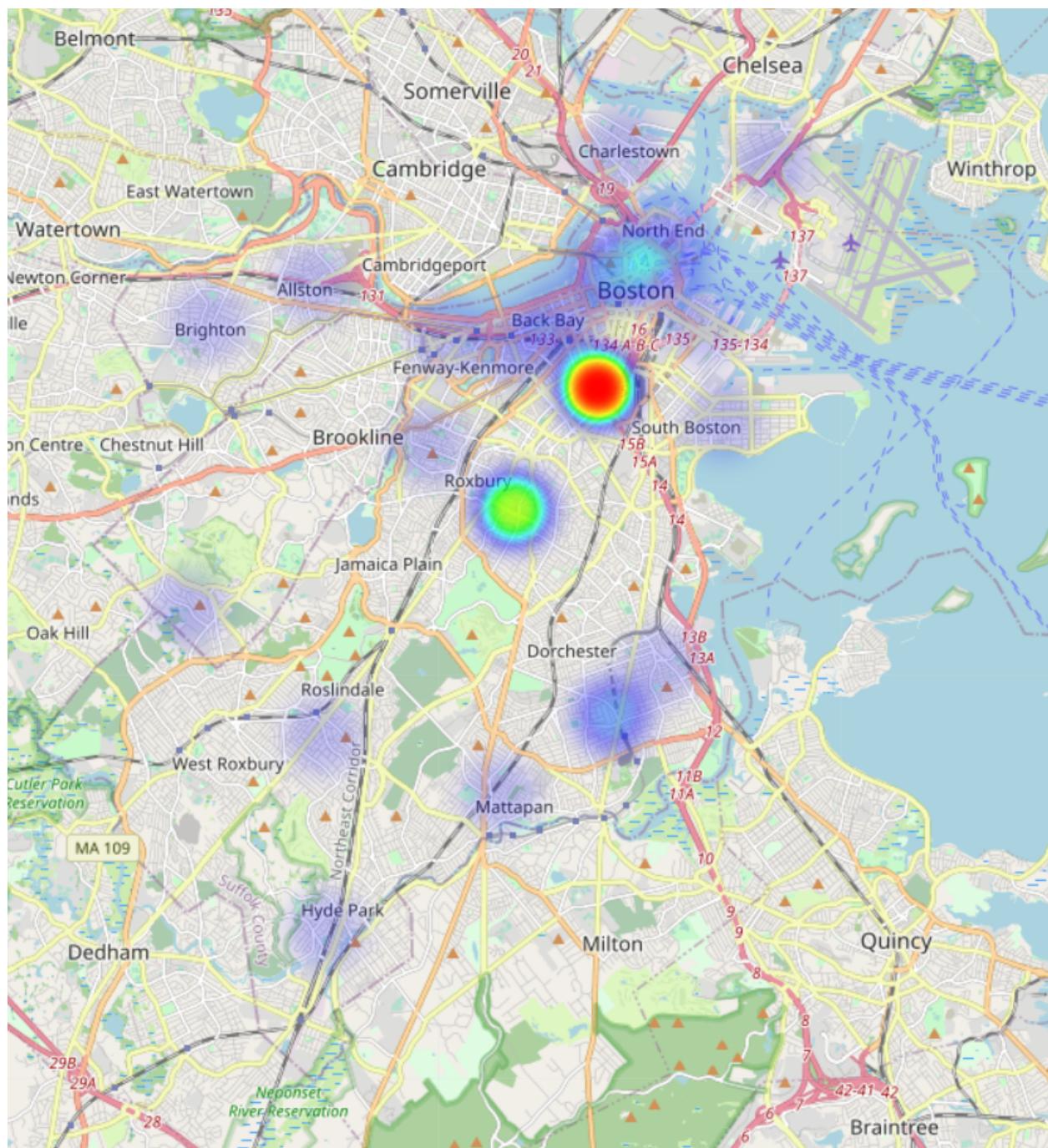
We can see that all the heatmaps are roughly similar, but that there appears to have been more active crime in high-crime areas during 2018, 2020, and 2021, due to more red hotspots during those years.

## 2. FIO Report Dispersion Heat Maps over Time:

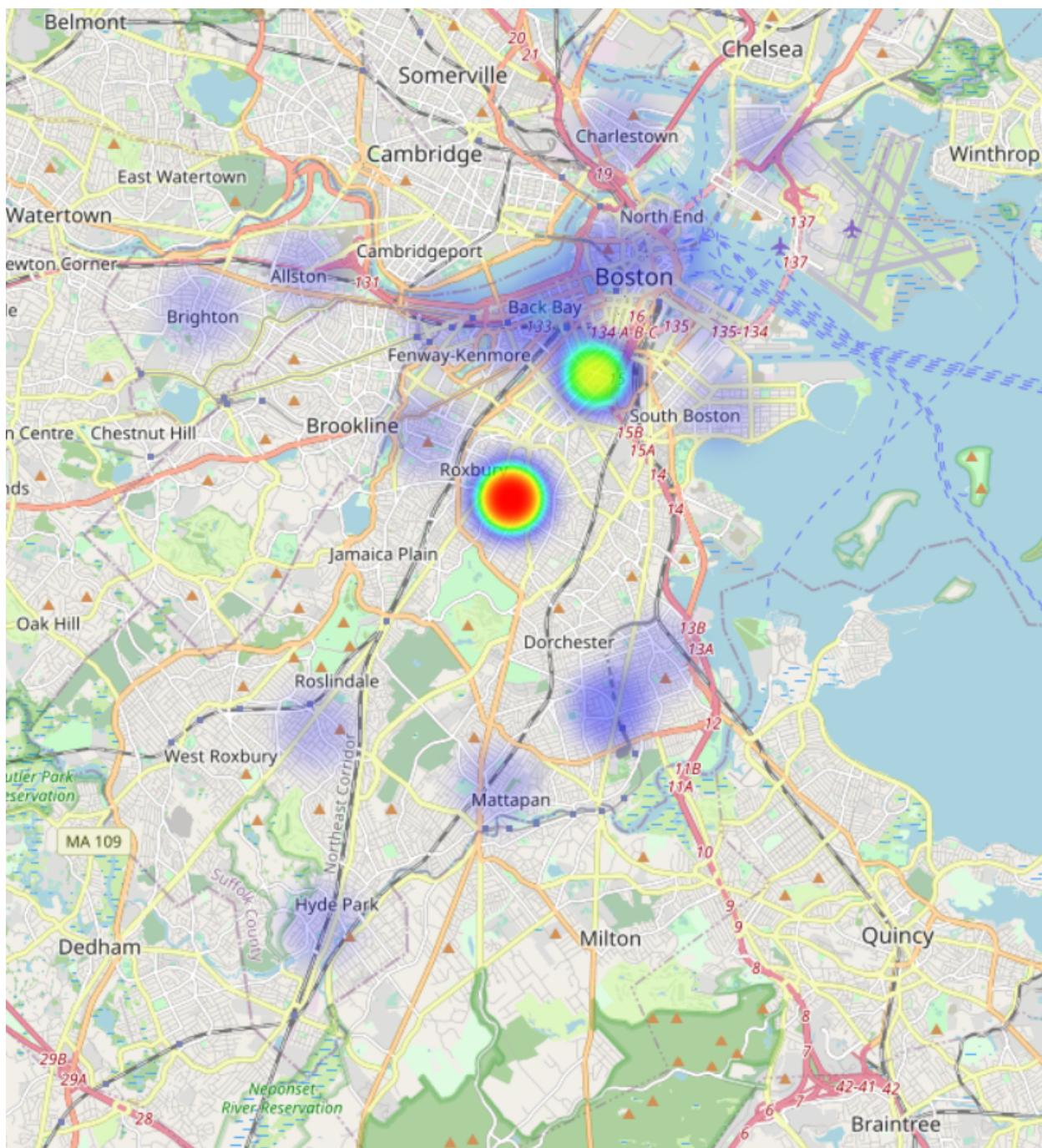
2021:



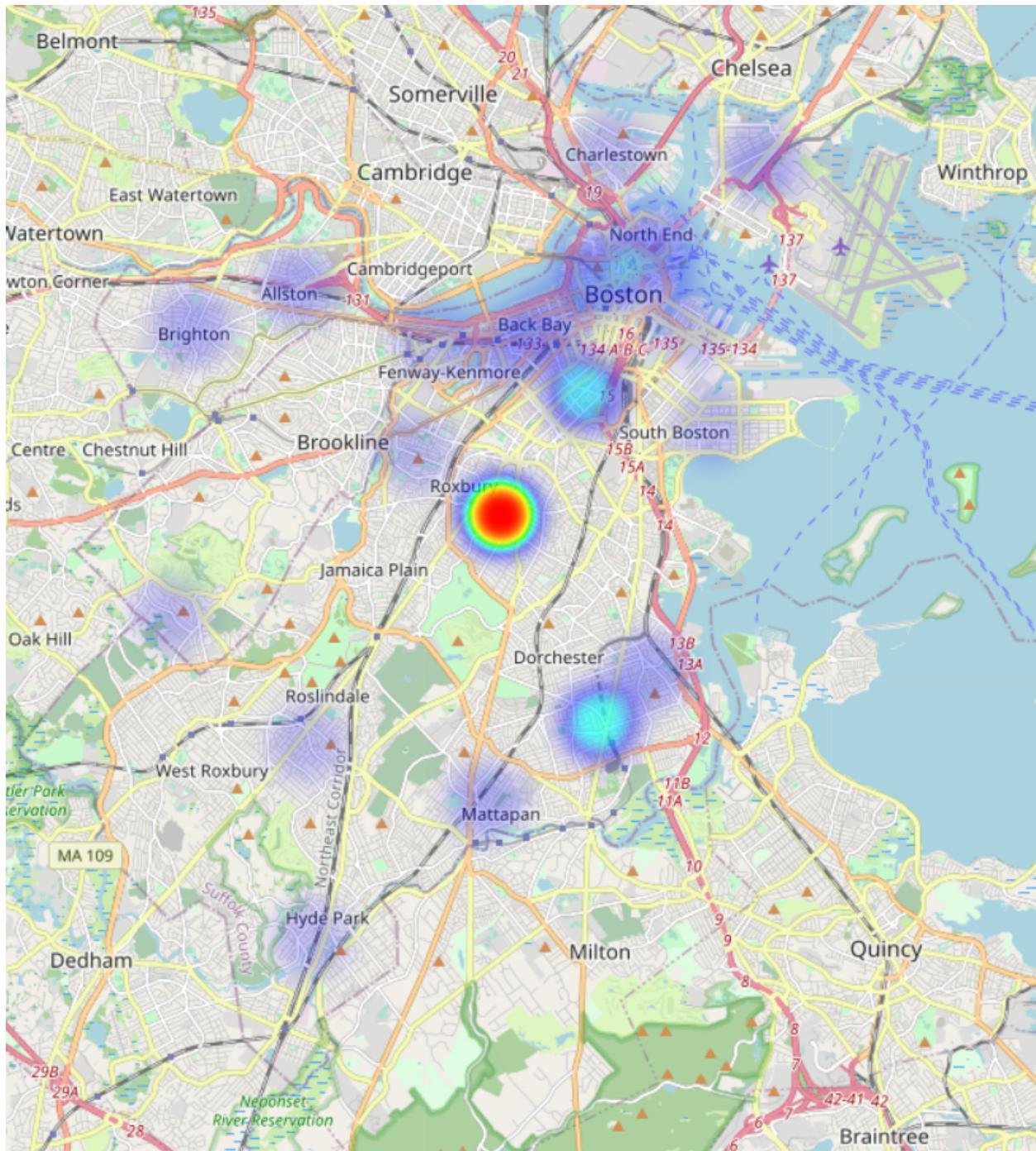
2020:



2019:

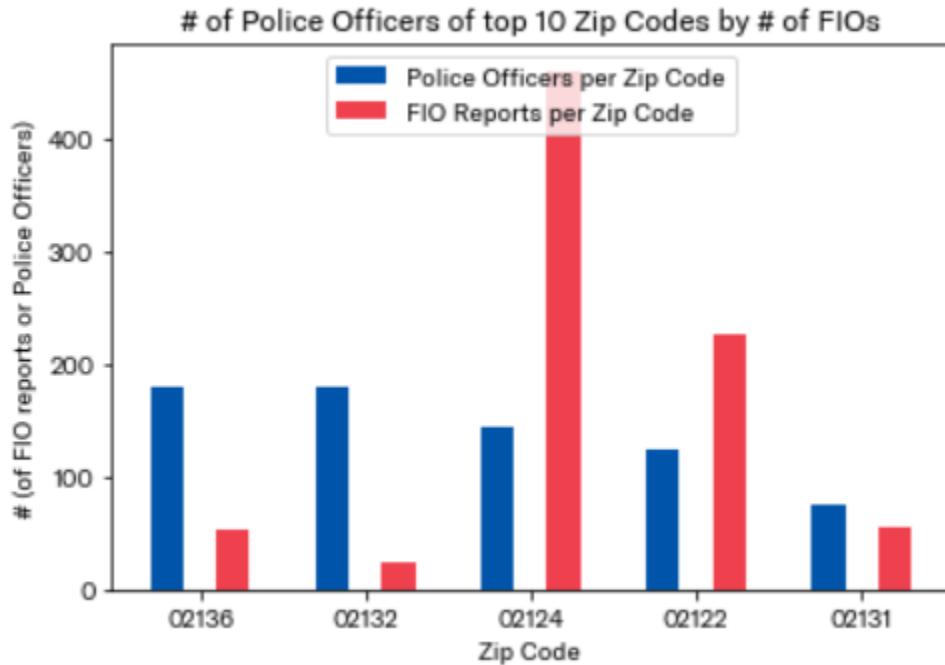


2018:



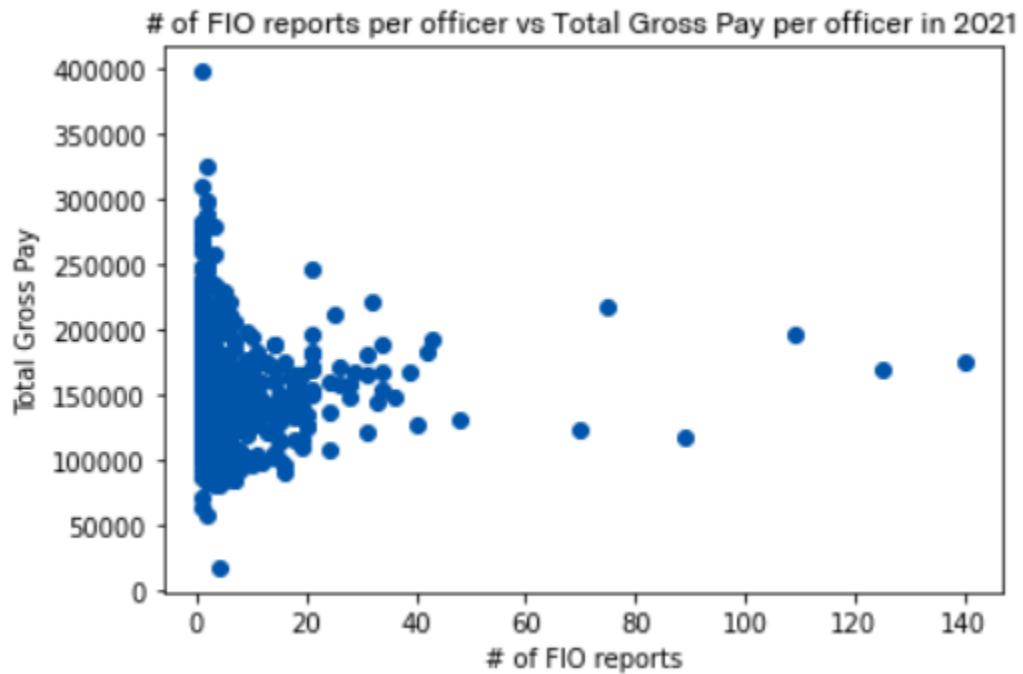
The FIO reports are dispersed throughout the city for all the years, but for all 4 Roxbury and South End (near South Boston) appear to be the most active FIO areas. Interestingly 2018 and 2019 Roxbury has more FIO reports, while in 2020 and 2021 South End now overtakes it due to the higher redness of the heat circle on that area. This sort of lines up with the crime data, but it's a bit strange that South End now has so many more FIO reports than other regions, when its difference in crime is not that large. This may indicate a misallocation of resources.

### 3. Top 5 Zip Codes by number of Police officers vs number of FIO Reports in those zip codes



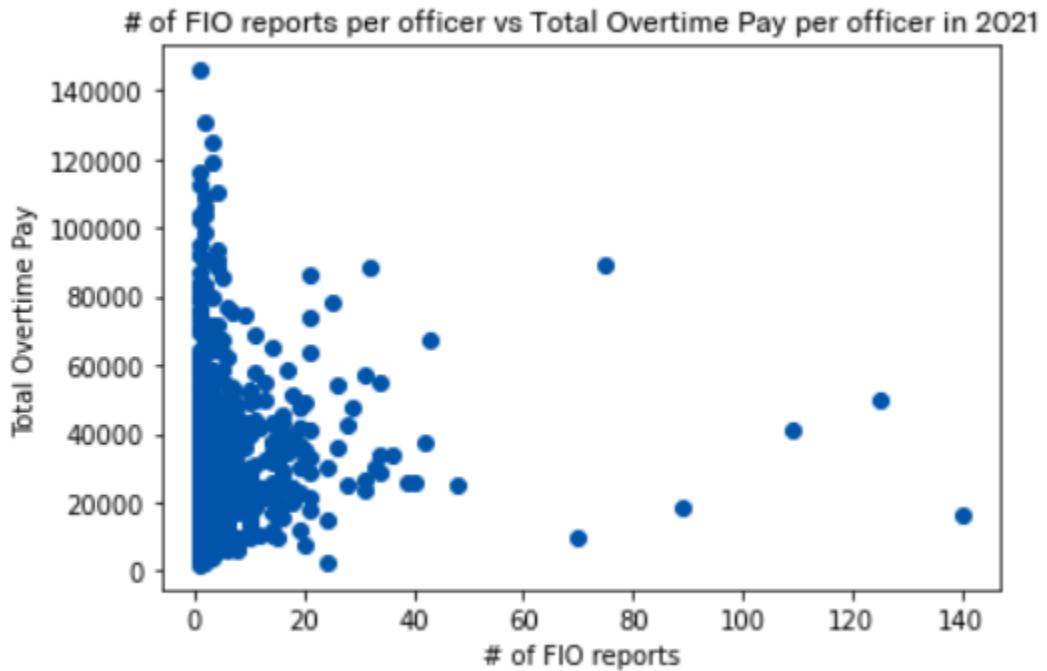
We took a look at the comparison between the top 5 zip codes by number of officers in them compared to how many FIO reports were generated for that zip code. This gave a weird looking bar graph that doesn't show much of a relationship, which is a bit strange since it's expected that the most populated zip codes by officers would have the most FIO reports.

#### 4. # of FIO reports per officer vs Total Gross Pay per officer in 2021



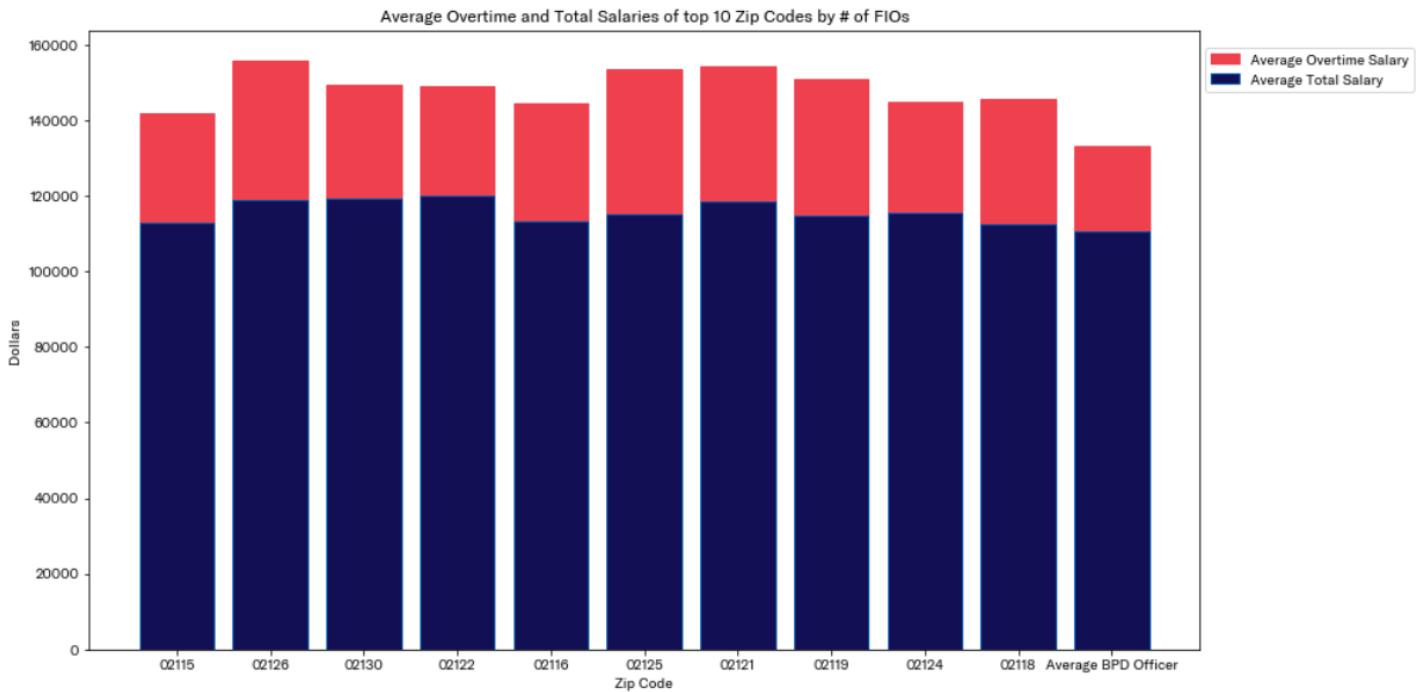
We can see that there's no clear trend between # of FIO reports and total gross pay per officer since all the data points are roughly in the same area, other than lots of outliers in the 0 to 20 range of # of FIO reports.

#### 5. # of FIO reports per officer vs Total Overtime Pay per officer in 2021



We can see that there's no clear trend between # of FIO reports and total overtime pay, and some individuals who have a lot of FIO reports assigned to them actually get paid less overtime than many who have very few.

## 6. Average total salary and overtime per zip code of FIO report for top 10 zip codes based on # of FIO reports per zip code



We can see that the gross salaries of the top 10 most reported FIO zip codes are relatively similar, all appearing around the 150,000 range. The overtime for all of them takes up around 30,000 for each zip code. Comparing this to the average BPD officer as seen in the last bar, we can see that these values appear to be higher, for both the total and overtime compensation for the top 10 zip codes. Thus, it seems like zip codes with higher numbers of FIO reports in them have higher salaries than the average BPD officer.

This may make sense intuitively, but also presents a question about incentivizing FIO reports as that may lead you to have more status in the BPD, and as a result get paid more. This incentive may cause police officers to over-patrol, issuing more FIOs than should be necessary.

## Sub-extension Project:

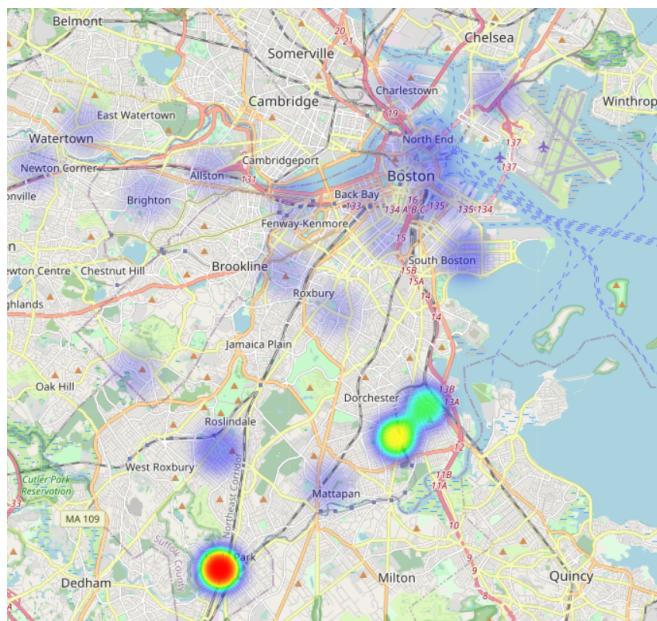
We have created an extra graph to examine at the request of Natasha during the client meeting at 12/5/2022. She was interested in seeing the relationship between the number of Boston Police officers who live outside of Boston and those who live inside of Boston. We decided to extend this further by also examining the average employee compensation and average overtime compensation for those who live in Boston and those who live outside of Boston. Although this might be outside the scope of our initial extension, we thought it would still be interesting to include as a sub-extension project.

Zip codes are based on this data: [https://www.cityofboston.gov/images\\_documents/ZipCodes\\_tcm3-47884.pdf](https://www.cityofboston.gov/images_documents/ZipCodes_tcm3-47884.pdf)

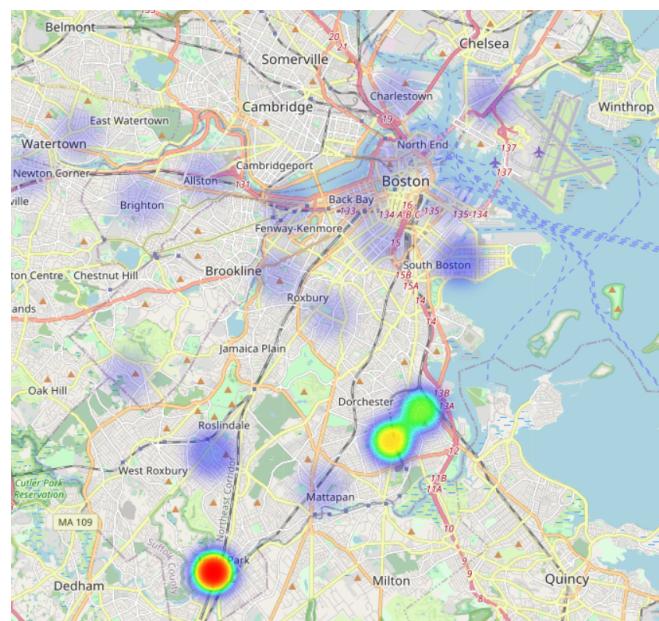
### 1. Police Officer Dispersion Heat Maps over Time:

We can see that the police officer dispersion throughout the years doesn't change much, though most police officers live near Hyde Park due to the very red dot on that area. Also, several officers live near Dorchester. Although Dorchester makes some sense as an area where many police officers live, it's interesting that Hyde Park is so populated even though it's not an area which has an overabundance of crime.

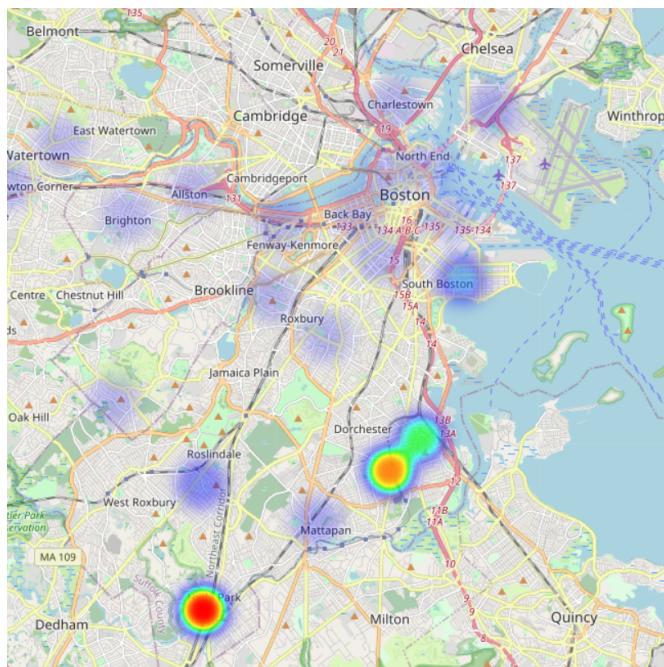
2021:



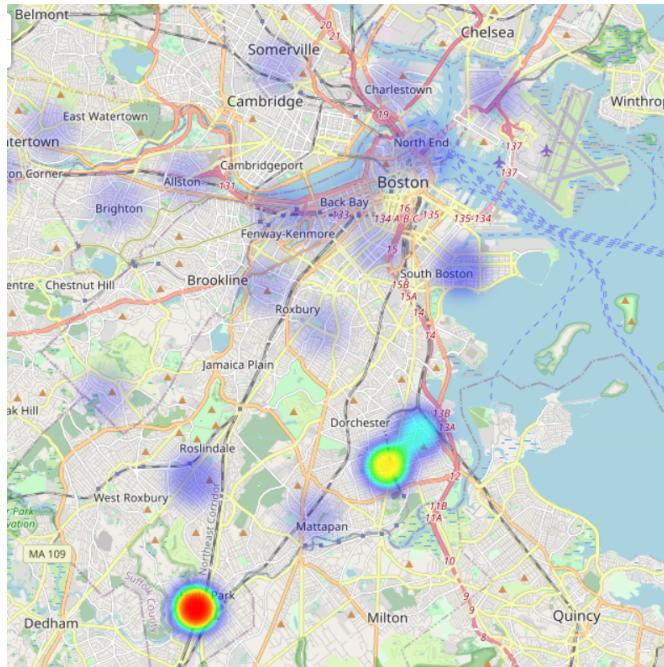
2020:



2019:

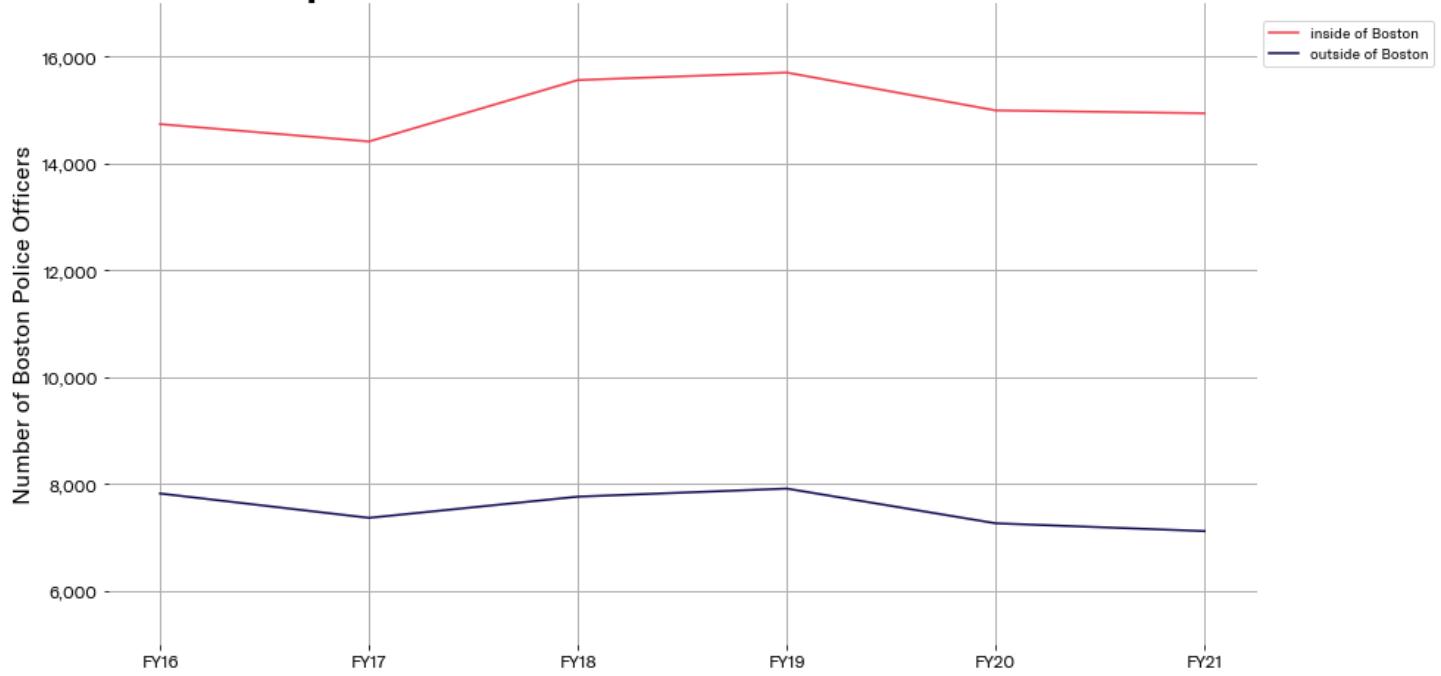


2018:

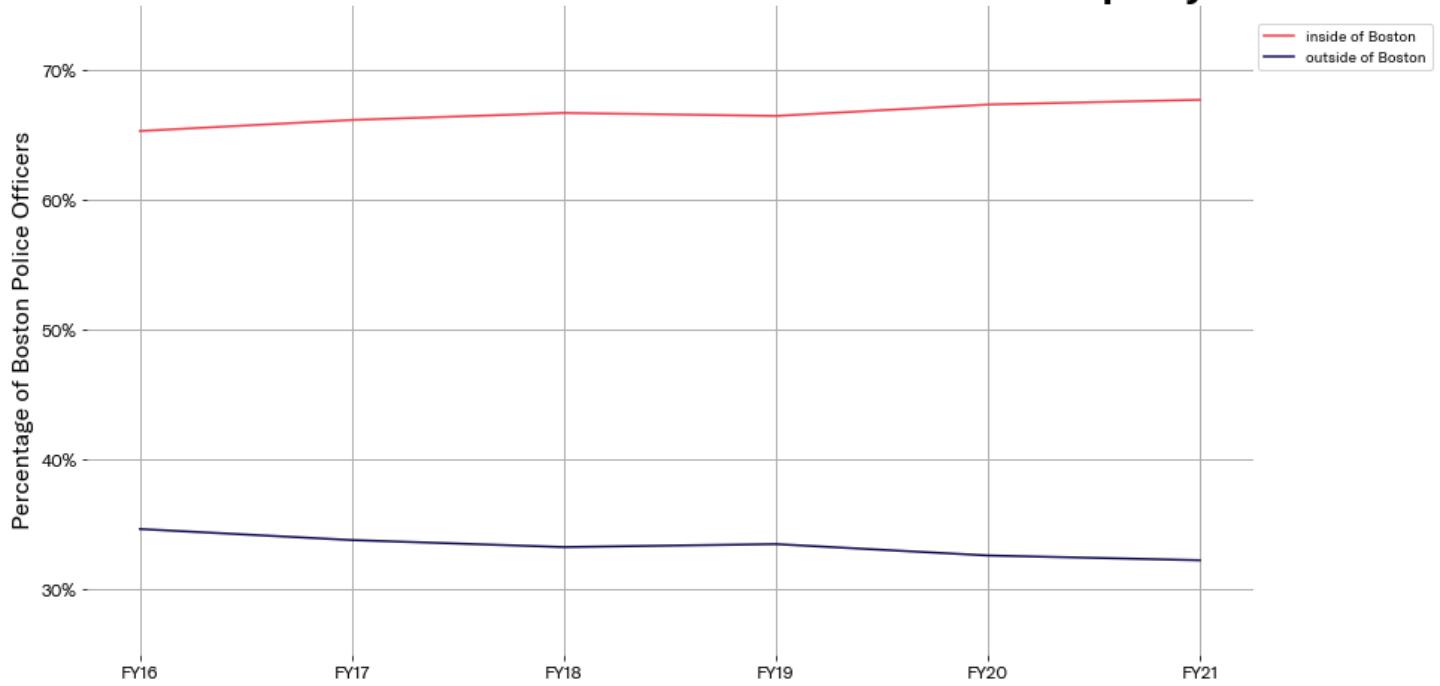


## 2. Number of Boston Police Officers by Residency

**There are almost twice as many police officers who live in Boston compared to the number that lives outside of Boston.**

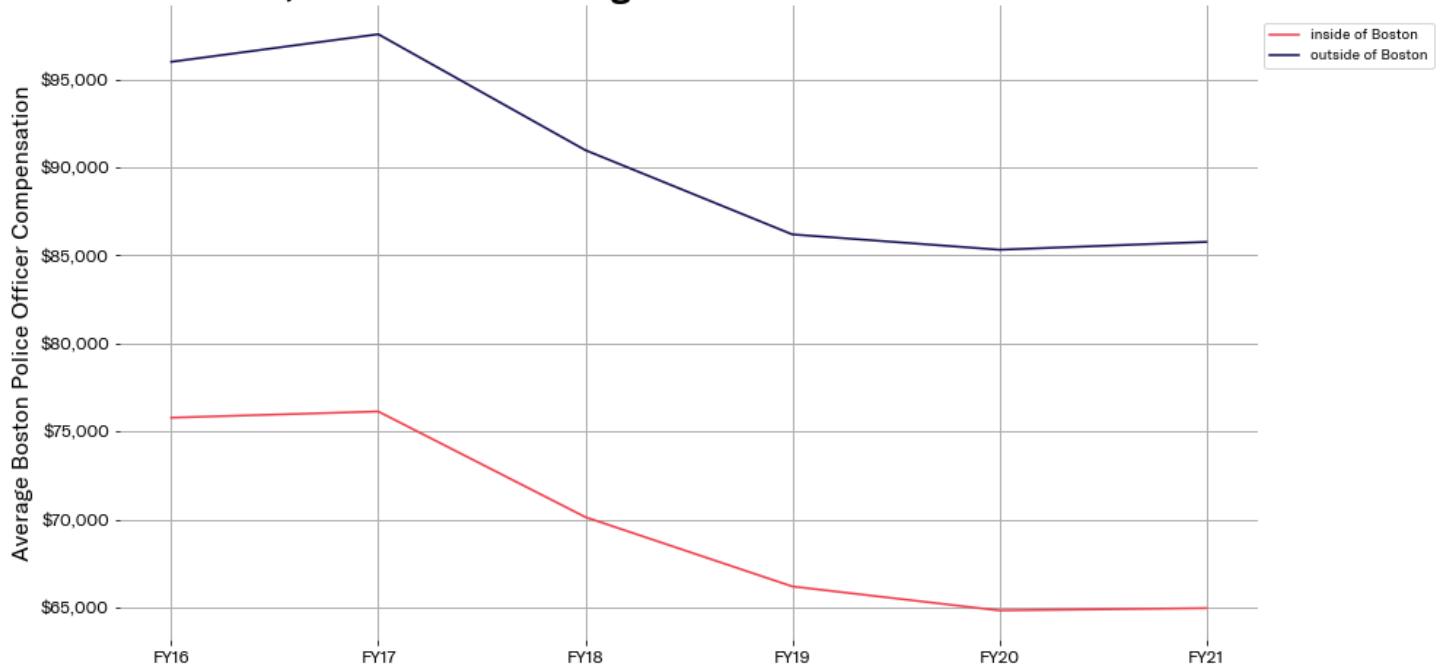


**~65% live in Boston while ~35% live outside of Boston for the past years.**



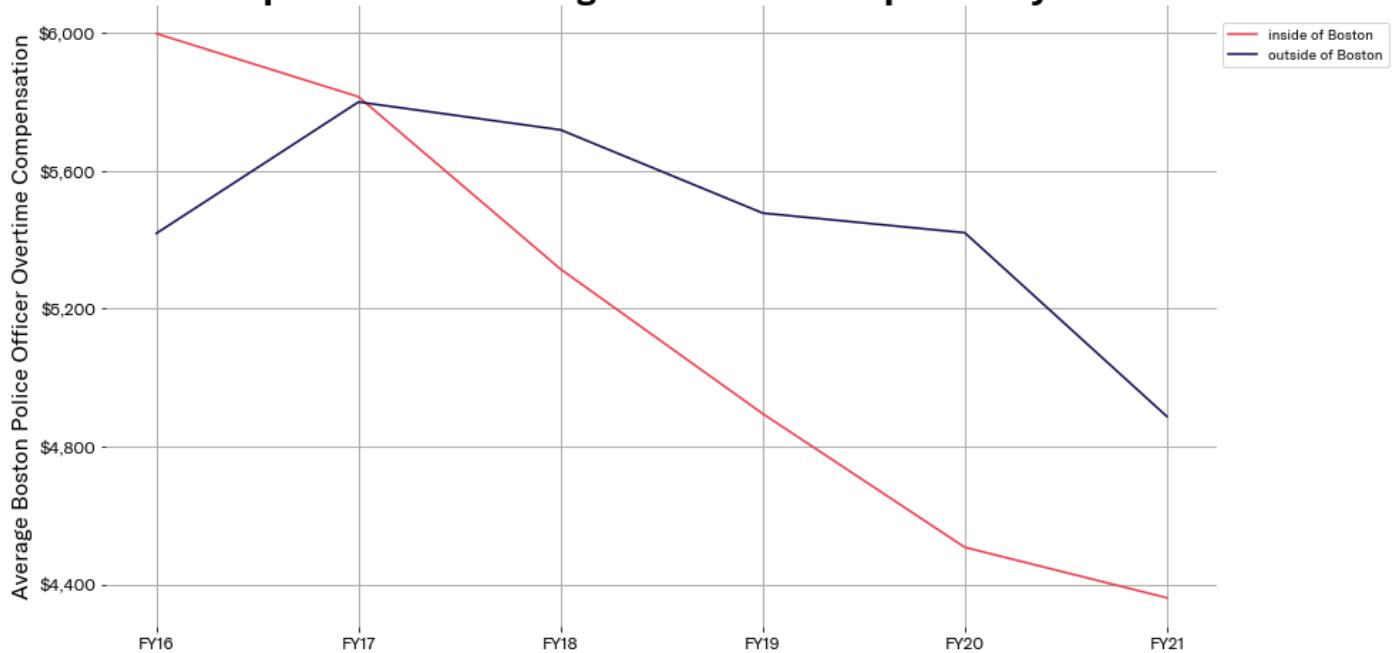
### 3. Boston Police Officers Average Employee Compensation by Residency

**Police officers living outside of Boston make almost \$20,000 more on average than those who live in Boston.**



#### 4. Boston Police Officers Average Overtime Compensation by Residency

**Police officers living outside of Boston have a higher average overtime compensation compared to those living in Boston for the past few years.**



#### Scope Changes:

There have been no more scope changes.

#### Overview of all Potential Risks:

Data for FIO reports may be difficult to compare effectively to some Employee compensation data. A decent amount of zip codes don't have FIO reports in them, and so the amount of relationship graphing and data extraction we can do with FIO report numbers may be limited simply due to the limited number of FIO reports that were made.

Zip codes span a large area of land and so grouping the FIO reports by zip code may group FIO reports that actually belong to different neighborhoods in terms of wealth or other signifiers even if they're within the same zip code, due to sub-neighborhoods that may be more or less wealthy within the same zip code.

For the sub-extension project, the data used to determine zip codes in Boston were taken from the cityofboston.gov website, and there are some zip codes which cover both Boston and another region. The ZIP code given in the employee data does not differentiate between whether the region of the ZIP code that the officer lives in is in Boston or not. When analyzing the data, we assumed that police officers reside in Boston if it is found within the list in [this URL](#).