

January 6, 2009

Mr. Paul A Leonard
Upper Dublin Township
801 Loch Alsh Avenue
Fort Washington, PA 19034

Dear Paul:

Subject: Fire House Risk Assessment

I was asked to conduct an assessment of the "added risk" that a fire station, located approximately one hundred feet from a high school, would have in regards to fire related vehicles hitting students going to and from class. Also, I indirectly address several of the questions raised in Kathy Kelley's email on 7/27/08.

Summary

I have reviewed the "added risk" of a student getting hit by a fire related vehicle due to the new location of the fire station at the Bonsell property. I have calculated that this "added risk" is so statistically small, that the fire safety benefits (to the students and school buildings due to fire station's closer proximity to the schools), would more than likely outweigh the "added risks" due to fire related vehicle accidents.

Background

For the current traffic pattern (2008), the main risks that I considered were as follows:

- How many vehicles pass by the Upper Dublin High School (UDHS) area during the hours that are at risk?
- How many "extra" fire related vehicles would pass by the UDHS area during the hours that are at risk, due to the new location of the fire station (Bonsell property)?
- How many accidents/injuries have occurred in the area during the hours in question?
- How much more or less dangerous are these fire related vehicles when it comes to safety?
- How many additional accidents/injuries could occur due to these additional fire related vehicles?

Calculation of Risk

I received traffic reports containing vehicle volume statistics on the roads adjacent to the schools in question. I received this information from PennDot as well as from a report written by Adrienne Eiss, Senior Project Manager at Orth-Rodgers & Associates, Inc. I received fire call data from President Dr. Jeffrey M. Fogel, President of the Fort Washington Fire Company. I also received

accident and injury information from the Upper Dublin Police Department. I made some assumptions in order to get data to match the appropriate hours of the day and locations where I am analyzing the risk. (Please refer to Appendix 1 for explicit details on these calculations.)

Here are my findings:

- Approx 1,073,100 vehicles pass by UDHS in one school year, at times where students are at risk.
- Approx 1,311 additional emergency fire vehicles due to the new Firehouse location (Bonsell property) pass by UDHS in one school year, at times where students are at risk.
- Approx 11 accidents and 1 injury occur in one school year, at times where students are at risk.

Therefore, if 1,073,100 vehicles produce 11 accidents and 1 injury per school year, then by simple ratio, the additional 1,311 emergency vehicles would account for .013438 accidents and .001222 injuries per year. In other words, **1 additional accident in every 74 years and 1 additional injury in every 819 years.** Compare that to the risk of a student in Upper Dublin getting injured by being struck by lightning: 1 in every 396 years. **It is more than TWICE as likely to be injured by a lightning strike.**

I am making the assumption that emergency vehicles are no safer, nor more dangerous than regular vehicles. Since there is no recorded data in the last 10 years of a fire related vehicle injuring a student, the best assumption would be to treat these vehicles as having the same safety risk as regular vehicles.

The above exercise could be done for traffic pattern data for years 2011 and beyond (new UDHS location). This information is available, but these are only best estimates. Although there may be increased volume of vehicles and a potential increase in fire calls, the new UDHS location would actually divert some of the increased traffic away from the school. The result would not be statistically different enough to draw a different conclusion than the one I came to for the current traffic pattern (2008).

Conclusion

The bottom line is, the risk of students being hit by these extra fire related vehicles is extremely small, roughly 1 additional accident in every 74 years and 1 additional injury in every 819 years. That risk would be somewhat offset by the probability that any of the 4 schools in the location could have a fire. The closer fire station location would actually save more student lives and prevent further building damage to the school than it would if it were located 1 mile down the road (current location). All you would need is one big Fire Event in the next 200 years to offset the added risk of students being hit by an emergency vehicle.

Fire Stations operate with 1 goal in mind, and that is "keeping the community safe". That is a blanket statement that doesn't just apply to putting out fires, it applies to all aspects of making the local community safer. Other than a few rare legal exceptions, ALL volunteer fire related vehicles have to abide by school zone speed limits, and I believe they would adhere to this rule more than the average

driver. However, I did not account for this in my report since I wanted to show how small the “added risk” is even under the most conservative of assumptions.

Please feel free to contact me with any questions or concerns as I would be happy to discuss this subject further with you.

Sincerely,

Jason Goldstein, ASA, MAAA

Disclaimer Statements

- Although much of the background data used for this report is actual data, the conclusions made in this report represent best estimates and should not be taken as factual information. I am NOT an expert in fire engine safety, but I am an expert in dealing with risk analysis relating to any field that contains risk. I look at the facts and data given, and give a fair assessment of the risk being analyzed.
- I am a credentialed Actuary in that I have passed the required examinations given by the Society of Actuaries (SOA) and have attained my Associate of the Society of Actuaries (ASA). An actuary is a professional that analyzes risk and formulates predictions and probabilities based on actuarial mathematics and risk concepts.
- I conducted this study solely on my own, and in no way is this report to be affiliated with my current employer.
- My conclusions made in this report do not mean that an incident cannot or will not occur. I am just giving my best assessment of the risk based on the information and data that was presented to me. It is my understanding that Upper Dublin Township will in no way hold me responsible or liable if an accident between a fire engine or volunteer vehicle and a student occurs, because no matter how small the risk may be, it is never zero.
- Most of my math was calculated in the attached Microsoft Excel worksheet (Fire Engine Risk – workfile.xls). The numbers in this report may be slightly off mathematically (statistically insignificant) because I did not want to show decimals, so discrepancies are only due to rounding. The rest of the materials that I refer to are available on the township website under 'firehouse':
www.upperdublin.net/fire/firehouse.aspx

Appendix 1 – Detailed Calculations

The number of vehicles that pass by Upper Dublin High School (UDHS) during the AM peak hour is approximately 1,024 vehicles. I will double this number to 2,048 to account for the 2-hour period from 7am – 9am that students will be arriving at both Fort Washington Elementary School (FWES) and UDHS. During the normal school dismissal hour, there are approximately 960 vehicles that pass by UDHS. (Please refer to Appendix 2 to see further details on these numbers). I will multiply that by 1.5 to account for all dismissal times from 2:20PM – 3:50PM, so now we get 1,440 vehicles. Students have approximately 5 minutes between classes and since they have roughly 7 to 9 class periods each day, let's round that up to another 1 hour where students could be exposed to the risk of being hit by a vehicle. I will estimate the number of vehicles to be around 600 vehicles per hour that pass by during off-peak hours. This accounts for 4,088 vehicles each school day.

Now, let's take the number of days during the year we should be concerned with. If we take ALL of the weekdays from September 3rd through June 21st, we account for approximately 210 school days and 858,480 (4,088 vehicles * 210 days) vehicles that could hit students. (PLEASE NOTE THAT EVEN THOUGH UDHS OPERATES UNDER A 180 DAY SCHEDULE, THE FIRE CALL INFORMATION (BELOW) WAS GIVEN FOR THESE SAME 210 WEEKDAYS SO I WANTED TO KEEP THEM THE SAME SO THAT WE ARE COMPARING APPLES TO APPLES. IF I ADJUST THE NUMBER HERE, I WOULD ADJUST THE CALL INFO PROPORTIONALLY AND YOU WOULD END UP WITH THE SAME ANSWER) Let's bump that number up 25% to account for after school sports and some weekend activities. $858,480 * 1.25 = \underline{1,073,100 \text{ vehicles per year}}$.

Total Vehicles				
Category	Time	Hours	Vehicles per hour	Total Vehicles
Arrival	7AM-9AM	2	1,024	2,048
In between classes	off peak 2:20PM -	1	600	600
Dismissal	3:50PM	1.5	960	1,440
Total Vehicles exposed to students during 1 school DAY				4,088
School Days Per Year				210
Total Vehicles exposed to students during 1 school YEAR				858,480
Sports/weekend/other events FACTOR				1.25
Total Vehicles exposed to students during 1 school year plus other activities				1,073,100

Next, let's take the number of calls made to the firehouse during these same times during the year. According to a 9/17/2007 e-mail written by President Dr. Jeffrey M. Fogel, President of the Fort Washington Fire Company, 61 calls were made in the 2005/2006 school year, and 66 calls made in the

2006/2007 school year that required emergency vehicles to travel through the school zone. I will estimate the number of calls made in the 2007/2008 year as 71 and for the current school year 2008/2009, the number of calls becomes 77 (using the same increasing ratio from the two data points given). This accounts for all calls made from 7AM – 4PM, Monday through Friday, that required emergency vehicles to travel through the school zone. Since I am only looking at 2 arrival hours, 1.5 dismissal hours and 1 off-peak hour where students are at risk, we only need to worry about 4.5 of the 9-hour period mentioned. For conservatism, let's cut the number of calls by 35% (instead of 50%). $77 \text{ calls} * .65 = 50 \text{ calls}$.

When you take into account the new location (Bonsell property), these numbers more than double (again according to Jeffrey Fogel's e-mail). I will bump these numbers by 110%. So, $77 * 2.10 = 162$. And again, let's cut the number of calls by 35% to account for the hours at risk. $162 \text{ calls} * .65 = 105 \text{ calls}$.

Next, let's say there are 4 fire trucks per call and 15 volunteer vehicles per call (both of these are very high estimates but I'm using these as conservative assumptions). For the current location, we get $19 \text{ vehicles} * 50 \text{ calls} = 953 \text{ vehicles}$. I will bump this number by the same 25% to account for after school sports and some weekend activities. $965 * 1.25 = 1,192 \text{ vehicles}$. The new location (Bonsell property), we get $19 * 105 * 1.25 = 2,503 \text{ vehicles}$. The difference is the INCREASE in the number of fire related vehicles per year due to the new fire house, $(2,503 - 1,192) = \underline{\underline{1,311 \text{ new fire related vehicles per year}}}$.

# Calls - weekdays 7AM-4PM - that required emergency vehicles to travel through the school zone		
Fire Related Vehicles		
	CURRENT LOCATION	NEW LOCATION (Bonsell Tract)
School Year		2.100
2005/2006	61	128
2006/2007	66	139
2007/2008 (estimate)	71	150
2008/2009 (estimate)	77	162
Reduction factor (non-related hours)	0.65	0.65
Total Fire Related CALLS exposed to students during 1 school YEAR	50	105
# Emergency Vehicles per call	19	19
Total Fire Related VEHICLES exposed to students during 1 school YEAR	953	2002
Sports/weekend/other events FACTOR	1.25	1.25
Total Fire Related VEHICLES exposed to students during 1 school YEAR plus other activities	1,192	2,503
Increase in # Fire Related Vehicles due to new firehouse location		1,311

Next, let's look at traffic accidents that have occurred in and around UDHS. From 11/2006 to 11/2008, there have been 43 traffic accidents. (I have attached 2 documents from Adrienne Eiss that provide

more detail on these accidents.) Of these 43 accidents, there were only 3 injuries, and zero deaths. Since we are looking at an annual rate and this study covers a 2 year period, let's cut these numbers in half and round up for conservatism. We are now looking at 22 accidents per year and 2 injuries per year. Again, we need to narrow the study to weekdays and only during the 4.5 hour period in question. Instead of making these numbers too small, I will just cut them in half for conservatism. That gives us **11 accidents and 1 injury per year.**

Let's recap:

- Approx 1,073,100 vehicles that pass by UDHS in one school year, at times where students are at risk.
- Approx 1,311 additional emergency fire vehicles due to the new Firehouse location (Bonsell property) that pass by UDHS in one school year, at times where students are at risk.
- Approx 11 accidents and 1 injury in one school year, at times where students are at risk.

Therefore, if 1,073,100 vehicles produce 11 accidents and 1 injury per school year, then by simple ratio, the additional 1,311 emergency vehicles would account for .013438 accidents and .001222 injuries per year. In other words, 1 additional accident in every 74 years and 1 additional injury in every 819 years. I am making the assumption that emergency vehicles are no safer, nor more dangerous than regular vehicles. Since fire engines have sirens and lights and the volunteer fire vehicles have lights, and since all non-emergency fire related vehicles are under strict law to abide by school zone speed limits (however, Emergency vehicles may pass a school bus if exercising "due diligence" as identified in 3101 (h) of the Motor Vehicle Code), you could argue that they are safer than regular vehicles, but again, for conservatism, I am choosing not to add these factors into my analysis. If I did account for this, the "added risk" would be even lower than what I am illustrating. Though more observable they are much more likely to cause injury or death in an accident.

	# Vehicles	# Accidents	# Injuries
Total Vehicles	1,073,100	11	1
Additional Fire related Vehicles	1,311	0.013438	0.001222
		1	1
per N years		74	819

Now let's compare these numbers to lightning strike injuries. If the US population is roughly 290,000,000 and 366 people in the US get injured per year due to lightning strikes, then if there are roughly 2,000 students in Upper Dublin, this amounts to .00252 students injured per year due to lightning strike. In other words, **1 student in 396 years.**

US population (estimate)	290,000,000
# US injured by lightning per year *	366
# Students in Upper Dublin (Estimate)	2000
# Upper Dublin Students injured per year	0.002524138
1 Upper Dublin Student injured per N years	396
<small>Source: http://safety.amw.com/weather/dont-become-one-of-the-thousands-struck-by-lightening-this-year/</small>	

Appendix 2

AM peak hour

Fort Washington Ave Location	Existing 2-way volume	Future 2-way volume
South of Loch Alsh	426	471
North of Hawthorne (Bonsell frontage)	598	464

School Dismissal Hour

Fort Washington Ave Location	Existing 2-way volume	Future 2-way volume
South of Loch Alsh	430	482
North of Hawthorne (Bonsell frontage)	530	471

PM Peak Hour

Fort Washington Ave Location	Existing 2-way volume	Future 2-way volume
South of Loch Alsh	619	701
North of Hawthorne (Bonsell frontage)	792	852

* Source - PennDOT website (forwarded by Adrienne Eiss)