1. No bus service.

All cases, including this one, have some aspect of randomness to them. As a result, you may find slightly different numbers during yours. This was the first case I made to ensure my model was working properly before implementing the bus routes.

Result:

- Walked: 20000
- Total travel time: 604665

The total number of person-minutes means the mean employee spent approximately 24 minutes walking to VMC station (perceived 30 minutes). Some would probably take an Uber, but the model assumes Uber is not an option.

2. Current service (AM rush):

- Route 20 - Jane runs every 13 minutes
- Route 320 - Jane Express runs every 14 minutes
- Route 26 - Maple runs every 38 minutes along Edgeley Boulevard.

This case is a baseline case which the current proposal can be compared to. Minor improvements indicate the resources may be better invested elsewhere.

Results:

- Walked: 4792
- Route 20: 9410
- Route 320: 2735
- Route 26: 3063
- Total travel time: 311375

3. The existing plan, AM rush hour:

- Existing route 20 - Jane runs every 13 minutes
- Existing route 320 - Jane Express runs every 14 minutes
- Rerouted route 21 - Vellore runs every 36 minutes along Edgeley to Langstaff.
- Rerouted route 26 - Maple runs every 38 minutes along the existing proposed route, i.e. along Creditstone north of Macintosh. Speed south of Creditstone / Locke assumed to be 17 km/h.
- New route 29 - Edgeley runs every 39 minutes along the existing Edgeley route of route 26 - Maple.

In addition to the 17 km/h assumption, I have run additional cases with higher speed assumptions. The results are shown in Table 1.

Speed (km/h)	Walked	Ridership (out of 20,000)					Total travel time
		20	320	29	21	26	
17	3864	8477	2368	2705	2122	464	287050
22	3831	8434	2343	2703	2121	568	286238
30	3808	8355	2305	2702	2120	710	285245
50	3784	8241	2271	2699	2117	888	283913

Table 1. Impacts on passenger behaviour from different Route 26 speeds.

There seems to be very little ridership on this route even when it is unrealistically fast. I imagine this is due both to the lack of area surrounding the route (being very close to Jane) and the Jane route running much more frequently. However, the total travel time is still significantly better, perhaps partly caused by route 21 (see Scenario 5).

The area seems to be a bigger factor, as a 50 km/h 26 would not surpass the 13-minute 20 - Jane within the study area unless it ran more than every 5 minutes (though interestingly, 320 ridership falls by nearly half, proportionally much more than 20 does, before this happens). With a 22 km/h assumption, this does not occur even when route 26 - Maple runs every minute on Creditstone.

Interestingly, there were nearly as many riders on route 21 (south of Langstaff). If I run similar cases with a more frequent 21, it surpasses route 29 at a 28-minute headway.

4. The existing plan, but routes 26 and 29 both run on Edgeley.

Route 26's routing does not change (simply copy-paste the Edgeley distance data from 29 to 26). This service assumes no coordination between routes 26 and 29, and the chance of either bus coming when you need it to is entirely randomized. With 38 and 39 being so close to each other, during any rush hour there would not be very much variation in reality. However, if these numbers are inaccurate it may be a better measurement than one might think.

I additionally ran a case where the two routes' schedules are blended. A blended schedule is one which allows for constant headways between routes or branches, e.g. two 30-minute routes combining to provide 15-minute service. The proposed service levels between routes 26 and 29 are very similar, so blending the schedules will provide very little difference in layover time. Both routes were thus treated as one route through the study area, running every 20 minutes (each branch every 40 minutes). The two cases are shown on Table 2 along with the original case.

<table>
<tr><th rowspan="2">26 on Edgeley?</th><th rowspan="2">Schedule blended?</th><th rowspan="2">Walked</th><th colspan="5">Ridership (out of 20,000)</th><th rowspan="2">Total travel time</th></tr>
<tr><th>20</th><th>320</th><th>29</th><th>26</th><th>21</th></tr>
<tr><td>No</td><td>No</td><td>3864</td><td>8477</td><td>2368</td><td>2705</td><td>464</td><td>2122</td><td>287050</td></tr>
<tr><td rowspan="2">Yes</td><td rowspan="2">No</td><td rowspan="2">3549</td><td rowspan="2">7749</td><td rowspan="2">2213</td><td>2488</td><td>2080</td><td rowspan="2">1921</td><td rowspan="2">264722</td></tr>
<tr><td colspan="2">4568</td></tr>
<tr><td>Yes</td><td>Yes</td><td>3417</td><td>7468</td><td>2143</td><td colspan="2">5451</td><td>1521</td><td>257189</td></tr>
</table>

Table 2. Effects of service improvement on Edgeley compared to the existing plan.

In the non-blended case, route 26 took very little ridership away from route 29 and 21, in total less than 10% of both routes' ridership. Route 20 had the biggest drop, but also only did so around 10% perhaps because of a lack of service on Creditstone (it can be assumed the 464 Creditstone riders took route 20 - Jane instead).

Blending the schedules increases ridership of the two routes by nearly 20%, but mostly at the expense of other routes rather than those walking. If both routes are improved until they have a 15-minute combined headway, their combined ridership would be expected to surpass that of route 20 - Jane whether or not route 21 - Vellore runs in the area.

5. Existing plan (AM rush), but instead of a new route on Creditstone one bus is added on Jane.

The frequency of route 20 - Jane during the AM rush would be improved from 13 to 12 minutes. This is a hypothetical scenario. It assumes route 29 ends at Vaughan Mills. This was primarily done to see if it were a more effective solution for reducing travel time than adding a new Creditstone route. In Table 3, this scenario is listed as 4A. Additionally, I tried the same scenario but route 26 ends at Vaughan Mills, giving Edgeley a 39-minute frequency. This scenario is listed as 4B in Table 3.

Scenario	Walked	Ridership (out of 20,000)					Total travel time
		20	320	29	21	26	
2 (17 km/h)	3864	8477	2368	2705	2122	464	287050
4A	3894	8971	2283	N/A	1970	2882	284407
4B	3963	9009	2302	2710	2016	N/A	285755

Table 3. Passenger behaviour under scenarios 4A and 4B compared to the existing plan.

This plan increases the total number who walked, but decreased total travel time compared to the existing plan. Route 20 ridership went up compared to the existing plan by about as much as the route 26 ridership in the existing plan. It also took a small number of riders from route 320. The Edgeley and Vellore (21) services took riders from each other, perhaps partly due to randomness in the sample.

In Scenario 4B, the total ridership on the Edgeley route went down about 100 compared to Scenario 4A, with those 100 either now walking or taking route 20 - Jane or 21 - Vellore. Walking time within the study area increased as well.

6. The previous two scenarios but without an improvement on 20 - Jane.

20 - Jane remains at its present 13-minute AM rush frequency. No Creditstone route is implemented. Route 21 - Vellore continues running along Edgeley south of Langstaff. Case 5A has a 38-minute frequency on Edgeley, and Case 5B has a 39-minute frequency from route 29.

Scenario	Walked	Ridership (out of 20,000)					Total travel time
		20	320	29	21	26	
2 (17 km/h)	3864	8477	2368	2705	2122	464	287050
5A	4061	8560	2448	N/A	2006	2925	287690
5B	4102	8629	2453	2775	2041	N/A	289132

Table 4. Passenger behaviour under scenarios 5A and 5B compared to the existing plan.

This is a better comparison for scenario 2 (the existing plan). The one-minute change in frequency on Edgeley apparently made more of a difference than a Creditstone route, but neither scenario shows an improvement. However, the lack of improvement from Scenario 5A to scenario 2 suggests that a Creditstone route has very little impact on travel speed for riders within the study area.

7. The existing scenario, but one bus on 20 - Jane is replaced by one extra bus on 26 - Maple.

Route 20 - Jane frequency is decreased from 13 to 15 minutes, while 26 - Maple frequency is improved from 38 to 29 minutes. This would likely help people catching the GO Train more than it helps anyone in this business park.

Result:

- Walked: 4042
- Route 20: 7681
- Route 320: 2747
- Route 29: 2766
- Route 21: 2164
- Route 26: 600
- Total travel time: 292115

20 - Jane ridership fell much more than 26 - Maple ridership rose. Clearly, this is not a good solution within the area.

8. Midday scenarios (taken at 1 p.m.)

In the early afternoon, route 20 - Jane's frequency begins to decline for two hours before the PM rush. This scenario does not capture that. Scenario 8A is simply the existing midday service. Route 20 - Jane runs every 15 minutes, 320 - Jane Express does every 17 minutes. Scenario 8B adds two buses to Route 20 - Jane so it instead runs every 12 minutes.

The other scenarios give route 26 - Maple midday service to Vaughan Metropolitan Centre. Scenario 8C brings the route to VMC via Creditstone every 45 minutes. Scenario 8D is the same except the route instead runs on Edgeley Boulevard like the existing rush hour routing. Table 5 shows all the midday scenarios.

Scenario	Walked	Ridership (out of 20,000)			Total travel time
		20	320	26	
8A (no improvement)	6816	9767	3417	N/A	380754
8B (Jane improvement)	5983	11302	2715	N/A	364983
8C (Creditstone)	6509	9679	3286	526	377507
8D (Edgeley)	5748	8576	2954	2722	338101

Table 5. Differences in travel behaviour between the different midday scenarios.

Scenario 8D shows a clear improvement over Scenario 8C, much greater than between scenarios 8C and 8A. Total perceived travel time is down nearly 40,000 minutes in Scenario 8D compared to Scenario 8C (an average of 2 minutes per person). This is bigger than the difference between the existing rush hour plan and modifying route 26 such that service on Edgeley operates on a 20-minute blended schedule. Clearly, this is a much better option.

There is a substantial decrease in the number of people who walked in Scenario 8B compared to 8C, but a much less substantial improvement in perceived travel time. This points to a very minor improvement for a majority of the population, who might barely notice the improvement. An Edgeley route still shows an improvement in both metrics compared to this one, so that solution is likely the best one to carry forward. However, it is more effective in both increasing ridership and reducing travel time than adding a Creditstone Road.

I additionally looked at if route 320 ran its Summer 2026 midday schedule, which has increased service due to Canada's Wonderland's longer hours. The difference between these modified versions of cases 8C and 8D were similar. Route 320's ridership increased compared to the usual case primarily from people no longer walking (noticeably more than the number who took 320 instead of 20).

9. PM rush, existing plan (20 km/h assumption on Creditstone)

Since AM rush conditions are very similar to PM rush conditions, much less time was spent running scenarios for it. However, it is a good sanity check to ensure your solution is also better in the other rush hour.

In the existing plan, Route 20 - Jane runs every 15 minutes, but is much slower than during the AM rush. Route 26 - Maple runs every 41 minutes. Route 29 - Edgeley runs every 40 minutes. Route 21 - Vellore runs every 36 minutes. Route 320 - Jane Express runs every 17 minutes. In the first Edgeley scenario, Route 26 - Maple instead runs on Edgeley Boulevard with a schedule not coordinated with Route 29. The second Edgeley scenario is the same except the Route 29 and 26 schedules are coordinated at a 21-minute headway.

<table>
<tr><th rowspan="2">26 on Edgeley?</th><th rowspan="2">Schedule blended?</th><th rowspan="2">Walked</th><th colspan="5">Ridership (out of 20,000)</th><th rowspan="2">Total travel time</th></tr>
<tr><th>20</th><th>320</th><th>29</th><th>26</th><th>21</th></tr>
<tr><td>No</td><td>No</td><td>4689</td><td>7797</td><td>2591</td><td>3059</td><td>522</td><td>1342</td><td>316236</td></tr>
<tr><td rowspan="2">Yes</td><td rowspan="2">No</td><td rowspan="2">4301</td><td rowspan="2">7172</td><td rowspan="2">2405</td><td>2826</td><td>2184</td><td rowspan="2">1112</td><td rowspan="2">291333</td></tr>
<tr><td colspan="2">5010</td></tr>
<tr><td>Yes</td><td>Yes</td><td>3854</td><td>6770</td><td>2192</td><td colspan="2">5573</td><td>1611</td><td>273004</td></tr>
</table>

Table 6. Differences in travel behaviour between the different PM rush hour cases.

Like during the AM rush, this version of Route 26 does not get much ridership within the business park. This points to investing the resources on Edgeley perhaps being a better option.

The first Edgeley scenario has a decent travel time reduction and shows much higher ridership between routes 26 and 29 compared to the same AM rush scenario, perhaps due to Route 20 - Jane being much slower in the afternoon than in the morning. The travel time reduction here gives me medium (but not high) confidence that enhancing service on Edgeley may be the answer during both rush hours as well as during midday hours.

The travel time reduction caused by blending the schedules is much greater in the afternoon than in the morning. The cause of the swing in 21 ridership is less clear and may be related to the randomness inherent in my model. Regardless, ridership is up across the board particularly on local routes put together as a result of this change during both rush hours, and thus a blended schedule on Edgeley Boulevard is the preferred solution.