

Toronto – Kitchener - London Ontario High Speed Rail

Pre- Feasibility Study prepared for
Ontario Ministry of Transport
Commercial in Confidence

March 11, 2014



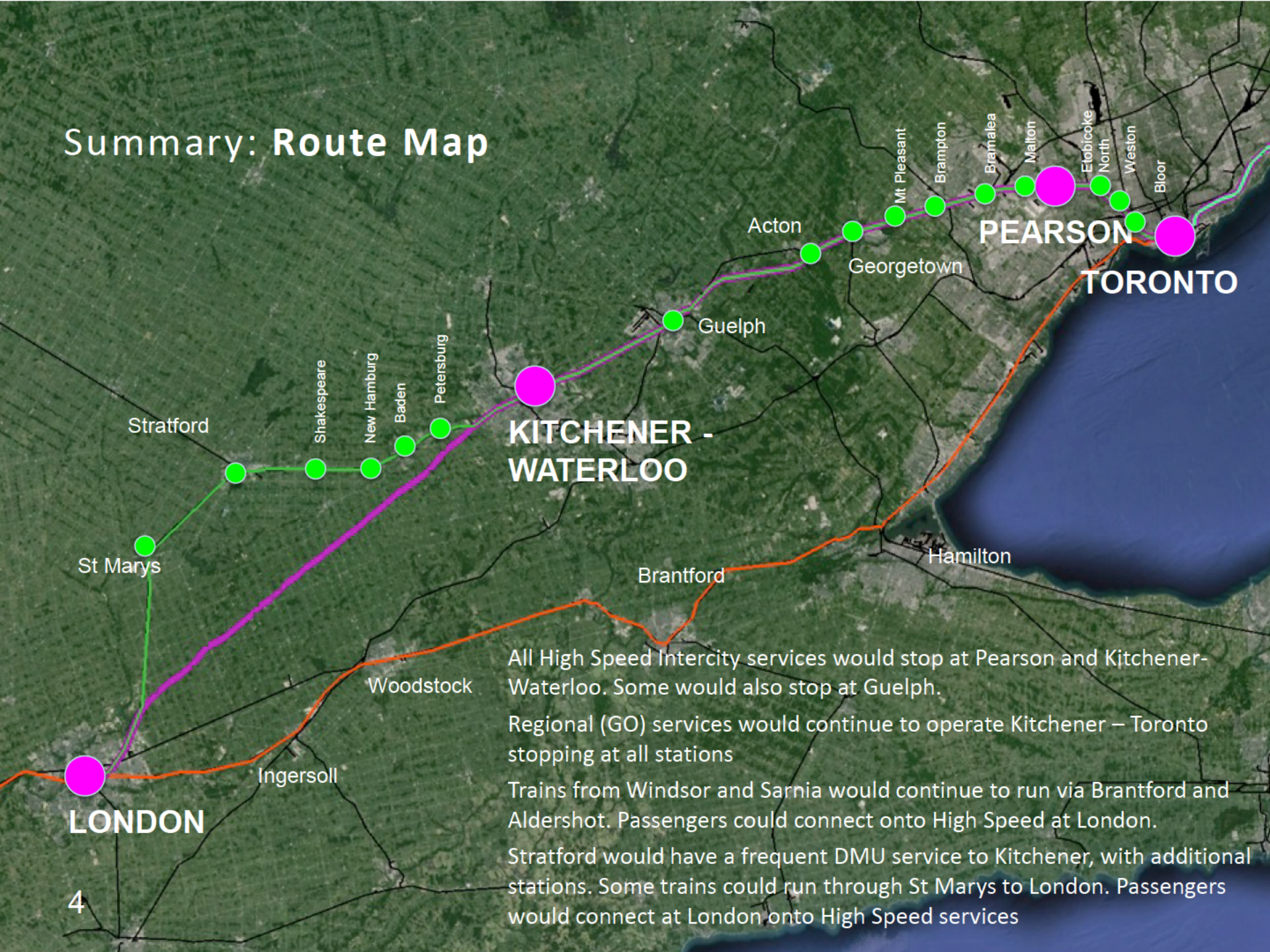
Summary: Concept

- Now 17 million intercity trips per year in Toronto – London corridor, and demand keeps growing
- Today, travel is overwhelmingly by car, on 401
- Bus and rail each have only 3% - 5 %
- In corridors with similar population, density, car ownership and incomes, High Speed Rail is commercially viable
- Has the time come to bring High Speed Rail to Ontario?

Contents

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Summary: Route Map



All High Speed Intercity services would stop at Pearson and Kitchener-Waterloo. Some would also stop at Guelph.

Regional (GO) services would continue to operate Kitchener – Toronto stopping at all stations

Trains from Windsor and Sarnia would continue to run via Brantford and Aldershot. Passengers could connect onto High Speed at London.

Stratford would have a frequent DMU service to Kitchener, with additional stations. Some trains could run through St Marys to London. Passengers would connect at London onto High Speed services

Summary: Key Findings

- Infrastructure cost would be about \$2.5 billion
- By 2025, it would attract about 6 million passengers per year
- About three-quarters of passengers would be “diverted”, with 20,000 car trips taken off 401 each day
- Fare revenues would repay most capital investment with a net cost to government of about \$500m .
- Toronto - London fare would average \$43
- While High Speed Rail would directly serve only London and Kitchener, GO riders from Guelph, and communities across south western Ontario would see benefits
- “Worst Case” estimate of 100 homes to be acquired for construction (probably less)
- Residents will be concerned about noise, vibration, and visual impacts along the rail corridor through Brampton, Guelph, Kitchener, London, but none will be severe and all can be mitigated
- No serious environmental or engineering challenges have been identified, so the scheme might be implemented in 8 years (3 - 4 years to plan and approve, then 3 - 4 years to build and commission)

We tested 5 service and investment options

	Trains	Description	Infrastructure		Intercity	Toronto to		Regional	Toronto to
				Capex \$millions	Trains/day	London	Kitchener	Trains/day	Guelph
0	160 km/h LRD	Existing	Existing	0	6	2h 24 (via Brantford)	1h 41	2	1h 33
1	160 km/h LRC	Do Minimum Base Case	Track renewal	\$190m	6	3h 20 (via Kitchener)	1h 37	2	1h 11
2	160 km/h Diesel	DMUs	Same	\$454m	8	2h33 (via Kitchener)	1h 10	20	1h 11
3	200 km/h Diesel	Improvement s to Kitchener	+ Acton- Rockwood bypass	\$924m	28	2h11	0h 56	20	1h 07
4	200 km/h Diesel	New line Kitchener - London	+ Kitchener – London Direct line	\$2,257m	28	1h 31	0h 56	20	1h 07
5	320 km/h Electric	Electric	Same	\$2,457m	28	1h 11	0h 48	20	1h 07

Note: In option 2, journey times from London via Kitchener to Toronto would still be slightly slower than the existing service via Brantford, which is assumed to continue operating in all cases, however, passengers would benefit from a higher frequency and also service to Pearson airport. Journey times from Kitchener would be substantially reduced.

Option 5 gives by far the greatest net benefits

	Trains	Intercity Riders 2025 (millions)	Intercity Operating Margin 2025 (a) (\$millions)	Financial NPV (\$millions) (b)	Highway and passenger benefits NPV (\$millions)	Net Benefits NPV (\$millions)	Transport Benefit/Cost Ratio (c) Absolute and Incremental	Benefit:Cost Ratio (with wider benefits)(d)
1	160 km/h LRC	0.8	(18)	(725)	569	(156)	0.9	1.9
2	160 km/h DMU	1.1	(41)	(1,120)	717	(401)	0.9 (1.0)	1.8
3	200 km/h DEMU	2.2	(40)	(1,455)	1,142	(313)	0.9 (23)	1.9
4	200 km/h DEMU	4.6	22	(1,466)	2,370	903	1.2 1.8	2.4
5	320 km/h Electric	5.9	102	(559)	3,122	2,563	1.5 1.2	3.1

(a) Net of rolling stock lease charges

(b) Financial NPV is funding support required from Government over 30 years, net of revenues, discounted at 5% per year. Incremental Financial NPV for options 2 – 5 can be calculated by deducting \$725m NPV capital and operating subsidies estimated to be required in the Do Minimum Base Case.

(c) Transport benefit cost:ratio is the total of passenger revenues, value of time savings to passengers not captured through fares, and highway benefits (congestion relief), divided by total capital and operating cost. The first figure is absolute; the second is incremental against Option 1

(d) Recent research indicates that wider economic benefits, including employment mobility and other agglomeration benefits, typically double the benefit:cost ratios for a scheme of this type.



Summary: 2 main types of Services

“Intercity”

- 2 trains per hour all day, 320 km/h + electrified
- 71 minutes from London, 48 minutes from Kitchener
- Business and Economy Class
- Dynamic market pricing, but average fare about \$43
- Trains might eventually run through to Peterborough, and perhaps Kingston, Ottawa, Montréal and Québec City



“Regional”

- Hourly all day service to Kitchener, 2 per hour from Guelph, Mt Pleasant, 4 per hour from Georgetown, and all stations to Union
- Additional trains in peaks and from Georgetown as required to carry traffic
- Presto fares, integrated with other GO and regional bus and rail services
- Trains might run through to Peterborough

Also DMU service for London – Stratford – Kitchener route



Route Details

- Toronto - Georgetown
- Bramalea – Georgetown
- Niagara Escarpment (Acton – Rockwood)
- Guelph
- Kitchener
- Kitchener – London
- London Centre
- Services to Guelph, Stratford, Woodstock
- Alternative: Toronto freight bypass

Route: Toronto - Georgetown

Do Minimum Base Case:

- Track is modernized and electrified for UP Express
- Additional tracks as required for 2-way all day services as defined in GO Upgrade Business Plan
- No additional capex required for 130 km/h Regional (GO) and 160 km/h Intercity services

Options 3, 4, 5

- 5 additional grade separations for 200 km/h+ operation (all rail over road @\$10m each so \$50m)
- \$50m contribution to Union Station costs

Route: **Brampton - Georgetown**

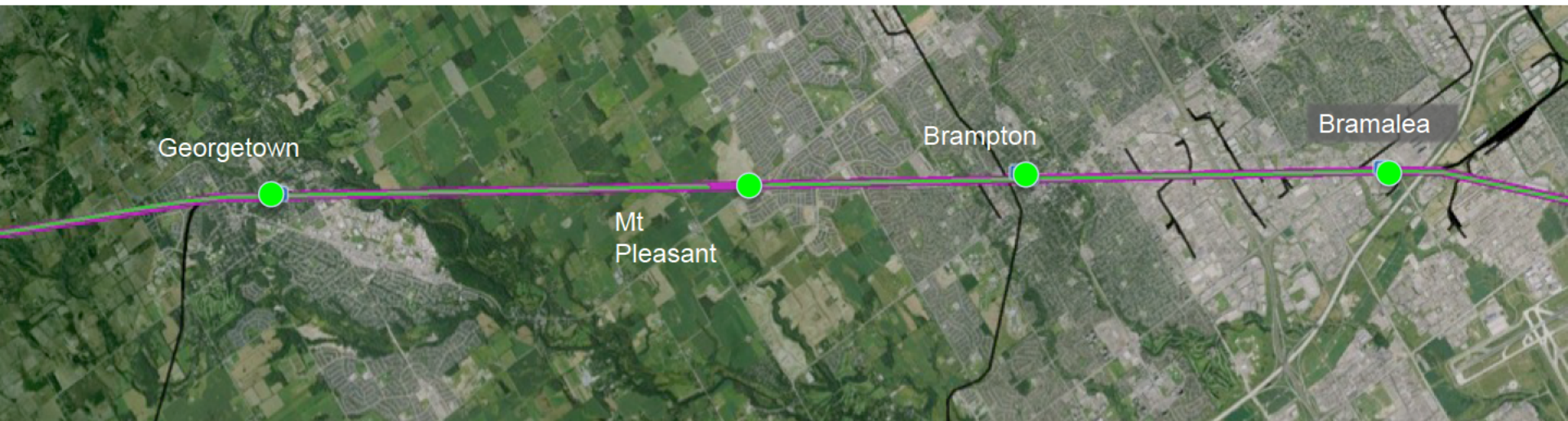
Impact

- No homes will need to be acquired, but about a hundred homes near rail corridor will be affected by increased noise, but mostly 7AM – 9PM.
- Line is mostly at grade and in cutting so impacts will be modest.

Benefits and Mitigation

- Traffic and safety will be improved as the line will be entirely grade separated

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Route: Georgetown – Guelph - Kitchener

Do Minimum Base Case:

- Existing single track is modernized and electrified for GO; No additional capital expenditure required for 130 km/h Regional (GO) services at hourly all-day frequency; 80 km/h curves remain (A)

Option 3 – as above plus

- 30 additional grade separations, allowing 200 km/h operation (all rail over road, with 5% gradients @\$5m each so \$200m)

Options 4 and 5 (Recommended Scheme)

- All double track for higher frequency services
- Acton – Rockwood bypass (B) and Guelph improvements

Mitigation Alternative

- Acton-Rockwood-Guelph bypass (C)
- Fewer residential impacts but would not serve Guelph City Centre
- Cost might be similar, including retention of existing line through Guelph for GO and Freight



Route: Through the Niagara Escarpment

Recommended Scheme

- 17 km new railway through farmland and woodland, and through the Niagara Escarpment, a "Unesco World Biosphere Reserve"
- 5- 10 homes would need to be acquired
- New cutting into the Escarpment

Benefits and Mitigation

- New Route removes existing rail line from Acton and Rockwood, avoiding 50 km/h curves
- Cuts the escarpment through existing quarry, which can be restored to a more natural state
- Route avoids all Conservation Areas
- Existing rail line can be converted into park and hiking/cycling trail
- Traffic and safety will be improved as the line will be grade separated

Rockwood

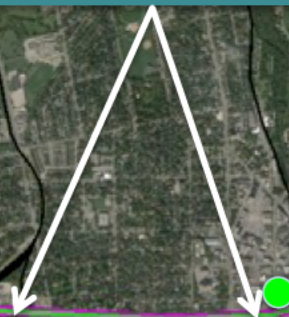
Acton

New 17 km line with 5% gradients up Niagara escarpment avoiding 3 x 80 km/h curves

Relocated Acton GO station (in quarry?)

Route: Through Guelph

Line dropped in cutting on existing alignment, eliminating level crossings



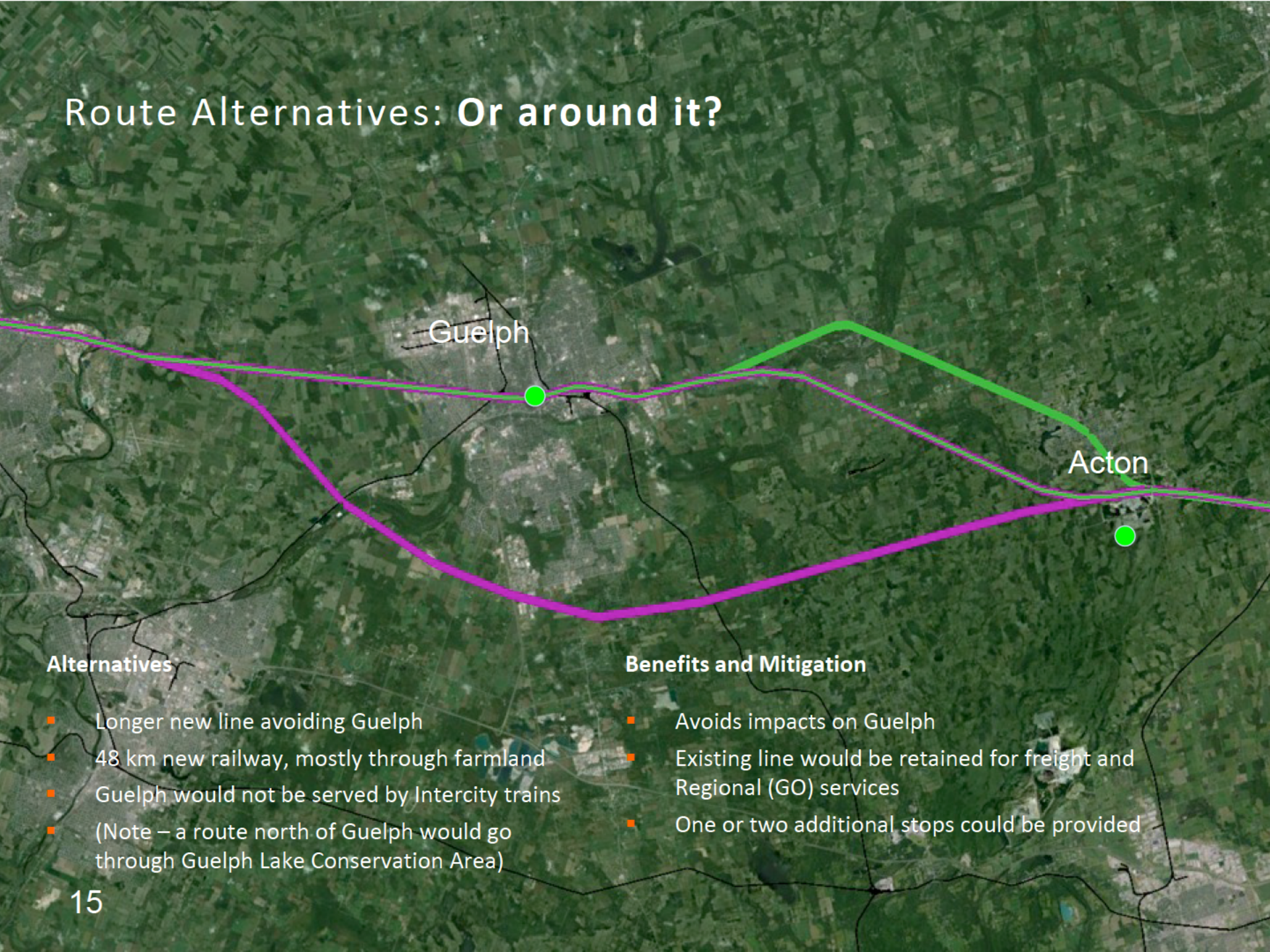
Recommended Scheme

- Up to 50 homes along the existing rail corridor may need to be acquired
- Substantial disruption during construction in the city centre

Benefits and Mitigation

- The existing surface line along Kent Street would be dropped in cutting (\$150 million?)
- Rail freight access for local industry would be maintained using lines to Preston and Campbellville
- Traffic and safety will be improved as the line will be grade separated

Route Alternatives: Or around it?



Guelph

Acton

Alternatives

- Longer new line avoiding Guelph
- 48 km new railway, mostly through farmland
- Guelph would not be served by Intercity trains
- (Note – a route north of Guelph would go through Guelph Lake Conservation Area)

Benefits and Mitigation

- Avoids impacts on Guelph
- Existing line would be retained for freight and Regional (GO) services
- One or two additional stops could be provided

Route: Through Kitchener City Centre

Recommended Scheme

- The existing surface line through the city centre would be dropped in cutting
- Some businesses, but no homes would need to be acquired
- Substantial disruption during construction in the city centre
- Issues as to future freight access to sidings

Benefits and Mitigation

- Rail freight access for local industry would be maintained using line to Preston
- Traffic and safety will be improved as the line will be grade separated
- Estimated \$200m cost including station

Route: **Kitchener – London (New Line)**

Kitchener

Stratford

St Marys

Impact

Recommended Scheme

- New direct line (62 km new line, with 56 crossing bridges, \$800 million)
- Severance of many farms, which will have fields across the railway requiring lengthy detours for farmers– or land swaps
- Some noise impacts on nearby homes
- Would not serve Stratford or St Marys

Benefits and Mitigation

- New alignment can be “wiggled” to avoid most farm houses and all communities
- The existing line via Stratford and St Marys would be retained for freight a regional passenger services

London

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Route: Typical Kitchener – London section



Route: London City Centre Approach

Recommended Scheme

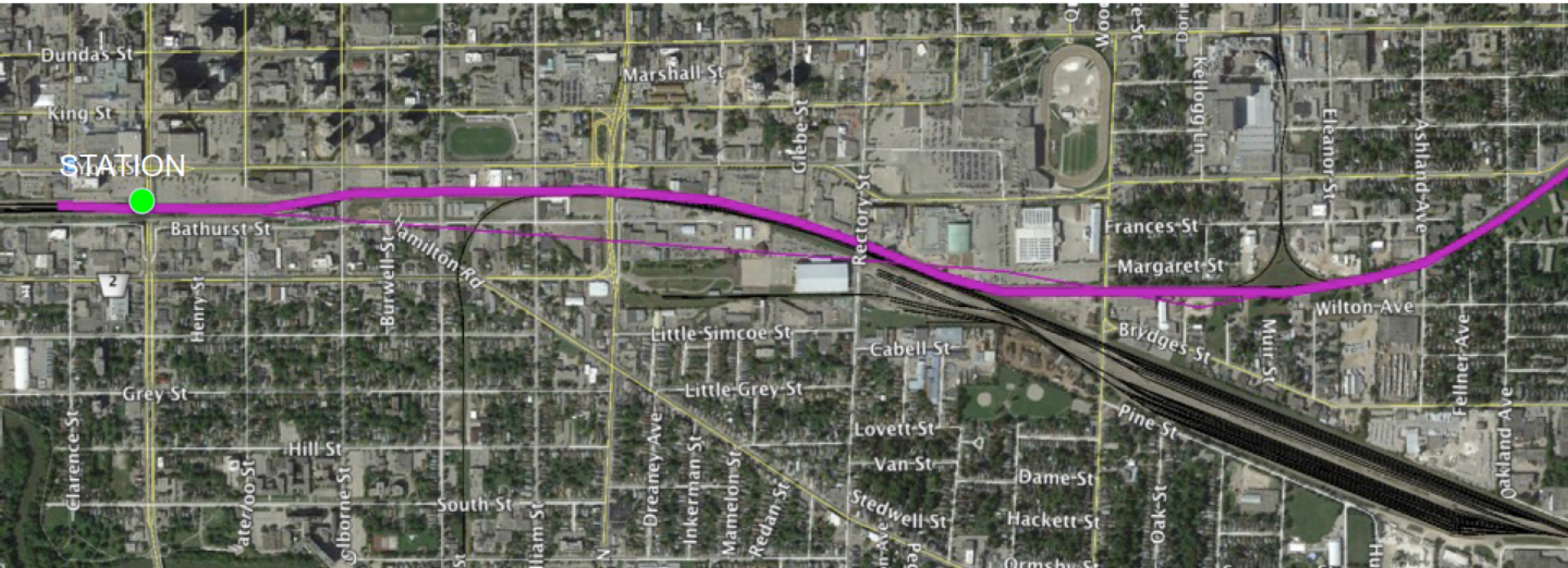
- Elevated line for final 5 km approach (\$100m)
- Some noise impacts on nearby homes (noise barriers can be used)
- Visual impacts from elevated line (mostly commercial/industrial corridor, but some residential)
- New or expanded station (\$100m)

Benefits and Mitigation

- The line could be lowered into cutting, but cost would be \$200m (?) higher as the length of line is longer than in Guelph or Kitchener and it would be more difficult to maintain rail freight access
- Local employment (main maintenance and crew base)

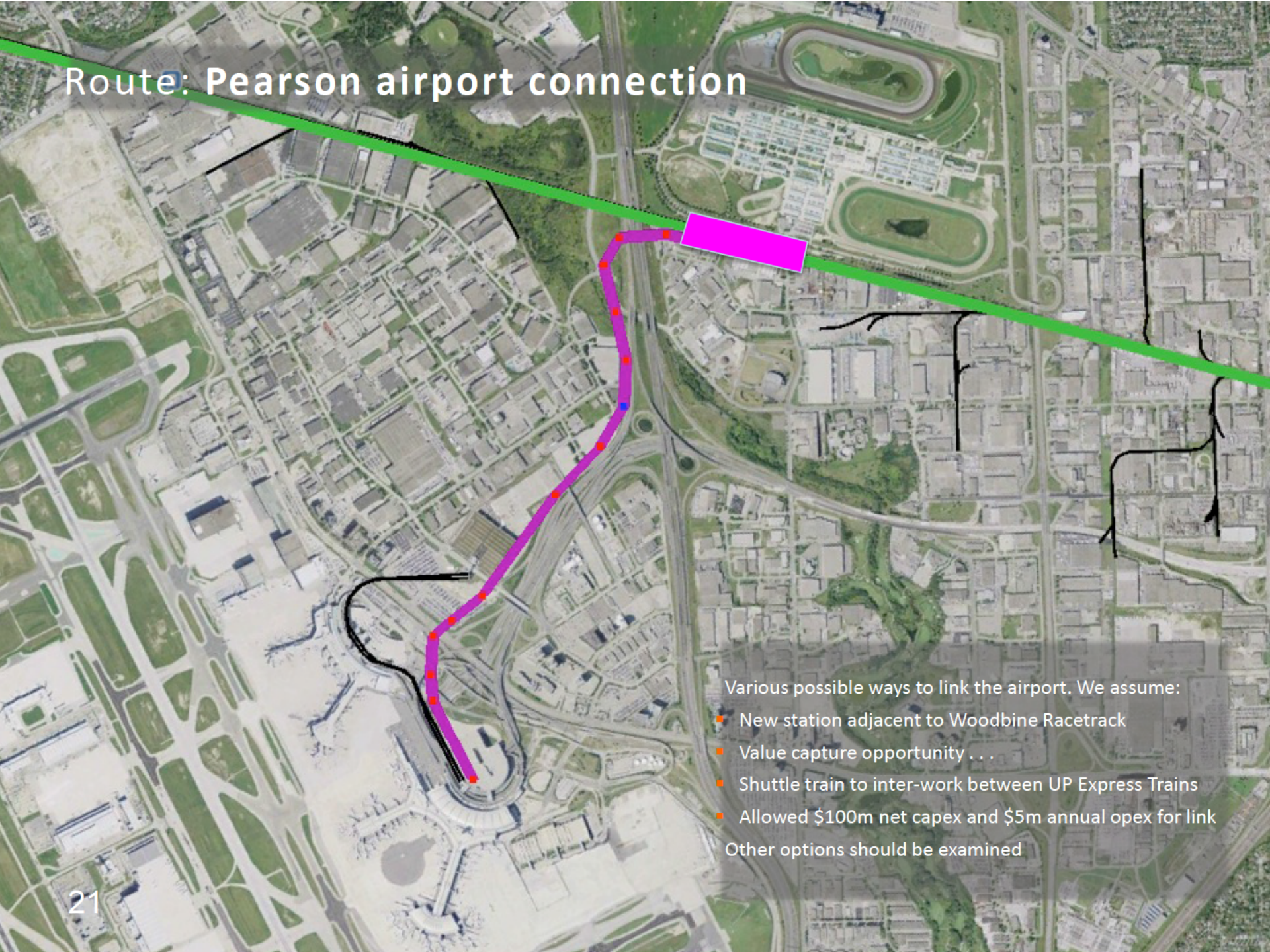
Image City of London
Image © 2014 DigitalGlobe

Route: London City Centre



- 5 km elevated line with elevated station will cost about \$200m
- Below grade option likely \$400m plus . . .

Route: Pearson airport connection



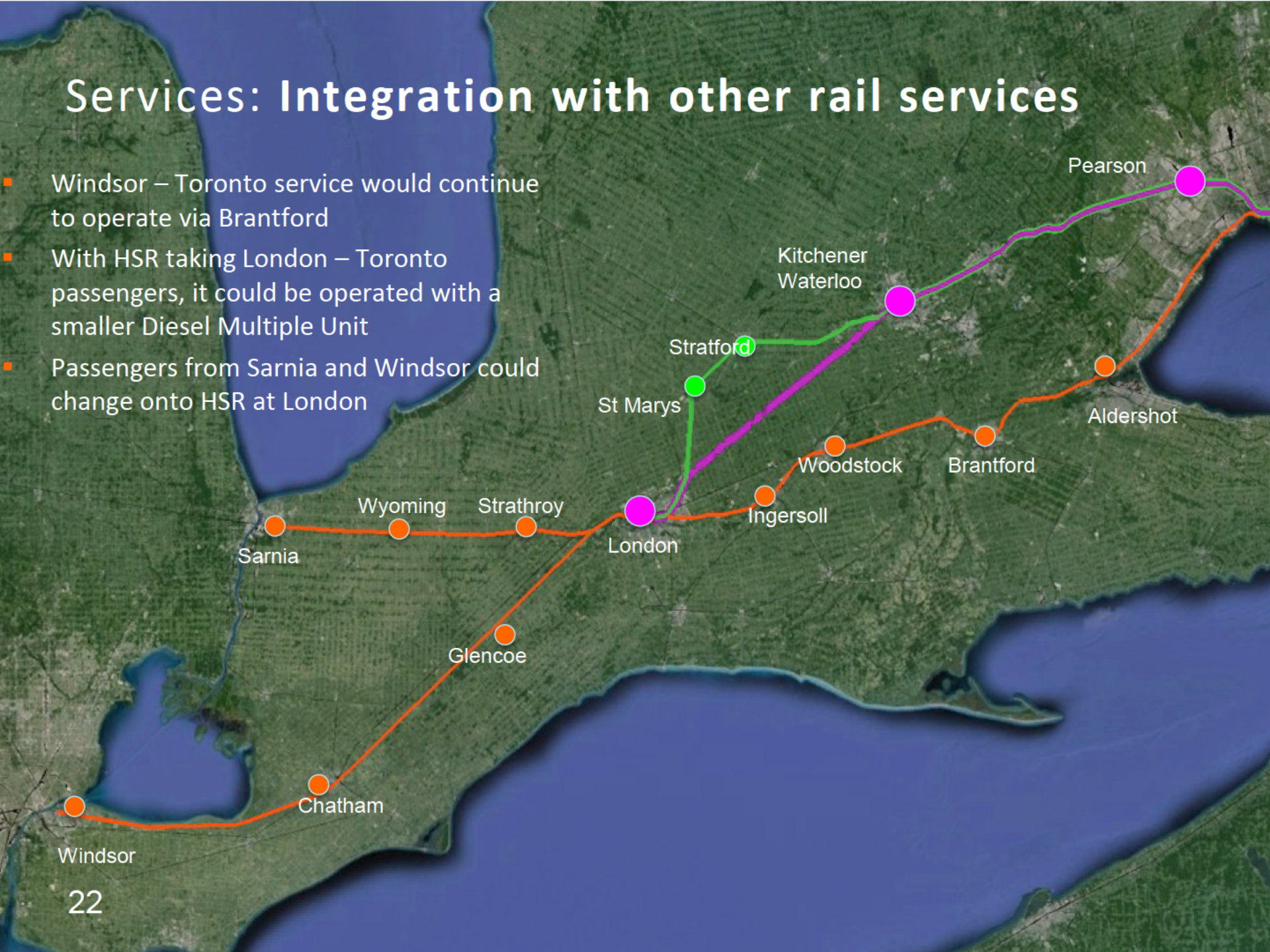
Various possible ways to link the airport. We assume:

- New station adjacent to Woodbine Racetrack
- Value capture opportunity . . .
- Shuttle train to inter-work between UP Express Trains
- Allowed \$100m net capex and \$5m annual opex for link

Other options should be examined

Services: Integration with other rail services

- Windsor – Toronto service would continue to operate via Brantford
- With HSR taking London – Toronto passengers, it could be operated with a smaller Diesel Multiple Unit
- Passengers from Sarnia and Windsor could change onto HSR at London



Services: Serving Stratford

- It is unlikely to be cost-effective to electrify line to Stratford and St Marys
- DMU service could shuttle between London and Kitchener, where passengers would interchange with HSR
- With through passengers using HSR direct to London, trains could make additional stops, at Petersburg, New Hamburg, Baden and Shakespeare. These might attract a market of commuters into Kitchener
- Some direct trains might operating from Toronto to Stratford during the Festival
- Even with the need to change at Kitchener, travel times and frequencies would be substantially improved from the current level



Evaluation

- Key assumptions
- Do Minimum Base Case Definition
- Capital costs
- Operating costs
- Traffic and Revenues
- Benefits

Evaluation: Key Assumptions

Key Assumptions

- 3%/year rail demand growth
- 1.6%/year incomes and wages growth
- 0.8%/year fares escalation (real)
- 5%/year discount rate (Metrolinx)
- \$14.32/hour value of time (Metrolinx)

Do Minimum Base Case

Assume implementation of GO Upgrade plan

- Union – Kitchener track renewed and electrified
- 2 new tracks Bramalea (Halwest) to Georgetown
- Single track Georgetown – Kitchener

See Excel Model for all assumptions and

detailed cost buildups

section 17(1) applies to the 2 excel models in their entirety

Capital and Operating Costs

- Cost rates from 2011 Federal-Provincial “Ecotrain” Study, subsequent VIA high speed rail study 2012-2013, and FCP sources
- Capital costs for new lines validated against reported TGV-Est costs (formal audit by Réseau Ferré de France)
- Operating cost estimates calibrated against GO and VIA existing costs, and UK train operating companies
- Rolling stock is assumed to be procured using a train service agreement (wet lease); lease charges are included with operating costs
- Cost estimates are inclusive of contingency, which is not added separately. Out-turn costs might be 25% higher or lower.
- Assume no real increases in diesel or electricity prices, or motoring costs

Evaluation: Traffic, Revenues, and Benefits

- Traffic and revenues estimated from existing traffic using LOGIT model
 - 7 Intercity zones (Inner/outer Toronto, Kitchener, London, plus Pearson)
 - Regional flows between Guelph, Georgetown, Brampton, and Malton to Toronto and Pearson
- LOGIT model used to estimate rail traffic growth due to improvement in rail service
- Time savings to passengers, not captured through fares, estimated using Metrolinx standard value of time
- Road user benefits estimated at \$5 per new rail rider diverted from road, on same basis as in GO Upgrade Study. This may be a considerable under-estimated, given the length of journeys and congestion on 401 that will be alleviated
- Wider Economic Benefits (agglomeration benefits) assumed to be 1x transport benefits

Evaluation: Fares

- Dynamic market pricing would be used to adjust fares in real time for Intercity Services. This will maximize ridership and revenues, and ensure seats are always available for last minute travellers
- Indicative fares are based on existing VIA fares, but Intercity peak fares 50% higher to reflect more frequent and faster services. Average Intercity fare would be about \$43 each way
- No increase from current VIA off peak fares
- Fares on GO Regional services are assumed to be as existing

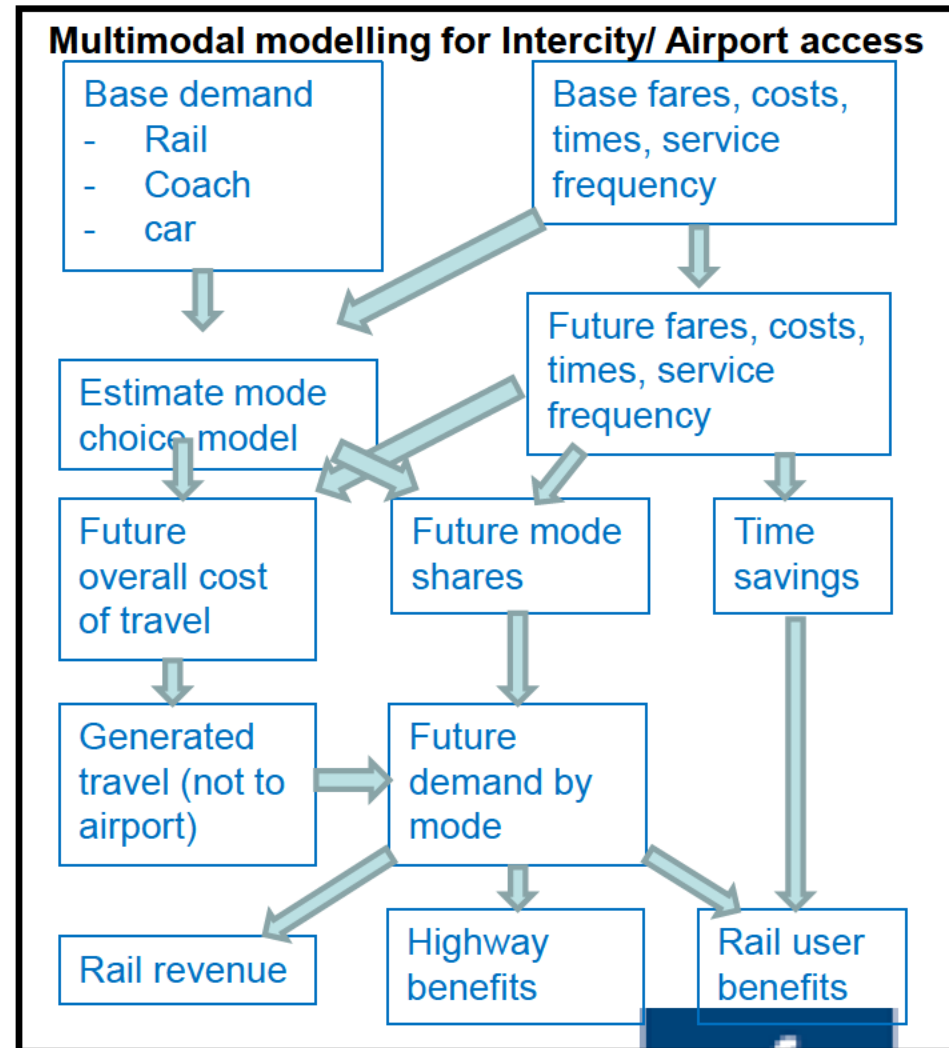
Proposed indicative London - Toronto fares compared to current VIA \$

Fare type	Current VIA	Proposed peak	Proposed off-peak
Business Plus	\$129	\$189	\$129
Business	\$65	na	na
Business Escape > 1 week	na	\$95	\$65
Economy Plus	\$75	\$115	\$75
Economy	\$38	na	na
Escape < 1 week	\$29	\$59	\$39
Escape 1 week – 1 month	\$29	\$44	\$29
Escape > 1 month	\$29	\$29	\$19

Evaluation: Transport Model Structure

Pre-feasibility study: make best use of available data using simple spreadsheet models

- 3 distinct markets considered:
 - Intercity between Toronto and Kitchener/London
 - Kitchener/London to Pearson Airport
 - Regional services from Guelph and inwards to Toronto
- Multi-modal modelling for Intercity and Airport
- third market followed same principles as that for GO enhancements – journey time elasticity for peak, with off-peak based as proportion of peak, dependent on service frequency



Evaluation: Traffic assumptions, data and calibration

Base data

- Base demand levels estimated from VIA data, coach service levels, highway traffic – assumed 50% of market captive to car
- Fares, journey times from internet
- Cities separated into areas close to and far from stations – population from government website
- Airport catchment area and interlining from Masterplan
- Value of time as previous studies
- Unit highway benefits from previous studies

Model estimated to give:

- Current mode shares
- Appropriate elasticities to fare and time
- Generation based on international experience of proportion of demand abstracted/generated

Model implemented to calculate proportional increase in demand by mode

Revenue and economic benefits calculated from the change in demand, unit time savings and highway benefits

Evaluation: **Options tested**

Options defined in terms of

- Journey times
- Service frequency
 - Hourly and half – hourly
 - checked that it is adequate to carry demand
- Fares – assume 50% peak fare increase for 320 km/h and above, 10% for 200 km/h; no increase on regional services
- Interchange for access to Pearson Airport
- No change assumed to car times or costs, or coach (although in reality coach service frequency would likely reduce substantially or cease to operate)

Evaluation: **Other assumptions (all conservative)**

- Air market between London and Toronto ignored, as assumed to be mainly interlining passengers
- Ignored demand for journeys to or from points beyond London and Toronto (eg, Windsor – Toronto, London – Montréal, Kitchener - Cobourg) many of which already use rail
- No competitive response from coach assumed, although in reality we consider they are more likely to withdraw than seek to compete strongly on price – marginal capacity on HSR can be sold cheaply with Advance Purchase tickets undermining coach market
- Highway costs and times assumed unchanged in future years, no increase in gasoline prices or parking charges, no increase in highway congestion

Evaluation: International Comparators

	London - Bristol	London - Leicester	Paris - Lille	Toronto – KW - London (proposed)
Population of second city	432,000	772,000	1,015,000	474,000 (London) 441,000 (K-W)
Distance km	187	160	217	175
Rail trip time (minutes)	90	63	63	71
Typical off-peak fare one-way	\$55	\$50	\$70	\$43
Annual intercity demand	3.7m	1.9m	5.5m	6m
Train type	Diesel 200km/h	Diesel 200 km/h	Electric bi-level 300 km/h	Electric bi-level 320 km/h +

Forecast demand is in line with comparable city pairs in the UK and France

Areas for Further Study

- Optioneering to confirm alignment and impacts
 - Through Guelph, or around it?
 - Elevated or in cutting in Kitchener and London?
 - Evaluate alternative strategies to serve Pearson Airport
 - Public consultation
- Validate capital and operating costs
- Develop and test train plans
- Detailed analysis of transport and wider economic benefits
- Implementation and AFP structures
- Options for VIA – GO relationship and Federal support
- Prepare Environmental Assessment and begin procurement

Supplemental Materials

1. FCP High Speed and Intercity experience

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1. FCP High Speed Rail Experience

- Michael Schabas led the study team. Toronto-born, he has played leading roles developing and operating intercity, regional and high speed passenger rail services and infrastructure in the UK, Germany, and Australia. He was retained as special advisor to British Rail during development of the high speed line between London and the Channel Tunnel. He is retained to advise VIA Rail and the World Bank, among other clients.
- Chris Stokes has 40 years experience developing regional and intercity passenger rail services, mostly in the UK. He has developed business plans for numerous passenger rail investments, ranging from incremental service upgrades and new stations to the \$10 billion Thameslink project. In the late 1980s, he was responsible for all network development in the London region, and then held the same role nationally at the Strategic Rail Authority.
- John Segal is probably Britain's leading rail transport economist. He was business planning manager for Eurostar, the London-Paris High Speed service, when it commenced service. As a consultant, he has advised on numerous high speed, intercity and regional rail schemes and operating franchises in the UK, France, and Australia. He led development of the Business Case for High Speed 2, the London – Birmingham – Manchester line now under development

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3. Toronto East Rail Strategy

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– GO Transit

Toronto East Opportunities



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January 2014

- GO serves regional trips, especially commuters, in and around the GTHA
- GO receives capital support from the Ontario Government
- GO fares are expected to recover about 80% of O&M costs
- New services and investment need to be supported by a robust Benefit Cost Analysis
- GO's over-riding mission is to reduce traffic congestion and avoid further highway capital expenditure

The 2010 “Ecotrain” scheme would run close to the lake, and would affect hundreds of homes but not actually serve local passengers



Could there be an integrated solution?

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Could there be an integrated solution?

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Business Case appears attractive

Preliminary financial and economic analysis suggests:

- Lakeshore GO service to Kingston, using 3 car DMUs could operate at profit. Road congestion benefits should justify at least £500m in capex

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225 km/h commuter trains operate profitably over the UK's high speed line



Next steps

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Appendix – Costs and Revenues

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