HIGH PERFORMANCE RAIL · CHAPTER 4

Route Alignment and Capital Cost

Where the line goes decides what it costs. This chapter chooses the route, then prices it against what comparable railways have actually cost — not against an in-house estimate.

Chapter 3 explained why passenger and freight traffic should be separated. This chapter answers the two questions that follow: where should the line go, and what will that route cost to build? The first half is a question about geography and people — whether the corridor is even still available, and what using it would mean. The second half prices that corridor against the real cost record of comparable railways, so the headline figure is a prediction drawn from evidence rather than a planner's hope. Route and price are handled together because they are the same decision seen twice.

Status of the figures. Figures attributed to a source are quoted from the named published source and can be checked there. Every other figure in this chapter is a calculation or estimate by the Initiative from those inputs, and the sentence or table note that carries it names the inputs used. Route lengths and land-cover areas are measurements taken from the Initiative's own digitised geometry; the cost figures are model predictions and order-of-magnitude planning estimates, not costed bills of quantities, and are reported as ranges where the inputs support a range. Journey times are estimates of the same kind as ALTO's published figures and have not been simulated. Where ALTO has not published something the text says so rather than inferring it, and no claim is made about why any particular figure was or was not published.

4.1 Is the Corridor Foreclosed for HPPR?

Whether a railway can follow an existing corridor, or has to cut a new one of its own, is settled by the speed it is designed for. Speed sets how straight it must be, and the relationship is steep: the sideways force in a bend grows with the square of the speed. A curve needs a radius of roughly 1,900 metres at 200 km/h, about 2,700 at 240, and about 4,250 at 300 — nearer 7,000 for a comfortable ride at that speed. Anywhere in the 177–240 km/h band those curves are gentle enough to follow a route already cut through the landscape, easing its bends here and there. At 300 km/h the curves run for kilometres, and no amount of easing fits them alongside Highway 401 or the CN Kingston Subdivision. Alto has said the same thing in its own defence of the northern route, stating that following the 401 would not be possible because of the wider curve radius its 300 km/h trains require. The line must strike out straight across open country. That is physics, not preference.

Which is why the project's own history matters. As Chapter 2 described, what became ALTO entered procurement as VIA High Frequency Rail. A Privy Council Office briefing note of 20 February 2025, signed by the Deputy Clerk of the Privy Council, Christiane Fox, and released under ATIP A-2025-00015, sets out what that was: in February 2022 the project was conceived as a conventional high-frequency concept, with speeds of up to 200 km/h, using dedicated tracks on mostly existing rights-of-way. That is a railway that follows corridors already cut through the landscape — the same approach HPPR takes.

The Request for Proposals issued on 13 October 2023 then required each of the three bidders to develop two solutions with respect to speed: one with trains reaching a maximum of 200 km/h, and a second including high-speed segments. Transport Canada described the second as a more ambitious option, and stated that this structure would allow the costs and benefits of incorporating high speed to be assessed on each segment of the corridor.

The same note records what came back. As the Request for Proposals progressed, the bidders presented designs more ambitious than the high-frequency concept: all of them favoured new alignments on largely new rights-of-way, and a high-speed concept at more than 250 km/h. The project announced on 19 February 2025 is a 300 km/h line on a new right-of-way. (Privy Council Office, « Note à l'intention du Lieutenant du Québec — Train à grande fréquence », 20 February 2025, pp. 000001–000002, released under A-2025-00015. The note is in French; translations are those of the ALTO HSR Citizen Research Initiative (the Initiative).)

Two things follow from those documents. First, the move to high speed was set out in the procurement documents from October 2023 onward, and the note records that all the bidders proposed it; it did not originate with any single consortium. Second, the note attributes the conclusion that the proposals would deliver greater benefits than the high-frequency concept to an analysis by a third party that it does not identify, and the Initiative has not located that analysis in any material released to date. The segment-by-segment comparison the Request for Proposals set out is therefore not available for public examination.

The consequences are the subject of this chapter. At 300 km/h the corridors already cut through the region are ruled out by specification along their whole length, and the new path through the Frontenac Arch, the land required, the cost and the opposition all follow from that.

THE SPECIFICATION FORECLOSED THE CORRIDOR

The government's own record describes the original project as a high-frequency concept with speeds of up to 200 km/h, using dedicated tracks on mostly existing rights-of-way (Privy Council Office briefing note, 20 February 2025). The project announced on 19 February 2025 is a 300 km/h line on a brand-new right-of-way (Chapter 2).

A 200 km/h railway can follow an existing route; a 300 km/h railway cannot. The specification ruled out the corridor along its whole length, before a single alignment was surveyed — the cheap option given up in the act of prioritizing speed.

> *The corridor was lost the moment the specification went from 200 to 300 km/h — so prioritizing speed left the cheapest path unused.*

The June 2026 announcement looks, at first, like that closure being reopened. Releasing ALTO's What We Heard consultation reports in Kingston on 22 June, the Minister of Transport announced a strong preference for a southern route and directed ALTO to assess a southern option between Peterborough and Ottawa, with a possible Kingston stop connecting to VIA Rail, subject to technical feasibility; consultation on that section follows in 2027. But the closure was never about which line ALTO preferred on a map. It was about the specification, and the southern option is still a 300 km/h railway. The Minister described a corridor roughly sixty metres wide that must mostly run straight, and accepted it is a longer and more expensive route, not a cheaper one. A station in Kingston is not the same as the 401 corridor: the city's own mayor, welcoming the news, accepted the route may not run "right along the 401." What has changed is the route's latitude and its station list — not the speed target that rules out the corridors already cut through the region.

4.1.1 Looking at the Whole System: A Less Connected Eastern Ontario

There is a second reason the specification is wrong, and it has nothing to do with curve radii. The first of the 10 Guiding Principles of HPR is to look at the whole system: treat the network as one connected whole. Applied here it asks a question the speed target never had to answer — does the new railway leave Eastern Ontario more connected, or less? Eastern Ontario is not a dense place. Between the Greater Toronto Area and Montréal the lakeshore corridor is a string of small and mid-sized communities — Cobourg, Belleville, Napanee, Kingston, Brockville, Cornwall — separated by farmland, forest and rock. A railway here cannot draw riders from density it merely passes through; it has to earn them from the places it touches.

Furthermore, growth in the region is structurally tied to Highway 401. That is already where the people, the jobs and the development are, and the widening now under way will reinforce it: interchanges attract commercial development, logistics parks follow, subdivisions follow them, and the utility corridors lock in behind (§4.9). The towns and businesses along it depend on that axis for both of the jobs it does. It moves their people, and it moves their freight — the distribution centres, food processors, manufacturers and farm operations of Eastern Ontario reach their markets over the 401. The same geography supports the region's water-dependent infrastructure as well: hydroelectric generation on the St. Lawrence, and the water- and power-hungry data centres now drawn toward that combination of water, power and highway access. Power, water, freight and people follow the same line on the map.

This is what makes a greenfield railway the less connected outcome. A 300 km/h line on a new alignment puts the region's one major new piece of transport infrastructure where its people, its freight and its growth are not. It serves the endpoints at the expense of the corridor between them, leaving the 401 to absorb the upcoming century of passenger and truck growth alone. A corridor-following railway does the opposite: it adds transportation capacity along its prime economic axis that is already growing, puts stations where the population will actually be, and — by separating passenger from freight traffic — frees capacity on the existing rail line, the freight dividend of Chapter 3. A valuable geographical corridor, doing several jobs, for the region that has to live beside it.

> *Looking at the whole system asks what the speed target never had to answer: does the railway leave the region more connected, or less? A 300 km/h line on a new alignment serves the two endpoints and bypasses everything the region is built around.*

4.2 An Opportunistic Solution

If the corridor is still available — just — the right move is to take it, for the generations that follow. But the route is not drawn to a speed target and justified afterwards. It is drawn to the 10 Guiding Principles of HPR, and the speed follows from them. Inside the Toronto–Ottawa–Montréal triangle the route comes in two parts, as Chapter 3 set out: a spine of roughly 479 kilometres on the Toronto–Montréal axis, from Pickering Junction to Dorval, built and upgraded as a dedicated passenger route; and the Ottawa legs, roughly 237 kilometres of upgrades on the publicly owned Smiths Falls, Brockville and Alexandria Subdivisions.

Four of the ten bear directly on where the line goes and how fast it runs. Go fast enough, not the fastest possible (P4) sets the target at 177–240 km/h: quick enough to compete with driving and flying door to door, without the cost of a brand-new, arrow-straight high-speed line. The 240 km/h ceiling is chosen because it is the more practical limit in Canadian heat and cold, and HPPR takes it as its design maximum. Mix new construction with upgrades (P8) says use existing track wherever it gives better value, and build new only where it is needed. Share the tracks (P9) points the line into routes that already carry transport. And build for communities (P2), with reach downtowns and smaller towns (P7), keeps the line near the places it is meant to serve instead of bypassing them across open country. Together, these rule out a 300 km/h railway. The speed comes down to the band because the principles put the line in corridors that already exist.

That is what makes the solution opportunistic, and it works on two levels at once. The first is the route. In each stretch the line follows whichever existing corridor runs straighter — Highway 401 or the CN Kingston Subdivision — sitting beside it rather than on it, grade-separated throughout, built for a maximum of 240 km/h, with a length-weighted average top speed of about 201 km/h and the whole spine costed at the 200 km/h standard, and with no major tunnels and a limited number of viaducts along a well understood corridor. The two run roughly parallel for most of the way, so the ground the railway follows is already a transport corridor rather than open farmland.

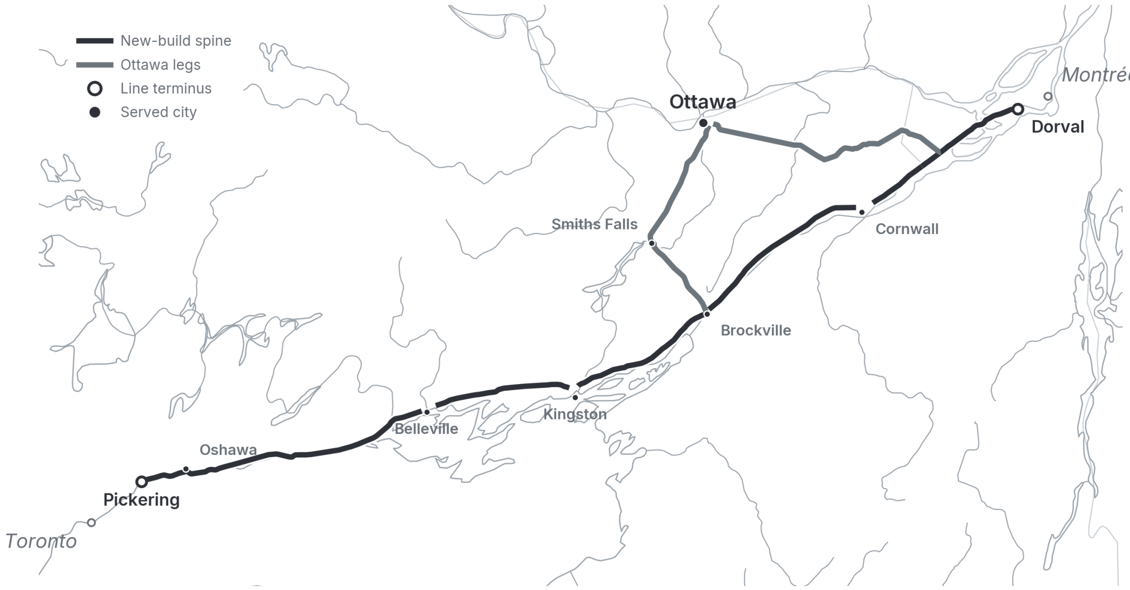
The second level is the top speed on each stretch, and this is what most separates the approach from ALTO's. Instead of fixing one number and forcing the ground to match it, the design takes the highest speed each stretch of corridor already offers, up to the 240 km/h maximum. Where the existing geometry is generous — the dead-straight run along the St. Lawrence from Brockville to Cornwall, the riverside stretch from Cornwall to Coteau, the inland 401 across the Napanee plain — the corridor supports the 240 km/h maximum with routine curve easing alone. The speeds here are what the infrastructure allows; using the upper end of the band assumes rolling stock rated for it, which today means an electric or electrification-ready fleet, since current bi-mode and dual-mode designs top out near 200 km/h. A fleet held to 200 would add about ten minutes end to end. Where it is not — the Frontenac Arch, where the line follows the least-bad path the 1850s builders found through the Shield, and the tight approaches through Durham and into Montréal — trains simply run slower. Buying speed in those places would mean buying tunnels, viaducts and a new right-of-way. Speed is taken where the ground already offers it, and never bought where it does not.

This is the reversal at the heart of the chapter. ALTO fixes the speed and lets it dictate the route, which is exactly how the corridor came to be closed off. HPPR fixes the principles, lets the ground set the ceiling on each stretch, and accepts a little extra journey time on the slow sections in return for a route that can be built along corridors already cut. For costing, the whole spine is priced at the 200 km/h standard — conventional structures, curves near 1,900 metres — so the stretches that can run faster are a bonus in service rather than an extra cost to build. The cost model in §4.3 never pays for speed the corridor gives away free.

4.2.1 Mapping Methodology

The route is measured, not sketched. It was drawn in Google Earth as eleven segments, and each segment's length taken from that geometry — which is where the ~479 km figure comes from. It is a measurement, not an estimate. The same geometry, laid over the national crop-inventory map, feeds both the capital-cost build-up and the expropriation assessment later in this chapter. The segment-by-segment measurements are held in the Initiative's corridor geometry file.

Figure 4.1 — The opportunistic hybrid alignment: the new-build spine from Pickering Junction to Dorval, following the straighter of Highway 401 or the CN Kingston Subdivision in each zone, with the Ottawa legs upgraded over the Smiths Falls, Brockville and Alexandria Subdivisions



The corridor switches between the two existing rights-of-way, with three hop points — Kingston, Brockville, Cornwall — where it crosses from one to the other. The Montréal approach (Coteau–Dorval) is a separate, tightly constrained job, treated on its own. Source: Initiative KML geometry, digitised in Google Earth.

Read west to east, the line moves between the highway and the lakeshore railway as the landscape dictates. From Pickering Junction it runs the most difficult stretch of the whole route — the approach through built-up Durham (Pickering, Ajax, Whitby, Oshawa) on the existing GO/Metrolinx Lakeshore corridor, south of the 401. Around Newcastle it picks up the 401 and runs just north of it through Port Hope. Just west of Cobourg it crosses to the CN Kingston Subdivision, following the lake shore through Cobourg, Grafton and Colborne, then the Bay of Quinte through Brighton and Trenton. At Belleville it returns to the 401 and holds it inland through Shannonville and Napanee. East of Belleville the two rights-of-way part company, and the line settles into a clean alternating pattern — 401, CN, 401, CN — across the roughly 310 kilometres from Belleville to Dorval, crossing between them at the three hop points.

The opportunistic alignment, Pickering Junction to Dorval, corridor by corridor (west to east)

Section	Corridor followed	Routing note
Pickering Junction → Newcastle	Lakeshore East (GO / Metrolinx)	The route's most constrained zone: built-up Durham — Pickering, Ajax, Whitby, Oshawa — on the existing multi-track Lakeshore corridor, south of the 401, at the route's maximum interchange density.
Newcastle → Cobourg	Highway 401 (just north)	The line picks up the 401 and runs just north of it through Port Hope, handing to the CN just west of Cobourg.
Cobourg → Belleville	CN Kingston Subdivision	South of the 401 throughout: closer to the Lake Ontario shore through Cobourg, Grafton, and Colborne, then along the Bay of Quinte through Brighton and Trenton into Belleville.
Belleville → Kingston	Highway 401	East of Belleville the line runs the 401 inland through Shannonville and Napanee, north of the CN; the CN spurs serve the Belleville and Kingston centres it bypasses, and the co-construction window applies.

Section	Corridor followed	Routing note
Kingston → Brockville	CN Kingston Subdivision	Through the granite of the Frontenac Arch the line follows the 1850s rail path via Gananoque and Mallorytown — the least-bad route already found through the Shield — rather than blasting a fresh 401-parallel cut.
Brockville → Cornwall	CN / 401 (parallels both)	Along the St. Lawrence the 401 and the CN run close together; the line parallels both on dead-straight terrain and can be co-built with the 401 widening at shared civil cost.
Cornwall → Coteau	CN Kingston Subdivision	A straight riverside run alongside Autoroute 20 toward the Québec approach.
Coteau → Dorval	Montréal terminal approach	The dense, interface-constrained terminal segment into the Montréal network, held apart and treated separately.

The mapped route includes five short chords through towns — at Belleville, Kingston, Brockville and Cornwall — the centres the line bypasses where it takes the 401 east of Belleville. The three hop points between the 401 and the CN fall in that same eastern stretch. Each is a chord of a few kilometres carrying only modest local structures, and none of them changes the corridor's complexity score. The one genuinely hard stretch is the 81-kilometre Kingston–Brockville segment, of which roughly 51 kilometres cross the Frontenac Arch itself, where the line defers to the CN Subdivision and the least-bad path its builders found through the Shield. Table 4.2 scores and prices the segment as a whole.

Reading the corridor this way makes the second kind of opportunism concrete. Because the design takes whatever speed each stretch already allows, the route does not run at a single speed: it runs at ten. The table below sets a realistic top speed for each segment, capped at the 240 km/h maximum, from the straightness of the corridor it follows, with the minimum curve radius each speed needs alongside it.

Realistic top speed by segment, capped at the 240 km/h design maximum

Section	Length	Corridor followed	Geometry	Top speed	Curve radius needed
Pickering Junction → Newcastle	40 km	Lakeshore East	Built-up, multi-track, station-dense	140 km/h	~925 m
Newcastle → Cobourg	35 km	Highway 401	Gentle 401 curvature past Port Hope	200 km/h	~1,890 m
Cobourg → Belleville	65 km	CN Kingston Sub.	Largely straight; minor curve easing	201 km/h	~1,910 m
Belleville → Napanee	35 km	Highway 401	Straight inland plain	240 km/h	~2,720 m
Napanee → Kingston	37 km	Highway 401	Straight inland plain	240 km/h	~2,720 m
Kingston → Brockville (Frontenac Arch)	81 km	CN Kingston Sub.	1850s alignment through the Shield	160 km/h	~1,210 m
Brockville → Cornwall	77 km	CN / 401	Dead-straight terrain	240 km/h	~2,720 m
Cornwall → Coteau	41 km	CN Kingston Sub.	Straight riverside run	240 km/h	~2,720 m
Coteau → Vaudreuil-Dorion	46 km	Québec approach	Channel crossings, approach curvature	200 km/h	~1,890 m

Section	Length	Corridor followed	Geometry	Top speed	Curve radius needed
Vaudreuil-Dorion → Dorval	22 km	Montréal terminal	Dense, interface-constrained	120 km/h	~680 m
Spine total	**479 km**	—	**190 km (40%) at the 240 km/h maximum**	**~201 km/h**	—

The 177–240 km/h band is the design target for open route, not a floor everywhere: the constrained metropolitan approaches and the Shield crossing necessarily run below it, and together account for about 143 of the 479 kilometres. Speeds are planning-level assignments read from corridor character and the segment complexity scoring of §4.3.1, not from a surveyed curve-by-curve analysis; a design study would refine them. Radii are the minimum a sustained curve at that speed requires, at 150 mm cant and 100 mm cant deficiency; short isolated curves can be eased locally. Source: Initiative KML geometry and dual-regime cost model.

Two things follow. About 190 kilometres — two-fifths of the spine — support the full 240 km/h, and they are the four segments where the existing corridors are straightest: the inland 401 across the Napanee plain, the dead-straight St. Lawrence run to Cornwall, and the riverside stretch to Coteau. One more, Cobourg to Belleville, is straight enough to reach 201 km/h with minor curve easing rather than new alignment. And the length-weighted average top speed across the whole route is about 201 km/h. That is why costing the spine at the 200 km/h standard is the right basis: the fast segments are bought with geometry the corridor already has, not with capital.

> *The route is not drawn; it is chosen. Following the straighter of two corridors already cut through the landscape is what lets the railway add to the region's transport geography rather than open a new wound in it — and it is what makes the corridor cheap to build.*

4.2.2 Corridor Land Use

The same digitised geometry that measures the route also measures what it crosses. Each segment was given a fifty-metre right-of-way and laid over the Agriculture and Agri-Food Canada Annual Crop Inventory, and the ground inside that footprint was added up by land-cover type. The types were grouped into three categories: agricultural (cropland and pasture or forage), natural (forest, wetland and shrub), and built. Open water was counted separately and left out of the shares, since the line bridges water rather than sitting on it. The result is a measured footprint, segment by segment, rather than a desk estimate.

What it shows cuts against the prime-farmland framing the corridor is usually argued in. At a fifty-metre right-of-way the footprint splits almost into thirds — but the largest share is natural cover, not farmland. Forest, wetland and shrub together account for about 41 per cent, agricultural land for 29 per cent, and already-developed land for the remaining 29 per cent. Of the whole corridor footprint, only about 19 per cent is actively cropped; cropland is roughly two-thirds of the agricultural share, the remainder being pasture or forage. Most of what the corridor crosses is either already disturbed or natural cover, not working cropland.

Corridor land-cover footprint at a fifty-metre right-of-way

Category	Hectares	Share	Composition
Agricultural	~692	29%	Cropland 448 ha (19%) + pasture or forage 244 ha (10%)
Natural	~975	41%	Forest 484 ha (21%) + shrub 296 ha (13%) + wetland 195 ha (8%)
Built / developed	~691	29%	Concentrated at the GTA-east and Montréal approaches
Water	~8	—	Excluded from the shares; crossings are bridged, not occupied
Total footprint	~2,357	100%	At the assumed fifty-metre right-of-way

Keeping the segments separate is what makes the figures useful, because they differ sharply. Three things stand out. Shrubland is the second-largest natural class, and it sits on just two segments — the Napanee plain between Belleville and Kingston, and the Frontenac Arch between Kingston and Brockville. That alvar, rock-barren and regenerating-scrub mosaic is also the habitat behind the corridor's species-at-risk exposure. The Brockville–Cornwall segment is the most forested of the whole route, with real woodland-fragmentation exposure over a long distance. And the built footprint is concentrated at the two city approaches: the GTA-east end and the Montréal end together hold roughly a third of all developed land on the corridor — the same two places where the cost model concentrates its spending.

Land-cover by segment at a fifty-metre right-of-way (hectares)

The land-cover segments are cut on the crop-inventory tiles and do not match the cost segments of Table 4.2, which are cut on the engineering regimes; the two tables are not intended to be read row against row. Both rest on the same KML geometry and the same 479 km route.

Segment	Crop	Pasture	Forest	Wetland	Shrub	Built
Pickering Jct → Oshawa	3.4	4.1	3.8	4.1	0.9	90.4
Oshawa → Belleville	124.0	45.5	94.3	58.0	76.6	207.1
Belleville → Kingston	38.9	54.4	62.9	22.7	88.8	61.0
Kingston → Brockville	75.1	82.6	63.9	30.3	70.6	34.7
Brockville → Cornwall	62.0	34.6	181.3	57.6	43.2	65.2
Cornwall → PQ border	49.0	11.3	40.4	10.7	6.1	30.7
PQ border → Dorval	87.8	10.5	27.0	2.5	0.2	143.7
Kingston (town)	0.4	0.4	3.0	6.5	7.2	14.8
Brockville (town)	0.0	0.0	3.1	0.2	0.8	14.5
Cornwall (town)	7.1	0.3	4.1	1.9	1.2	28.4
Total	448	244	484	195	296	691

Two cautions travel with these numbers. First, they assume a fifty-metre right-of-way and scale in proportion to it, so the working width should be settled before the areas are quoted as absolute. Second, the Belleville through-town segment, which is mostly developed ground, was dropped by a geometry error and is missing from the totals; this understates the built category slightly but does not affect the agricultural or natural shares. This is the same land-cover layer that drives the expropriation assessment, and it measures footprint rather than impact: it shows what the corridor crosses, not how much each crossing matters.

> *Measured rather than asserted, the corridor crosses more forest, wetland and scrub than it does farmland — and only about one part in five of it is actively cropped.*

4.2.3 Structures: Road and Water

A dedicated, fully grade-separated railway at 200 km/h needs two families of structures, and both can be counted from the route rather than assumed. Where the line crosses a public road it needs a grade separation; where it crosses a river or stream it needs a bridge or large culvert. How many of each is set by what the corridor crosses — geography the route has already fixed. What they cost, though, is governed mainly by the design speed. Held at 200 km/h, every structure can be built to ordinary, conventional rules. At the 250–350 km/h of true high-speed rail the same structures have to cope with the forces of much faster trains, making them heavier, more numerous, and plausibly half again to twice as costly. Holding the speed is the single most consequential structural decision in the programme.

Grade separation across the corridor removes every level road crossing. The line crosses roughly 220 public roads, and each becomes a grade separation in one of two cost classes: the more numerous two-lane rural and local roads, and the heavier four-or-more-lane arterials and freeways, which cluster at the two city approaches, the town passages, and the Highway 401, 416 and Montréal autoroute crossings. The count splits roughly 175 local and rural crossings to 45 arterial and freeway crossings. Unit costs of about thirteen and forty-five million dollars respectively are Initiative planning assumptions benchmarked against recent Canadian road-rail grade separations, where cost is dominated by approaches, retaining walls and roadworks rather than by the bridge itself. On those counts and rates the programme is on the order of $4.3 billion, about twenty million dollars per crossing blended. The rates carry the estimate: at fifteen and twenty-five million the programme falls to about $3.3 billion, and at twenty-five and fifty-five million it rises to about $5.2 billion, moving the bottom-up build by roughly a billion either way. Both the counts and the unit costs should be firmed up against the Transport Canada Grade Crossings Inventory, the inventory of record; with the unit costs now corrected, the crossing count is the larger remaining uncertainty.

Road grade separations, Pickering Junction to Dorval

Crossing class	Count	Unit cost	Subtotal
Two-lane rural / local road	~175	$13M	$2.28B
Four-or-more-lane arterial / freeway	~45	$45M	$2.03B
Road grade separations	**~220**	**~$20M blended**	**~$4.30B**

Watercourse crossings are costed from the digitised route rather than carried as a lump allowance. Each named river and stream the corridor crosses was located along the route and given a representative structure length. At about $220,000 per linear metre — a 2024-dollar rate for a double-track-capable rail bridge including foundations and approaches — the thirty-two crossings come to roughly $0.64 billion, rising to about $0.80 billion once engineering and contingency are added. Four classes carry the cost.

Watercourse crossings, Pickering Junction to Dorval (by class)

Watercourse class	Count	Cost
Major river bridges	3	$130M
Channel crossings (Île Perrot)	2	$253M
Medium river bridges	8	$200M
Minor creeks / culverts	19	$57M
Watercourse crossings	**32**	**~$0.64B → ~$0.80B**

Two structures dominate. The Île Perrot channel crossings on the Montréal approach — where the line must bridge two branches of the St. Lawrence to reach the island — account for roughly two-fifths of the watercourse total on their own. The three inland major bridges, over the Trent at the Bay of Quinte, the Moira at Belleville and the Cataraqui at Kingston, are modest by comparison. The principal named crossings, west to east:

Principal named crossings, west to east

Principal crossing	Class	Span (m)	Cost
Ganaraska River (Port Hope)	medium	120	$26M
Trent River (Trenton / Bay of Quinte)	major	250	$55M
Moira River (Belleville)	major	160	$35M
Salmon River (Shannonville)	medium	120	$26M

Principal crossing	Class	Span (m)	Cost
Napanee River	medium	130	$29M
Cataraqui River / Rideau Canal (Kingston)	major	180	$40M
Gananoque River	medium	110	$24M
Raisin River (Cornwall)	medium	120	$26M
Beaudette River	medium	100	$22M
Delisle River	medium	100	$22M
Rouge River (Vaudreuil)	medium	110	$24M
Île Perrot W channel	channel	600	$132M
Île Perrot E channel	channel	550	$121M

Two qualifications attach. The spans are representative rather than surveyed — the Trent at the Bay of Quinte is the most likely to run longer than assumed, and because each crossing is priced per metre, a revised span changes its cost directly. And the count of thirty-two covers the significant crossings; the many minor culverts on small drainages are carried within the per-kilometre rates rather than listed, and a complete count would draw on the Ontario Hydro Network. The nineteen minor creeks are grouped in the class table above rather than listed individually.

Taken together, the structures programme is on the order of $5.6 billion: about $4.3 billion of road grade separations, about $0.80 billion of watercourse crossings, and roughly half a billion for rail-to-rail junctions, flyovers, and retaining or elevated sections. These structures feed the bottom-up build in §4.3.2, where they are the largest single reason the build sits where it does. Their significance is that the road grade separations alone now exceed the whole structures allowance a lighter estimate carried. Pricing them properly is what raises the bottom-up build to about $19 billion, in agreement with the reference-class model. (Costs are order-of-magnitude planning estimates in 2024 dollars, on the same basis as §4.3.)

> *What the corridor crosses sets how many structures it needs; how fast the trains run sets what they cost. Holding the design at 200 km/h keeps every bridge conventional — the single most consequential structural decision in the programme.*

4.2.4 Stations: Using What Exists

A railway needs stations, and stations are where high-speed projects spend money that moves nobody. This corridor already has its stations. VIA serves Cobourg, Belleville, Kingston, Brockville and Cornwall on the Toronto–Montréal axis, Smiths Falls and Ottawa on the Ottawa leg, and Dorval on the approach, with Toronto Union and Montréal's Gare Centrale at the ends. All are in daily use and stand where the town already is. HPPR upgrades them and builds no new station where one exists.

That means a works list, not a building programme: platforms lengthened and raised for level boarding, accessibility brought to standard, ticketing and information renewed, parking and bus links improved as demand grows. Where the alignment runs inland on the 401, the existing CN spurs reach the downtown station rather than a new one on the bypass; the downtown geometries — the through-town chords and the station approaches at each centre — are held in the same geometry file. The works can be staged as ridership justifies them, which is what Guiding Principle P10, build it in stages, is for.

Figure 4.2 — Egress from the HPPR spine into Kingston

Alignment options between the Highway 401 corridor and the city. The blue marker is the station site, beside John Counter Boulevard at the western landing of the Waaban Crossing, the city's new third crossing of the Great Cataraqui River. Siting the station here keeps it inside the built-up city and on the road that now carries the third crossing, rather than on a bypass at the edge of town. Source: Initiative alignment study; base imagery Google Earth.

GOLD-PLATING: WHAT ONE STATION CAN COST

HS2's terminus at Euston was budgeted at £2.6 billion in 2020. By 2023 the National Audit Office put it at £4.8 billion — nearly double — after a redesign that replaced an eleven-platform scheme with a ten-platform one costing £0.4 billion more.

£106 million of scrapped design work was written off and design fees reached £289 million before construction was paused: hundreds of millions spent designing a station that was never built.

The mechanism is not incompetence, and it is worth being precise about what drives it. What the speed dictates is train length: high-speed sets run to 400 metres, roughly double a corridor train, so platforms and their approaches must be lengthened to match. Platform count is a separate matter, driven by frequency and turnround rather than by speed — Euston's eleven were calculated from 25-minute turnrounds at 18 trains an hour — but a segregated high-speed railway cannot share the conventional network's platforms, so it needs its own regardless. Between them, longer platforms and separate ones mean rebuilding the station rather than adapting it; a rebuild on a constrained city-centre site is among the most expensive civil engineering there is; and once a landmark building is in scope, redesigns follow. A 200 km/h railway running conventional-length trains into the platforms already in the ground never begins that sequence. Upgrading rather than replacing removes a cost with no natural ceiling, removes the land assembly and siting disputes that drive friction, and — because VIA's stations are already downtown — protects the door-to-door times §4.8 shows to be what moves people out of cars.

One later addition is worth flagging, because it belongs to the freight side of the corridor rather than the passenger side. Keeping passenger trains in the existing downtown stations does not oblige freight to stay there with them. As the freight dividend of Chapter 3 is realised, city bypasses can be built around the town centres so that through freight — and dangerous goods in particular — no longer runs past station platforms and residential streets in Belleville, Kingston, Brockville or Cornwall. A bypass also opens the option of new intermodal terminals on the edge of town, sited where trucks reach the 401 without crossing the centre. None of this is needed to open the passenger railway and none of it is costed here; it is a later phase the corridor's geometry leaves available, and one more reason to separate the two traffics rather than go on mixing them.

4.3 The Pickering–Dorval Spine Cost

The spine is the new-build heart of the proposal — the 479 kilometres from Pickering Junction to Dorval — and it is priced here two ways. The first works from the outside in: a model that reads cost off what comparable railways have actually cost. The second works from the inside out: a component build that prices the structures, track and land item by item. The test is whether the two agree, and they do. Both land at about $19 billion as specified. That figure is then adjusted in §4.6 against the record of what projects like this really end up costing.

4.3.1 The Dual-Regime Reference-Class Model

The cost is estimated from the outside view — from what comparable railways have actually cost — rather than by adding up this project's own line items. The tool is a two-regime cost model: two statistical relationships fitted to a set of real high-speed and higher-performance projects, predicting cost per kilometre from two things about a corridor: how hard it is to engineer, and how much trouble it causes. Two relationships are needed because building across open country and building through cities follow different cost rules. The open-country model, fitted to sixteen projects, explains 90% of the cost differences between them; the urban model, fitted to eight, explains 86%. Both are small samples for a two-variable fit, and the urban model especially so; they are read here as indicative of the direction and rough scale of the relationship rather than as precise predictors.

The first input is engineering complexity, scored on the Engineering Complexity Index. Six weighted measures — ground conditions and major structures at 20% each, terrain 20%, water crossings and interfaces at 15% each, climate 10% — combine into a single score on a 20–100 scale. The HPPR spine, scored section by section and weighted by length, comes out at 54, in the Moderate band, against ALTO's 77. This is a new railway, not a reuse of old track: even where it runs beside Highway 401 and the CN Kingston Subdivision it is fresh alignment with new earthworks, new drainage and a large grade-separation programme, and following a developed corridor adds complexity at the interfaces rather than removing structural work. So the score sits in the Moderate band, not below it — the engineering is real, it is simply not ALTO's. It is also not spread evenly: the roughly 51 kilometres of the Frontenac Arch carry the route's genuine difficulty and rise into the High band in the granite core. What holds the overall score to Moderate is the design speed. At 200 km/h the line needs no continuous spine of tunnels and viaducts — the category where high-speed budgets concentrate and overrun. That is the absence of an elevated spine, not the absence of structures: the corridor still needs roughly 220 road grade separations and its river crossings, counted in §4.2.3 and priced in §4.3.2.

The second input is corridor friction, measured by the Latent Friction Index (LFI) — the forward-looking form of the Community Friction Index, and the variable written as CFI in the fitted equations of Table 4.1. It captures the trouble a corridor generates by its very design — consultation, land tenure, environmental exposure, scope growth and political opposition. The spine scores 29 against ALTO's 65. Friction belongs in a cost model because it is a cost, not only a social matter: the reference-class study finds it a statistically significant predictor of cost escalation, which is why it sits in the model beside engineering complexity rather than in a separate discussion.

Table 4.1 — The dual-regime cost model

Regime	Projects	Model ($\log_{10}$ cost \$M/km)	R^2
Greenfield	16	0.0097·ECI + 0.0116·CFI + 0.656	0.90
Urban	8	0.0173·ECI + 0.0081·CFI + 0.816	0.86

Two regimes, fitted separately because open-country and urban construction follow different cost rules; segments that straddle the boundary are scored in between. The inputs are the Engineering Complexity Index and the Latent Friction Index. Source: Initiative reference-class cost study.

> *The model predicts cost from two things a corridor either has or hasn't — engineering difficulty and friction — and it explains ninety per cent of what real railways have cost. That is the outside view: the price is read off the record, not asserted by the people proposing the project.*

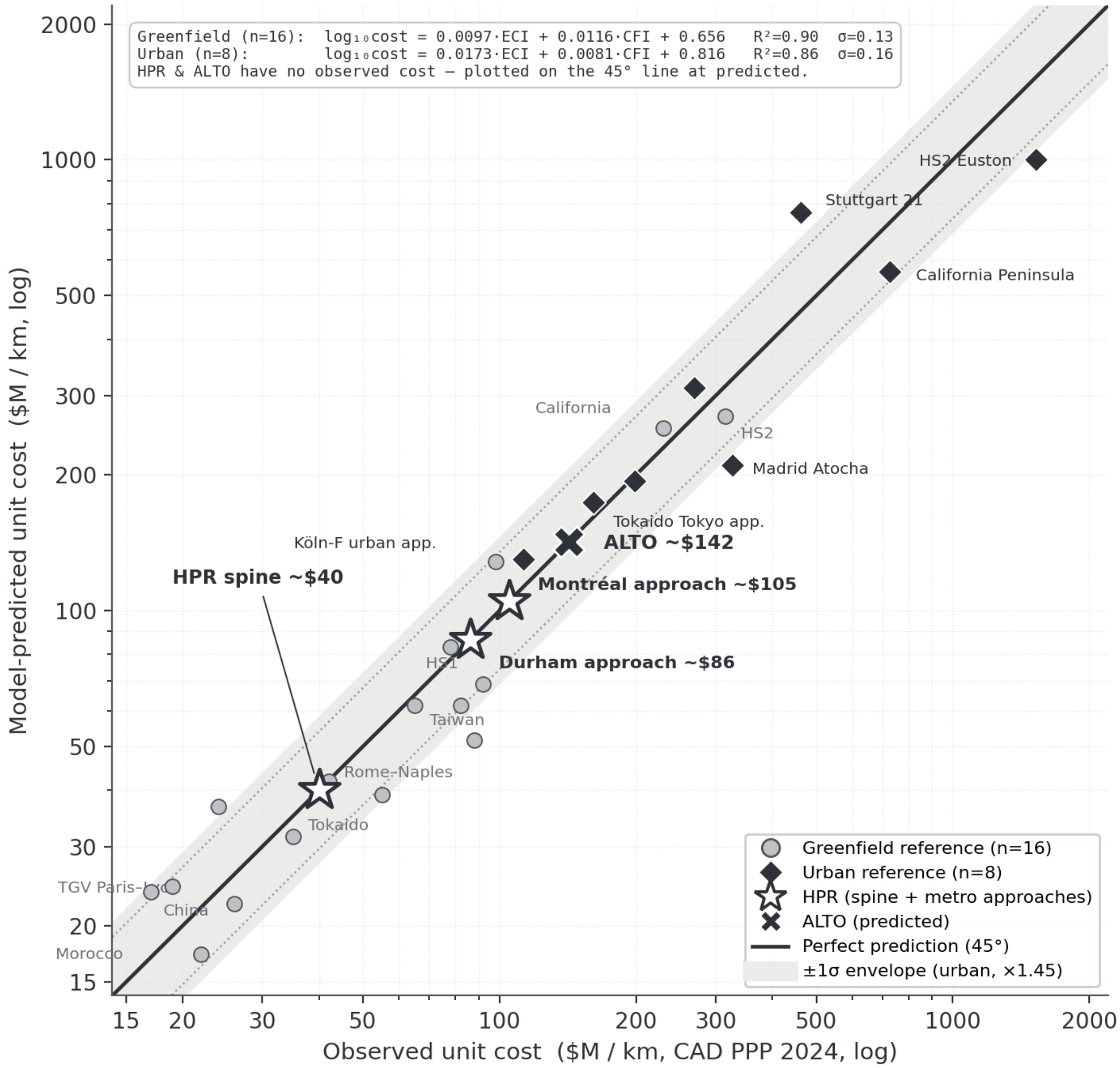
Applied to the measured spine at its re-scored complexity, the model gives a central estimate of about $19.0 billion for the 479-kilometre diesel spine as specified — roughly $40 million per kilometre, built up segment by segment in the table below. That is the outside-in figure. The next section builds the same spine from its parts as an independent check.

Table 4.2 — Reference-class cost by segment, Pickering Junction to Dorval (~479 km)

Segment	Length	Regime	ECI	$M/km	Capital
Pickering Junction → Newcastle	40 km	Urban	62	$86M	$3.44B
Newcastle → Cobourg	35 km	Greenfield	48	$28M	$0.98B
Cobourg → Belleville	65 km	Greenfield	50	$29M	$1.90B
Belleville → Napanee	35 km	Greenfield	52	$31M	$1.10B
Napanee → Kingston	37 km	Greenfield	52	$31M	$1.16B
Kingston → Brockville (Frontenac Arch)	81 km	Greenfield	64	$41M	$3.32B
Brockville → Cornwall	77 km	Greenfield	48	$29M	$2.21B
Cornwall → Coteau	41 km	Greenfield	48	$29M	$1.18B
Coteau → Vaudreuil-Dorion	46 km	Greenfield	52	$31M	$1.44B
Vaudreuil-Dorion → Dorval	22 km	Urban	67	$105M	$2.31B
Spine total	**479 km**	**—**	**ECIw 54**	**~$40M**	**$19.0B**

Each segment's cost is the model's prediction at that segment's complexity and friction (friction 28–29 throughout); the two city approaches carry the 0.66× reduction that comes with designing for 200 km/h. The model is applied identically to every segment — the town passages are priced at full new-build rates rather than credited as existing-corridor work, which is conservative. Open country ~417 km, city approaches ~62 km. Source: Initiative reference-class cost model; lengths from KML geometry.

Figure 4.3 — Dual-regime cost model, predicted versus observed: the reference projects calibrate the 45° line, with the HPPR spine (~$40M/km) and its Durham and Montréal approaches well below ALTO (~$142M/km).



TOP-DOWN CENTRAL	PER KILOMETRE	GREENFIELD SHARE
$19.0B	**~$40M**	**~87%**
Dual-regime reference-class model on the spine at ECIw 54.	Blended across the greenfield and urban regimes over 479 km.	Of route-kilometres on the lower-cost greenfield regime.

4.3.2 The Bottom-Up Sanity Check

The bottom-up build prices the same spine from its parts. As the segment table shows, about 417 of the 479 kilometres run across open country at $28–41 million per kilometre, while about 62 kilometres — the two city approaches, into the GTA-east and across Île Perrot into Montréal — run at $86–105 million per kilometre. Roughly 87% of the route is on the cheaper open-country rate, and the expensive urban kilometres, though they dominate the per-kilometre headlines, are short.

So the route sits mostly in the cheapest conditions even though the cost concentrates in the dearest. The two city approaches are the most expensive kilometres on the line — the GTA-east approach threads a built-up corridor, and the Montréal approach carries the Île Perrot channel crossings — and together they account for roughly $5.8 billion across just 62 kilometres. But they are short. The remaining 417 kilometres of open-country double track, at a quarter to a third of the urban rate, carry the bulk of the route for well under half the money. The table prices the town passages at full new-build rates rather than crediting the trackbed already in the ground, so where the corridor reuses existing track the build is, if anything, conservative.

The reason open-country construction is itself cheap comes down to geometry. At 200 km/h the line follows the gentle curves the existing corridors already provide, with no continuous spine of tunnels and viaducts — the category where high-speed budgets concentrate and overrun. What it does need, even without that spine, is a defined grade-separation programme: a fully grade-separated 200 km/h railway carries road traffic over or under the track rather than across it. On this corridor that means roughly 220 overpass and underpass structures at about $20 million each — about $4.3 billion for the road grade separations, and on the order of $5.6 billion for a full programme adding river crossings, rail junctions and retaining or elevated sections, pending a structures inventory. These are real structures and a real cost, and the bottom-up build prices them explicitly rather than carrying them as a light allowance.

With the grade separations costed at corrected rates, the bottom-up build prices the spine, as specified, at roughly $20 billion for the 479-kilometre diesel configuration. That is deliberately a rough figure: a component build at this stage is an order-of-magnitude exercise, not a costed bill of quantities. What matters is that it lands within about a billion of the model's $19.0 billion — two methods agreeing to within roughly five per cent. That agreement is the point, and it is this as-specified figure — call it $19–20 billion — that §4.6 then adjusts against the overrun record. The corrected grade-separation costs raise the build well above a structures-light estimate, and the two methods agree at that higher, more defensible level rather than at the optimistic one.

BOTTOM-UP ESTIMATE	STRUCTURES PROGRAMME	THE TWO METHODS
~$20B	**~$5.6B**	**~$19–20B**
Rough component build with full grade separation; a conservative cross-check.	Grade separations, river crossings, and junctions — the largest single driver.	Top-down and bottom-up agree to within about a billion.

> *Full grade separation is a real cost, not a rounding error — some $4.3 billion of overpasses and underpasses. But it buys discrete structures at 200 km/h, not the continuous elevated spine a 300 km/h line cannot avoid. That is why the corridor is still built for a fraction of the high-speed figure.*

4.4 The Ottawa-Leg Upgrade

The second element of the triangle is costed separately, and on a different basis. The Ottawa legs — roughly 237 kilometres over the publicly owned Smiths Falls, Brockville and Alexandria Subdivisions — are not new construction but upgrades to existing VIA-owned track, and they are priced at a much lower rate accordingly. Keeping them on a separate line, rather than blending them into the spine's average, avoids letting a low-cost upgrade flatter the spine — or the spine's new-build average inflate the upgrade. They are different kinds of work and are kept as different lines.

The upgrade means track renewal, signalling and grade-separation works, and the clearances needed to leave the corridor ready for electrification — all on a route already publicly owned and already carrying passenger trains. Public ownership is the decisive advantage for both cost and risk: there is no land to assemble, no new severance, and no host railway to negotiate with, because the operator already owns the track. The Ottawa legs are, in effect, the part of the network where separation is achieved by improving what the public already has rather than by building something new. One assumption in that figure should be explicit. All three subdivisions are single track with passing sidings under centralised traffic control, and the base case upgrades them in place without adding a second main track. That configuration handles symmetric traffic well: trains meet at the sidings. What it handles badly is overtaking, and that is the case HPPR creates — a fast express coming up behind a regional service calling at every station. Sections of both legs would therefore be doubled to carry the two together, but as a separately priced later phase, on the same footing as electrification: an option the base case is built ready for rather than a cost folded into it. Doubling would want continuous sections either side of the overtake points, the Ottawa terminal approaches, and the junction throats at Smiths Falls and Brockville, rather than longer sidings scattered along the line. A second main track inside an existing right-of-way is of the order of $10 million per kilometre, so a partial doubling is order $1 billion — indicative arithmetic, not a costed figure, and not included in the capital total here. Whether it stays optional depends on whether single track with sidings carries the Ottawa flows Chapter 6 counts; that check belongs with the ridership.

WHY THE OTTAWA LEGS ARE COSTED SEPARATELY

The ~237 km of Smiths Falls, Brockville and Alexandria Subdivision is existing VIA-owned track upgraded in place — a cheaper and lower-risk class of work than the new-build spine, and priced at a much lower rate per kilometre.

Blending the two would hide both. The spine carries the new-build engineering and cost; the Ottawa legs carry the economics of upgrading publicly owned track. The triangle total is the sum of two distinct lines, not a single averaged rate — and the priced Ottawa-leg line is carried alongside the spine build in the capital model.

> *Where the spine is built, the Ottawa legs are improved. The cheapest separation of all is the one achieved on track the public already owns — no land to assemble, no corridor to sever, no host railway to bargain with.*

4.5 Peterborough: Regional, Not High-Speed

ALTO's original alignment ran north of Lake Ontario through Peterborough, and the June 2026 announcement moved the stated preference south. That leaves an open question about what Peterborough should get, and this report's answer is a regional service rather than a stop on a high-speed spine.

Peterborough's rail demand has been studied for the better part of two decades, and it comes back the same shape every time: a peak-hour commuter flow to Toronto, not an intercity flow between major centres. The Shining Waters feasibility work that preceded VIA's proposals projected roughly 950 passengers in each direction on a service of two morning trains to Toronto and two evening returns, Monday to Friday, with reduced weekend service. That is a commuter railway's timetable, and a commuter railway's number.

The high-speed forecasts for the same city rest on a weaker footing. The corridor ridership work that carries Peterborough is survey-derived — respondents asked how often they would use a service that does not yet exist — and the published origin–destination matrix has drawn criticism for results that do not balance between city pairs. Whatever the explanation, a stated-preference survey is a thin basis on which to route a national spine through a particular city, and it is a much thinner basis than the measured commuter demand already on the record.

PETERBOROUGH: WHAT THE NUMBERS SAY

Projected commuter demand: about 950 passengers each way, on two morning and two evening trains (Shining Waters feasibility work). Costed at roughly $233–300 million for track refurbishment, six stations, bridge repairs and rolling stock — a fraction of one per cent of the ALTO budget.

Population without passenger rail today: about 83,000. The CPKC Havelock Subdivision already runs through the city on maintained track.

The cheap answer is therefore already in the ground. The Havelock Subdivision runs through Peterborough on maintained track, and reactivating a commuter service over it would cost a fraction of one per cent of the ALTO budget, for a city of 83,000 people that has no passenger rail at all today. The earlier costed plans sat in the range of $233 to $300 million for track, six stations, bridges and rolling stock. Against a high-speed alignment, that is a rounding error.

Routing the spine through Peterborough would also buy friction the corridor route avoids. The northern alignment leaves the developed 401 axis for the Kawartha lakes and drumlin country, where the line is new-build across farmland, shoreline and cottage country rather than beside an existing highway or railway. That means more private land taken, more severance, more consultation and more opposition — incurred for a city whose demand is a commuter flow that can be served without any of it.

Peterborough belongs in the network, but on the regional tier rather than the spine. That is what Guiding Principle P1, look at the whole system, actually requires: match the service to the demand rather than route the fastest line past the places that need the slowest. A commuter service on the Havelock Subdivision gives Peterborough the connection it has been asking for since 2008, at a cost the corridor barely notices, while the spine stays where the population, the freight and the growth already are. That service sits outside the priced triangle. HPPR as costed in this chapter runs Toronto–Ottawa–Montréal with the lakeshore communities between, and the ridership of Chapter 6 counts that network and no other; a Peterborough branch is a recommendation about what the city should get instead of a high-speed stop, not a line item in the capital total here.

4.6 Reference-Class Uplift

The as-specified build is the start of the cost estimate, not the end of it. The central discipline of this report, set out in Chapter 1, is to check an estimate against the actual overrun record of comparable projects — because in-house estimates systematically come in low, and the outside record is the corrective. Applied to the spine, that discipline raises the as-specified diesel figure of about $19.0 billion to a central estimate of about $26.1 billion, or roughly $54 million per kilometre. That is the prudent figure to commit against — not because this project is expected to overrun, but because comparable projects reliably have, and a forecast that ignores that record is an in-house forecast wearing an outside-view label.

Two things specific to this corridor shape the size of that adjustment, and both are treated as differences from the comparison set rather than as assertions. The first is cold climate. The corridor's Leda clay, karst and freeze–thaw are real engineering hazards, and the international record shows what they can do to a high-speed project: China’s Harbin–Dalian line, the first high-speed railway built for a cold, high-latitude climate, cost about 25 per cent more than its original budget, had sections rebuilt before opening because of frost-heave deformation, and opened roughly a year late. But that is a 300 km/h record. At 200 km/h the track tolerances are far more forgiving, and frost heave that would force a speed restriction on a high-speed line is a maintenance item on a higher-performance one. The cold-climate adjustment HPPR must carry is therefore smaller than the one ALTO's 300 km/h profile demands. The lower design speed buys a smaller penalty — a cost consequence of an engineering choice.

The second is traction. The spine is costed diesel-first, which is what the $19.0 billion as-specified and $26.1 billion adjusted figures describe. Electrification is treated as a separately priced option of roughly $3.1 billion, which can be deferred — bringing the electric spine to about $22.1 billion as specified — rather than as a fixed requirement. Building to electrification-ready standards keeps the option alive cheaply, and lets the expensive, irreversible electrification money be committed once demand is demonstrated rather than merely forecast. A 300 km/h line has no such option: electric traction is mandatory and up-front, locked in before the demand that would justify it has appeared.

Deferral is not only a financial convenience; it answers a physical constraint. Eastern Ontario's bulk electricity system is already under active capacity assessment — the system operator's Eastern Ontario planning work, including a dedicated supply study for the Belleville area and a parallel assessment for the Greater Ottawa region, is testing whether the existing grid can meet ordinary demand growth over the next two decades before any railway load is added. A 300 km/h electric line is a heavy new customer on exactly that system. Alto's chief executive, Martin Imbleau, put the requirement at "50 megawatts of power to supply a train running at 300 kilometres safely" in a February 2026 interview with The Canadian Press, while acknowledging the demand as "a significant block". In the same reporting, Ryan Katz-Rosene of the University of Ottawa estimated the line would draw between one and three per cent of Ontario and Québec's current electrical capacity, and likened each traction substation to powering a small town. Hydro-Québec and Hydro One have said that specific energy-use projections have not yet been made, because the route is not final. An electric design makes that load mandatory and up-front, to be committed before the corridor even opens. HPPR reverses the exposure. A diesel-first railway opens on the traction it carries with it, and electrification, lighter in any case at 200 km/h, follows only once the grid has the headroom and the ridership justifies it. The railway's opening is decoupled from the grid's expansion timetable: the line neither waits for nor forces transmission reinforcement in a region whose supply is already under strain. Seen this way, the deferrable $3.1 billion buys an option that also sidesteps a supply risk a 300 km/h line must absorb in full.

AS-SPECIFIED (DIESEL)	DE-BIASED CENTRAL	ELECTRIFICATION
$19.0B	**$26.1B**	**+$3.1B**
As-specified build for the 479 km diesel spine, grade separations included, before de-biasing.	Reference-class commitment figure — about $54M/km — against the actual overrun record.	Deferrable option; electric spine ~$22.1B as specified, committed when density warrants.

> *Adjusting for the record is not pessimism; it is honesty about it. The as-specified build is what the corridor costs if everything goes to plan. The adjusted figure is what comparable projects have actually cost when it didn't — and committing against the second is the discipline ALTO never applied to itself.*

4.7 The HPPR / ALTO Per-Kilometre Comparison

The chapter's figures resolve into a single comparison, and it is the one the whole report turns on. On the two-regime model, the HPPR spine costs about $40 million per kilometre. ALTO, scored on the same model, prices at about $142 million per kilometre. That figure is the model's prediction at ALTO's own complexity and friction scores, not a division of its published budget. Alto's public range of $60–90 billion, spread over its roughly 1,000-kilometre Toronto–Québec City corridor, implies something closer to $75 million per kilometre — so the reference class predicts a figure near double what the project currently publishes. Which of the two is right is the subject of §4.6; for the comparison here, what matters is that both railways are scored the same way. The two railways are being asked to serve the same corridor and the same cities, and one is priced at roughly three and a half times the other for every kilometre of route. That multiple is the heart of the argument: the corridor's transport problem is real, but it does not require — and cannot afford — a solution that costs three and a half times what an effective alternative costs.

The gap splits roughly one-third engineering, two-thirds friction. About 35% of it is engineering complexity: ALTO's 300 km/h line across open country, with its tunnels, viaducts and fresh cut through difficult ground, against HPPR's 200 km/h build, which needs no major spine tunnels and only a limited number of viaducts. The remaining 65% is corridor friction: ALTO's new-corridor consultation, land-tenure and political burden against a route that asks far less of the land and the people it crosses. The split matters because it shows the gap is not the product of one assumption. It is built about a third from how the line is engineered and two-thirds from where it is put — and HPPR is cheaper on both counts at once.

Table 4.3 — Reference-class cost comparison, per kilometre

Line	$M/km (reference-class)	Basis
TGV Paris–Lyon	~$26M	Flat, low-friction early French high-speed line
***HPPR spine**	~$40M	Dual-regime model central — the cheapest-delivered tier
Tokaido Shinkansen	~$35M	Dense, high-utilisation Japanese line
***ALTO**	~$142M	300 km/h greenfield — above the international range

The HPPR spine lands among the most efficiently delivered high-speed railways in the international record; ALTO sits above the range, roughly three and a half times the HPPR figure. ALTO per-km is the two-regime model's prediction at ECI 77 and CFI 65, not a division of its published budget. Source: Initiative two-regime cost model and reference-class set.

Where the figure sits among real railways is the final check on it. The HPPR spine's ~$40 million per kilometre is not an implausibly cheap number invented for the argument. It sits between Japan's Tokaido Shinkansen and Italy's Rome–Naples line — efficiently delivered high-speed railways built on workable ground — in the part of the record where flat, low-friction, well-executed lines actually land. ALTO's figure sits above the international range. An estimate that places the cheap option among the genuinely cheap real lines, and the expensive option above the expensive ones, is doing the one thing an in-house estimate cannot: locating both projects on the map of what railways have really cost.

> *About three and a half times the cost per kilometre — a third from how it is engineered, two-thirds from where it is put. The corridor's transport problem is real, but it is not a problem that needs, or can afford, the most expensive answer on the map.*

4.7.1 Minimising Engineering Complexity (ECI)

About a third of the gap is engineering complexity. The HPPR spine holds its Engineering Complexity Index to 54, in the Moderate band, where ALTO's 300 km/h route reaches 77. That difference is not incidental. It follows from a few deliberate design choices:

- Lower design speed. At 200 km/h the line can take tighter curves and steeper gradients than a 300 km/h line, so it follows the existing terrain and transport corridors instead of cutting a near-straight new path through whatever lies in the way. Speed class is the single biggest lever on the terrain and structures scores.
- No spine of major tunnels and viaducts. ALTO's speed forces a large programme of raised sections and viaducts — the categories where high-speed budgets concentrate and overrun. HPPR needs no such backbone — only a limited number of viaducts — so its major-structures score stays moderate.
- Following the straighter of Highway 401 or the CN Kingston Subdivision in each stretch. Routing beside ground that is already graded and surveyed keeps the ground-conditions and terrain scores down, and avoids fresh cut through difficult country.
- Discrete, conventional structures. What the line does need is a finite, countable set of grade separations rather than a continuous elevated or tunnelled formation — real cost, but bounded, and built using well-established 200 km/h practice rather than frontier high-speed methods. At 300 km/h even ordinary bridges must cope with the forces of trains passing at speed, which can shake a deck close to resonance; meeting those limits pushes structures toward heavier, stiffer and costlier designs. At 200 km/h those effects are far milder and conventional structures suffice.
- Drainage, and farm drainage in particular. Water crossings are lighter for a line that follows an established corridor: it cuts across fewer field tile-drainage systems and municipal drains at awkward new angles than a fresh route would, and at 200 km/h on a conventional embankment those crossings are reinstated with standard culverts rather than the more elaborate works a 300 km/h formation demands. Farm tile and municipal drains are also far easier to maintain and reinstate where the line follows the existing 401 and rail corridors than where a new route severs working field systems.
- Noise mitigation. Railway noise rises steeply with speed: air noise, negligible at 200 km/h, becomes a governing source by 300 km/h. A 300 km/h line therefore needs far more extensive noise barriers through every settled and farmed stretch it passes. A 200 km/h line largely avoids that cost altogether.

Together these keep the spine in the Moderate complexity band, where the international record is cheapest to deliver — and they account for roughly a third of the distance between the two costs.

4.7.2 Minimising Community Friction (CFI/LFI)

The larger share — about two-thirds of the gap — is community friction: what a corridor costs not to build, but to site, permit and defend. The HPPR spine scores 29 on the Latent Friction Index against ALTO's 65, because it asks far less of the land and the communities along it. The index has five parts, and the corridor scores low on each:

- Land tenure. By following existing public and rail rights-of-way rather than carving a new corridor through open country, HPPR takes far less private land. Expropriation concentrates at the city approaches, while the rural stretches need little — fewer properties, less land cut in two, less damage to what remains.
- Environmental exposure. Running beside already-disturbed transport corridors keeps the line clear of the fresh cut a 300 km/h route would drive through sensitive ground — the Frontenac Arch, the Napanee plain, the river watersheds, and the species-at-risk habitat documented elsewhere in the Initiative's work.
- Consultation. A line largely within established corridors disturbs fewer landowners and communities, generating less of the consultation and objection burden that drives delay on contested projects.

- Political opposition. An incremental, understandable scope — a defined set of works on known corridors — is far easier to defend than an open-ended, all-new high-speed programme.
- Scope growth. Because the works are bounded and conventional, the scope creep that inflates new-build high-speed budgets has little room to operate.

Much of that friction is incurred not in the abstract but in how the line is built and run, and on both counts the HPPR approach lowers it further:

- Materials moved on the infrastructure already there. The spine runs beside a working freight railway and the country's busiest highway, so aggregate, track and prefabricated structures — bridge spans included — can be delivered on the CN Kingston Subdivision and along Highway 401, corridors already built for heavy loads, rather than on a new network of haul roads cut across the countryside. HS2 had to engineer exactly this after the fact: a “materials by rail” programme that moved millions of tonnes by freight train, and then along the line's own route, specifically to keep lorries off local roads. The HPPR corridor has that capacity in place from the outset.
- Less rural construction disturbance. Staging the works from the existing rail line and highway concentrates construction traffic where heavy traffic already runs, and keeps it out of the villages and concession roads — the dust, mud and truck movements that dominate community objection on new-build projects.
- No municipal road damage bill. Heavy haulage on roads never built for it is both destructive and contentious: along HS2, councils reported local roads severely damaged by construction trucks, multi-million-pound repair funds, and unresolved disputes over who pays. A corridor that hauls by rail and on Highway 401 spares the municipal network that cost and that fight.
- Noise against a quiet rural baseline. Noise is judged against the background around it, and rural Eastern Ontario's background is very low — so the same passing train intrudes far more here than in a city. International guidance, including the World Health Organization's environmental-noise guidelines, sets correspondingly low reference levels for railway noise. A 200 km/h line stays within them far more readily than a 300 km/h line, whose noise climbs steeply with speed.

Community friction is where most of ALTO's premium is incurred, and it is the part of the gap that follows from where the line is put rather than how fast it is meant to run. On both measures — complexity and community friction — the HPPR corridor is engineered and sited to keep the number low.

4.8 Journey Time

Speeds are only interesting for what they add up to. Taking the segment speeds of §4.2.1, and assuming an express that stops once, at Kingston, the journey time from Toronto Union to Montréal’s Gare Centrale works out at a little over three and a half hours. The build-up is set out below. It covers the whole trip, including the two ends the spine itself does not carry: the shared approach out of Toronto and the terminal run into Montréal.

Toronto–Montréal express journey time, Kingston stop only

Component	Distance	Time
Toronto Union → Pickering Junction	35 km	21 min
Spine: Pickering Junction → Kingston	212 km	65 min
Kingston stop (dwell, braking and acceleration)	—	6 min
Spine: Kingston → Dorval	267 km	85 min

Component	Distance	Time
Dorval → Montréal Gare Centrale	19 km	16 min
Speed-step losses and timetable recovery	—	19 min
Toronto–Montréal express	533 km	3h32

Segment speeds from §4.2.1. Speed-step losses are taken at 5% of spine running time and timetable recovery at 6%, both conventional planning allowances. Platform to platform; door-to-door time depends on station siting. Source: Initiative KML geometry and segment speed assignments.

That is 533 kilometres at an end-to-end average of about 151 km/h — Toronto to Kingston in roughly 1h36, Kingston to Montréal in another 1h53. Run through without the stop, the same train takes about 3h26, so calling at Kingston costs roughly six minutes — and lifts the end-to-end average from 155 km/h to 151. The Kingston stop is well placed: it falls where the line speed drops for the Frontenac Arch anyway, so part of the braking is absorbed by geometry the train must respect in any case. The Arch is also where the time goes. Its 81 kilometres take 30 minutes — a fifth of the spine's running time for a sixth of its distance — and it is the one stretch where money spent easing curves would buy meaningful journey time: raising it from 160 to 200 km/h would save about six minutes.

Express journey times compared, Toronto–Montréal and Toronto–Ottawa

Service	Journey time	Basis
Toronto–Montréal: HPPR express, Kingston stop	~3h32	Estimated here from segment speeds and corridor geometry
Toronto–Montréal: HPPR non-stop	~3h26	Same alignment and speeds, running through Kingston
Toronto–Montréal: ALTO, 300 km/h	3h07	ALTO's published figure — a spreadsheet estimate, not a simulation
Toronto–Montréal: VIA HFR base case, 177 km/h	3h59–4h19	The only journey time ever simulated for this corridor
Toronto–Montréal: VIA Rail today	~5h00	Current scheduled service on shared CN track
Toronto–Ottawa: HPPR express via upgraded Ottawa leg	~2h55	Spine as far as Brockville, then 117 km of upgraded VIA-owned track at 177 km/h

ALTO figure as published (3h07); the memorandum's own estimate table gives 3 hours for the 300 km/h case. VIA HFR base case from the journey-times memorandum released under A-2025-00333 and analysed in the Initiative's research note Estimated, Not Simulated (June 2026); the 110 mph case was modelled in RailSys, while the faster 160 mph and 186 mph figures in the same record are distance-divided-by-average-speed estimates offered, in the memorandum's own words, for comparison.

The comparison needs one caution and delivers one conclusion. The caution is that the figure above is an estimate of the same kind as ALTO's: distance divided by speed, with allowances. Neither has been simulated. The conclusion is that the honest gap between the two railways is about twenty-five minutes — and about nineteen against a non-stop run. ALTO buys that quarter of an hour or so over an opportunistic 240 km/h railway, and it buys it at about three and a half times the capital cost per kilometre. The released record sharpens the point further: the only journey time ever actually simulated for this corridor is the 177 km/h base case at just under four hours — slower than the railway priced in this chapter, and slower than the times ALTO now advertises on the strength of a spreadsheet. The same method applied to Toronto–Ottawa — the spine as far as Brockville, then the 117-kilometre Ottawa leg upgraded to 177 km/h — gives about 2h55 for that 445-kilometre journey, against roughly four and a quarter hours on today's service.

The same arithmetic answers a question the endpoint times do not: what the line is worth to the communities along it. Every intermediate centre gains a fast connection to Toronto, and for most of them the gain is larger in proportion than the one the endpoints get, because they start from a slower and less frequent service. The times below are for the regional train, calling at every station in turn, so each row carries the stops made before it.

Regional train journey times, Toronto to the intermediate stations

Station	Distance from Toronto	Journey time	Average speed
Cobourg	110 km	0h53	124 km/h
Belleville	175 km	1h21	130 km/h
Kingston	247 km	1h47	139 km/h
Brockville	328 km	2h26	134 km/h
Smiths Falls	373 km	2h52	130 km/h
Cornwall	405 km	2h54	140 km/h

Regional train, calling at all stations. Cumulative running times on the segment speeds of §4.2.1, with the same allowances as the table above and, for Smiths Falls, the junction at Brockville and 45 km of upgraded leg at 177 km/h. Each row adds six minutes for every station called at before it, so Cornwall and Smiths Falls carry four stops and Cobourg none; a faster service skipping stops would gain about six minutes for each one omitted. An Oshawa or Durham stop, not assumed here, would add a further six minutes to every row. Kingston appears in both tables, and the two figures are not the same: the express reaches it in 1h36 having run non-stop from Toronto, while the regional train arrives at 1h47, eleven minutes later, having called at Cobourg and Belleville on the way. The same station is served by both, at different times, by design. Source: Initiative KML geometry and segment speed assignments.

Read down the column, the pattern is the point. Cobourg at 0h53 and Belleville at 1h21 come within the range people accept for a regular commute, and they do so on the regional train, calling everywhere, rather than on a special fast service. Kingston sits at 1h47, Brockville at 2h26, and Cornwall and Smiths Falls just under three hours — every one of them a substantial saving on today’s timetable, and every one of them achieved while calling at each community in between. That is the trade the corridor-following alignment makes. A 300 km/h line bypassing these places on a new alignment delivers none of it, because the times that matter to the corridor’s own communities depend on stopping in them, not on the speed between the endpoints.

> *ALTO’s 3h07 is a spreadsheet estimate. The only time ever simulated for this corridor is about four hours — slower than the railway costed here at a third of the price per kilometre. The real gap is about twenty-five minutes.*

These times are the input to the demand case. Modal shift is not decided by top speed; it is decided by the door-to-door comparison a traveller actually makes — the train against the car on the 401, and against the drive-park-fly sequence to the airport. What the corridor offers on that comparison is set out above: about three and a half hours between the two largest cities on the express, under an hour to Cobourg and 1h47 to Kingston on the regional train, and Ottawa reached in 2h55. Chapter 6 takes these times as its starting point and asks the question this chapter cannot: how many people they actually move, and away from what.

4.9 100 Years From Now

A rail corridor is not a project; it is an asset that lasts a century. The decision taken now is the corridor the region will live with long after today's arguments about cost and timetable are forgotten. The right test of a route is therefore not only what it costs to build this decade, but what kind of corridor it still is a century from now — what kind of corridor it leaves to the people who inherit it. By that test the questions in this chapter matter most, because they are the irreversible ones. The route, once built, is fixed for generations, while the trains, the traction and the timetable can all be changed.

What closes that corridor over a century is not, in the main, the highway widening. The widening is the most visible short-term threat, but it is only the leading edge. The larger and more permanent closure comes from the ordinary growth of Eastern Ontario itself — the industrial and residential infill a growing region brings to the edge of its busiest highway over decades. As the region grows, the open corridor fills in step by step: commercial development at the interchanges, then logistics parks and distribution centres moving east from the Greater Toronto Area, then housing subdivisions at the growth centres, then the utility corridors — hydro, gas, fibre, water — that lock in behind them. None of this reverses. A logistics park, once built on the margin, is not removed; a subdivision is not un-built; a utility corridor is not moved cheaply. By late in the century the corridor that is open today is set solid, and a surface railway through it is no longer possible — only an elevated or tunnelled line, at a cost approaching ALTO's.

THE INFILL RATCHET

The 401 margin is consumed less by highway widening than by the growth of the region around it, in a series of permanent steps: commercial development at the interchanges (now–2035) · logistics and distribution parks moving east from the GTA (2030–2045) · housing subdivisions at the growth centres (2035–2060) · utility lock-in, hydro to fibre (2040–2070) · the corridor set solid (2060–2100).

Each step is cheap and fast to build, and expensive and slow to remove. That imbalance is the whole point: development on the margin can be reversed in principle, never in practice. Every year of inaction moves the corridor one notch further — and the notches do not turn back.

That closure has a price, and it is large. A first-principles estimate by the Initiative puts the cost of letting the corridor close at roughly $42.6 billion in 2025 dollars, in a range of about $28 to $55 billion. It has three parts that add together: the rise in land-acquisition cost as farmland on the margin becomes developed land; the construction premium as an at-grade build on open ground, at about $40 million per kilometre, gives way to elevated and tunnelled construction through developed corridor at $100 to $200 million per kilometre; and the present value of the benefits lost through decades of delay. The full three-part build-up is carried in the financial analysis of Chapter 8. The headline is what matters here: the cost of missing the window is on the order of the cost of building HPPR itself — and it is incurred by waiting, not by building.

LAND ESCALATION	BUILD PREMIUM	FOREGONE BENEFIT
$2.6B	**$19.3B**	**$20.7B**
Agricultural margin re-valued as developed land at the point of acquisition.	At-grade open-ground build giving way to elevated and tunnelled construction through infill.	NPV of the passenger, freight, and emissions benefits lost through decades of delay.

The corridor this proposal leaves, if it is kept open, serves two purposes at once. The “build one, make one free” principle of Chapter 3 means the separation that gives the region modern passenger rail also gives it, in the same corridor, a freight dividend: a better freight path that takes trucks off the 401 and serves the regional economy for as long as the passenger service does. A century from now the corridor is not a single-purpose passenger line but a shared spine doing both jobs, on ground the region cut once and then used twice.

The most consequential thing about this route, in the end, is not its cost advantage or even its lower friction. It is its permanence. The corridor chosen now is the one the next century lives inside, and the window to choose it is closing on a generational clock, not a budget cycle. The argument of this report is that the region should choose, while it still can, the corridor the next hundred years will thank this decade for keeping open — the one that asked the least of the land and the people, cost less than a third of the alternative per kilometre as specified, and left a shared spine rather than a closed door.

> *The highway widening is only the leading edge. What closes the corridor over a century is the growth of the region around it — logistics parks, subdivisions, utility corridors, none of which reverse — at a cost, on the order of forty billion dollars, incurred not by building the railway but by failing to.*

The corridor, then, is available but closing, opportunistic by design, and priceable from the outside view at roughly less than a third of ALTO's cost per kilometre as specified: a $19.0-billion as-specified, $26.1-billion adjusted diesel spine, an electrification option held open, and a separately costed Ottawa-leg upgrade. Whether that corridor will carry enough riders to justify the investment — the demand case, built on the journey times of §4.8 and the same outside-view discipline — is the subject of Chapter 6.

References

Procurement and specification (§4.1)

- Privy Council Office. « Note à l'intention du Lieutenant du Québec — Train à grande fréquence », 20 February 2025, pp. 000001–000002, released under access-to-information request A-2025-00015 — the February 2022 high-frequency concept at up to 200 km/h, the October 2023 two-speed Request for Proposals, and the bidders' new-alignment high-speed proposals. The note is in French; translations are the Initiative's.
- Transport Canada and ALTO. Public announcements of 19 February 2025 and June 2026, and the What We Heard consultation reports released in Kingston on 22 June 2026 — the 300 km/h specification, the southern-route preference and the possible Kingston stop — altotrain.ca, canada.ca
- Canada's National Observer. "Kingston mayor welcomes high-speed rail pitch amid widespread opposition", 7 July 2026 — Alto's statement that following the Highway 401 route would not be possible because of the wider curve radius required at 300 km/h
- CBC News (Dan Taekema). "Kingston officials cheer Alto announcement, but concerns about high-speed rail remain", 23 June 2026 — Mayor Bryan Paterson's response to the announcement, including the remark that even if the line is not "right along [Highway] 401" the city will continue to press the corridor case

Route geometry and land cover (§4.2)

- ALTO HSR Citizen Research Initiative. Corridor KML geometry, digitised in Google Earth — the eleven-segment alignment, the ~479 km spine length and the fifty-metre right-of-way footprint — citizenresearch.ca
- International Union of Railways (UIC) and the European Technical Specifications for Interoperability (TSI), infrastructure subsystem — the geometry standards behind the curve radii of §4.1 and the speed table of §4.2.1: the UIC recommendation of a 7,000 m minimum radius on 300 km/h lines for ride comfort, and the cant and cant-deficiency limits from which the 150 mm / 100 mm basis used here is taken
- Agriculture and Agri-Food Canada. Annual Crop Inventory — the land-cover classification behind the corridor footprint tables of §4.2.2 — agriculture.canada.ca
- Ontario Hydro Network — the watercourse layer against which a complete crossing count would be drawn (§4.2.3).

Stations and comparators (§4.2.4)

- National Audit Office (United Kingdom). HS2 Euston station reporting, 2023 — the £2.6bn to £4.8bn cost movement, the £106m of written-off design work and the £289m of design fees — nao.org.uk
- HS2 Ltd rolling stock and station specification — the 400-metre trainset length and the matching 400-metre platforms at Euston and Old Oak Common, the basis of the platform-length point in §4.2.4
- W. Barter, New Civil Engineer. "Explained: why 11 platforms are needed at HS2's Euston terminus", 2021 — the platform-count arithmetic cited in §4.2.4: 25-minute standard turnrounds with a five-minute run-out and run-in give nine platforms at 18

trains per hour, a tenth for the Anglo-Scottish services turning in 55 minutes, and an eleventh so the station is not worked at full capacity

Cost model (§4.3, §4.6, §4.7)

- ALTO HSR Citizen Research Initiative. Reference-class cost study — the dual-regime model of Table 4.1, the sixteen greenfield and eight urban reference projects, and the Engineering Complexity and Latent Friction indices — citizenresearch.ca
- ALTO. Published capital cost midpoint of roughly $75 billion for the Toronto–Québec City corridor — the basis of the ~$142M/km figure — altotrain.ca
- Harbin–Dalian high-speed railway — the 25 per cent overrun on original budget, the pre-opening rebuilding of sections deformed by frost heave, and the delayed opening; the cold-climate comparator used in §4.6

Traction and electricity supply (§4.6)

- Independent Electricity System Operator. Eastern Ontario bulk system planning, including the Belleville-area supply study and the Greater Ottawa regional assessment — the capacity position described in §4.6 — ieso.ca
- The Canadian Press. “High-speed rail line would demand big slice of energy grids already under pressure”, 8 February 2026 — Martin Imbleau’s 50 MW per train and “significant block” remarks, Ryan Katz-Rosene’s one-to-three-per-cent capacity estimate and small-town substation comparison, and the Hydro-Québec and Hydro One statements that specific projections await a final route

Journey times (§4.8)

- VIA Rail Canada. Current Québec City–Windsor corridor timetables — the conventional-rail times of §4.8 — viarail.ca
- ALTO. Published journey-time targets for the Toronto–Québec City corridor — the 3h07 Toronto–Montréal figure — altotrain.ca
- ALTO HSR Citizen Research Initiative. Estimated, Not Simulated, June 2026 — analysis of the journey-times memorandum released under A-2025-00333; establishes that the 177 km/h base case is the only journey time simulated for this corridor — citizenresearch.ca

Peterborough (§4.5)

- Shining Waters Railway. Peterborough–Toronto passenger service feasibility work — the ~950 passengers each way on two morning and two evening trains, and the $233–300 million costing for track, six stations, bridges and rolling stock.
- McGill University TRAM. High-speed rail survey research, tram.mcgill.ca — the stated-preference survey and published origin–destination matrix underlying the corridor ridership work discussed in §4.5; see also D. Sullivan, “High Speed Rail: Ridership forecasting”, 30 April 2026, for the criticism that the matrix does not balance between city pairs

Companion chapters

- HPR Research Report: Chapter 2, ALTO’s scope escalation; Chapter 3, the HPR concept and the freight dividend; Chapter 5, environmental and community impact; Chapter 6, ridership, built on the journey times of §4.8; Chapter 8, the financial case, which carries the three-part corridor-closure build-up of §4.9.