



Figure 1: Vitoria-Gasteiz Tramway
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Green Tracking of Light Rail: Creating Future-Focused Biophilic Transport Infrastructure

By Ed Clayton

Background

Tāmaki Makaurau Auckland is the largest city in Aotearoa New Zealand. Home to around 1.5 million people, it has been experiencing rapid growth and now houses around 30% of the national population. Congestion is a hot topic in the media with estimates that it [costs the city up to \\$1.3 billion \(NZD\) annually, or around 1.4% of the GDP](#). While undoubtedly this congestion is due to growth, it has roots in several historic decisions made in the 20th century. In the 1950's and 1960's,

Tāmaki Makaurau Auckland's once extensive tramways were removed and replaced with trolley buses. At the same time, a decision was made to focus on building a motorway network at the expense of extending the commuter rail system. Now, a light rail network has been proposed to alleviate congestion and help enhance community connection for several different routes (ironically, down some of the very same tram routes removed 70 years ago). The first of these is the [connection between the city center and the international](#)

[airport](#), an approximately 20km line that will access areas expected to host around 17% of the population growth and 33% of the job growth occurring in the next 30 years² (Figure 2).

Essential Freshwater Reforms

Recently, new national water management legislation has provided a driver to turn this light rail route into a biophilic transport asset that can provide not just improved access, but a myriad of other benefits as well. The new national direction governing water management

for Aotearoa New Zealand are the [Essential Freshwater reforms](#). They demand immediate improvement to our freshwater systems and the need to bring waterways to a healthy state within a generation. Te Mana o te Wai (roughly translated: the power/authority of the water) is the central concept and sets out the directions local body authorities (city, district and regional councils in Aotearoa New Zealand) need to take to improve waterways. Key to this are the principles of governance and stewardship, where those with authority must prioritize (improving and enhancing where required) the health of waterways now and into the future to ensure the needs of future generations are sustained.

To give effect to Te Mana o te Wai, councils must apply the following hierarchies of obligation: 1) the health and

well-being of water; 2) the health needs of people; and 3) the social, economic and cultural well-being of people and communities. Following such directions, it can be reasonably interpreted that councils should take steps to ensure that infrastructure supports Te Mana o te Wai. For transport, this means building infrastructure that firstly has low pollutant generation and secondly can actively treat pollutant loads by sequestering contaminants within its structure, ensuring any discharged water is filtered and cleaned before entering the receiving environment.

But, our current transport paradigm remains inherently polluting. Centering cars and private vehicles in our urban spaces creates swathes of impervious surfaces. This results in “[Urban Stream Syndrome](#)”, where paved areas create faster

runoff, leading to streams that have higher flood peaks and more erosive power, transport more pollutants and sediment, and have fewer species and less complex ecosystems. Compounding this is the fact that the more we drive, not only do we require more impervious surfaces to drive on, we also increase the number of [tyres, which are major sources of heavy metals and microplastics](#), released to the environment as they wear. Tyres are 1-2% zinc oxide by weight, added during vulcanization to make tyres harder wearing and longer lasting. [In Tāmaki Makaurau Auckland, zinc is a major contaminant in our marine receiving environments](#), where too much zinc creates toxic conditions for macroinvertebrates and small benthic organisms that are integral parts of the food web. [Wear and tear on road surfaces from tyres](#) is estimated to directly contribute 10% of all microplastics in the world's oceans.

None of the above is new. Auckland Council recognizes that [roads carrying more than 10,000 vehicles per day are high contaminant generating activities](#). To mitigate this, such roads should have treatment devices within the corridor that can do a mix of reducing pollution and runoff. Yet retrofitting existing roads is challenging because these treatment devices generally take up more room than is available without a drastic reshaping of the corridor. Changing our vehicle powertrains from

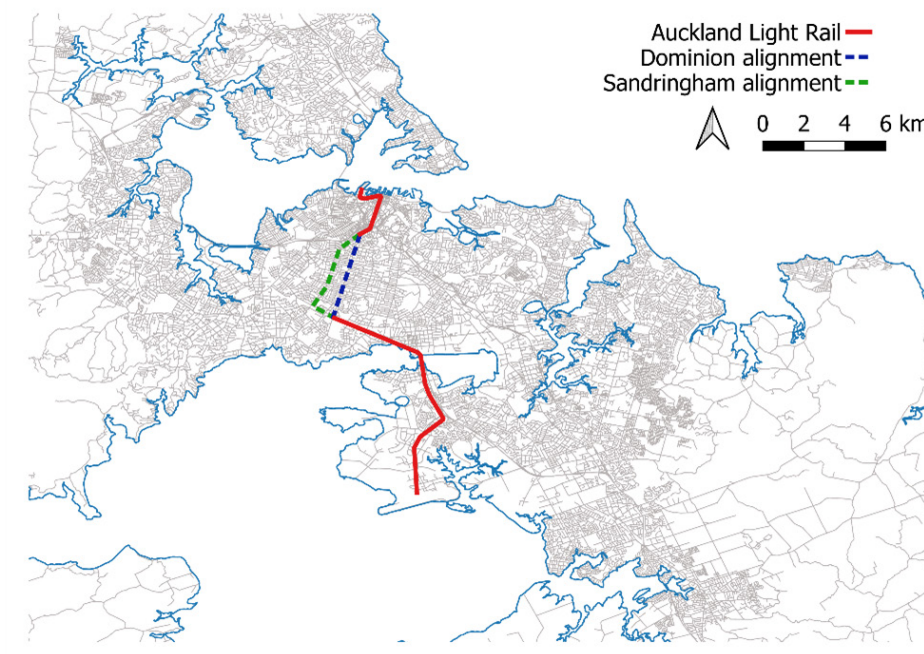


Figure 2: Potential Auckland Light Rail route showing two different central alignments, to be decided. City centre is at the north end of the route, airport is at the south end. Contains data sourced from the LINZ Data Service licensed for reuse under CC BY 4.0

internal combustion to electric or hydrogen will not address tyre wear, or reduce impervious surfaces either.

Knowing that we need to improve our waterways but continuing to design systems for cars that create toxic freshwater environments leads to incompatible outcomes. The requirements of Te Mana o te Wai legislation will place responsibilities on local government that creates conflict with building roads as normal. Application of biodiversity net-gain concepts can help explore the choices we face (Knight-Lenihan 2019). We need to ask the question “What would urban transport look like if the fundamental requirement was a net-gain in water quality?”

Green Light Rail

We may have an answer if we can build a light rail network that is integrated with engineered swales and biofiltration devices. The use of “lawn” or “grass” tracking in light rails is extensive in Europe and implemented in a range of other countries including China, the U.S., Australia and Spain (Figures 1 and 3). These tracks incorporate grasses and groundcover plants over infilled soil. Often, the only visible parts of the light rail network will be the rails themselves and the overhead wires. [Such designs have important benefits](#). Compared to a standard concrete light rail surface, they improve air quality by helping filter airborne contaminants and improve community wellbeing through

increased visual green space. They reduce the noise associated with light rail vehicle movement, lower urban heat island effects, and have lower embedded emissions as there is less concrete used in construction. The Parramatta Light Rail line, currently under construction in Western Sydney, Australia, has 10% of its length as grass track. Where used, this has reduced the required concrete by 81% compared to standard construction and [overall the project reduced carbon emissions by 36%](#) due to material reuse and recycling.

Most importantly for this discussion, grass tracks allow surface water to soak in, thereby removing contaminants and slowing stormwater runoff with studies showing [up to 90% of rain falling within the rail corridor soaking in and being used by the plants](#). Yet, these tracks are not designed with water quality outcomes as a priority. Usually, these tracks are built to delineate the light rail lines, stop cars from using them, and provide aesthetic quality to local areas.

The proposed idea of “green” tracking takes these ideas one step further and prioritises the water quality outcomes as a fundamental design requirement. How this might look is similar to the photos of European examples but with specific engineered soils designed to infiltrate and treat contaminants. Cross sections would be altered to drain water from road surfaces to a center running light rail line. Effective treatment trains would consist

of vegetated swales for pre-treatment before discharge to raingardens, removing sediment in swales and ensuring efficient infiltration in the raingardens. Native groundcover plants could be used to provide a rough surface texture that slows water movement, keeping water visible at the surface when it rains and providing food for bees and pollinators when dry. In areas where road stormwater discharges to streams and marine areas, we could remove contaminants generated from tyres. Where possible, clean water would soak to the aquifers below in much the same way as it does now, but at slower and more manageable rates. In places where the corridor has a wide margin, trees could be planted to create a linear forest (Figure 3). We know that climate change is likely to deliver more extreme heat events that impact on rail systems, trees can create a more consistent microclimate that shade and protect the infrastructure.

While the final alignment of Auckland light rail is yet to be decided, the alignment will likely be adjacent to roads carrying between 15,000 and 25,000 vpd, all classified as high contaminant generating activities. Some of this overlies fractured basalt zones where stormwater is directed to soakage (and then to aquifers) or combined stormwater/sewer networks. The aquifers feed urban catchments that in turn discharge to coastal areas under permanent swimming bans. Other areas have more standard stormwater systems that discharge directly



Figure 3: Grass tracks, Barcelona
Image Credit: wikimedia/addshore (CC BY-SA 3.0)

to urban streams. Treatment for these roads is sporadic at best with gross pollutant traps only at a select few locations (usually not good enough to filter out microplastics and particulate bound contaminants such as zinc). Making a conscious decision to put water quality outcomes first means that we could build light rail with swales and raingardens that can treat all of the runoff from adjacent road surfaces (see Figures 4 and 5 for example designs).

As an example, to treat the 4.9 km stretch of Dominion Road between the two proposed stations at Mt. Roskill Junction and Dominion Road Junction (see the proposed 2016 Dominion Road route map, Figure 6), only 1500 m of swales and 150 m of raingardens would be needed (assuming treatment efficiencies as described in Auckland Council's GD01 document). These would not be needed in a continuous stretch, rather short sections of treatment could be targeted at suitable areas with

enough hard space in between for stations, vehicle crossings and intersections.

Continuing this design along the proposed light rail line, we could build such a system to tie into the central city where plans are afoot for a revitalized Queen Street in the central city. Much discussion has been had around daylighting the stream buried during the colonial settlement (Waihorotiu). Together with the green light rail it would make a green and blue space that could create a stunning biophilic linear transport network from the city center to Māngere (Figure 7).

Next Steps

As this article is written, it is unknown if the planned light rail for Tāmaki Makaurau Auckland will have green tracks. Likely a detailed design with route selection and station location will be released soon. From consultation documents it is clear that the central government has charged the

Auckland Light Rail team with considering environmental and climate outcomes while making these decisions. This could be the example we need to take a systems approach to transport infrastructure and put our freshwater systems first when we plan infrastructure, together with an urban design process that addresses not just the light rail line but the adjacent land use too.

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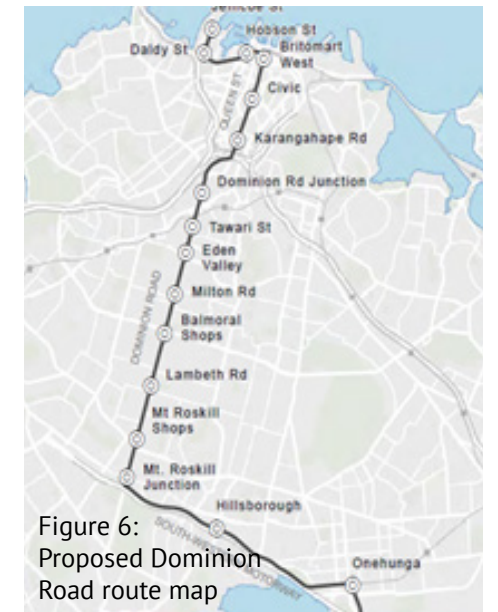


Figure 6: Proposed Dominion Road route map



Figure 4: Raingarden design, Jellicoe St. Auckland



Figure 5: Vegetated swale, Seattle



Chris DARBY @DarbyatCouncil · Jul 3, 2021

Recreating the Waihorotiu stream that once flowed down the Queen St valley, has been on my mind for a few years. Artist Chris Dews has got me thinking of how we could imagine light rail gliding down Queen in a blue and green environment.



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