Map of Anticipated Network Expenditure and Network Constraints

As required by sections 2.3.13 - 2.3.16 the following text details the projects/programmes that represent the largest forecast operational and capital expenditure and the network/equipment constraints that could be addressed by the projects/programmes.

The map is intended to be used in digital form and contains layers that relate to some of the items detailed below. In paper printed form, the map will be very difficult to interpret.

10 Largest (by Value) Operational Projects/Programmes

ID	Name	Description	Timing	Average Value ($)	Location
(OA) 12003	**Overhead Repairs to Restore Power**	The immediate work required after a fault has occurred on all voltages of the overhead network to restore supply to all affected consumers.	2022-2031	628k p.a.	All Line Locations (Map inset)
(OB) 12024	**Inspecting, Organising and Trimming Trees**	The inspection of trees, the liaison with tree owners and the subsequent trimming or felling of trees which are considered be a risk to the electricity network.	2022-2031	731k p.a.	All Line Locations (Map inset)
(OC) 11998	**ZSS Asset Inspection, Testing & Minor Maintenance**	The inspection of zone substation assets, routine testing of those assets, and minor maintenance that arises as an immediate result of those inspections and tests.	2022-2031	279k p.a.	***Zone Substations*** Layer
(OD) 12001	**Overhead Inspection, Testing and Minor Maintenance**	The inspection, testing and minor maintenance of overhead line assets of all voltages.	2022-2031	130k p.a.	All OH Line Locations (Map inset)
(OE) 12018	**DSS & D Switchgear Planned Maintenance**	The planned maintenance of all types of distribution substations and distribution switchgear. Includes ring main units, pole-mounted switches and circuit-breakers, kiosks, and LV switchgear within the kiosks.	2022-2031	272k p.a.	All Distribution Substation Locations
(OF) 12002	**Overhead Planned Repairs & Maintenance**	Scheduled maintenance of overhead line assets of all voltages. Generally, a consequence of inspections revealing an issue more widespread than a single structure. Work is normally planned the prior year.	2022-2031	526k p.a.	All OH Line Locations (Map inset)

(OG) 12018	Distribution Transformer Refurbishment	When distribution transformers are recovered from service for whatever reason they are inspected and where necessary refurbished to allow continued service at another substation.	2022-2031	182k p.a.	*EA Networks HQ* Layer
(OH) 12017	D Substation and D Transformer Inspection, Testing and Minor Maintenance	The inspection of distribution substation and distribution transformer assets, routine testing of those assets, and minor maintenance that arises because of those inspections and tests.	2022-2031	135k p.a.	Substations & Workshop
(OI) 12021	Underground Asset Planned Repairs & Maintenance	The planned maintenance of all types of underground cable assets. Includes 66 kV, 33 kV, 22 kV, 11 kV, & LV underground cables.	2022-2031	95k p.a.	All Locations
(OJ) 12015	ZSS Asset Planned Repairs & Maintenance	Scheduled maintenance of assets within the zone substations. Generally, a consequence of inspections revealing an issue that is not readily resolved during the inspection process and requires additional parts or resources to complete.	2022-2031	133k p.a.	*Zone Substations* Layer

Few of the items described above have specific locations that can be readily mapped. Zone substations (11998, 12015) are shown explicitly on the map and are on their own layer (as are the zone substation names).

The operational expenditure projects/programmes identified above:

Status	Situation
Are not	already subject to a contract.
Are	forecast to require the supply of assets or goods or services by a related party.
Are	currently indicated for supply by a related party.

10 Largest (by Value) Capital Projects/Programmes

ID	Name	Description	Timing	Average Value ($)	Location
(A) 11136, 11058, 11172	Consumer Connection	The addition or modification of assets of all voltages that relate to connecting new or increased loads to the electricity network. This can be the addition of a fuse to a pillar box or the construction of significant 11 kV or 22 kV assets to service a large industrial load. These loads appear without advance notice on most occasions.	2022-2031	2 546k p.a.	All Locations
(B) Various	Urban Underground Conversion	As overhead lines in urban areas reach the end of their useful life, the network is replaced with underground cabling and ground-mounted substations. Multiple projects per year are completed and, on average, sum to the amount identified. This programme of work is due for completion in 2026.	2022-2029	1 824k p.a.	Urban Areas Identified on Map
(C) 700	New/Smart Technologies	The need to gather additional information on the electrical network and then provide assets that can react to compensate for rapid changes in load or power flow direction are covered by this programme. The initial phases allow for ICP-level metering, control, and communication. This will permit the network to dynamically interact with loads and generators to ensure a stable supply to all consumers. Additional assets, such as control software, batteries, and dynamic VAr compensation are allowed for in later phases of the programme.	2022-2031	1 756k p.a.	All Locations
(D) 11704, 11079, 11078, 11059	Unscheduled Projects	This programme of work is to accommodate the unexpected or unscheduled projects that occur when additional information about condition or constraints becomes known. The largest component of this value is the overhead line rebuilds beyond 2024. The likely rebuild candidates have been grouped but not scheduled at this stage.	2022-2031	1 646k p.a.	Predominantly Rural
(E) Various	Overhead Line Rebuild	Known, condition-based overhead line rebuilds of all voltages are included in this category. There is a pool of lines that are becoming candidates for rebuilding (post 2024) but they are yet to be scheduled and therefore not in this category (they are in the D category above).	2022-2031	987k p.a.	Rural Line Locations (Map inset)

(F) Various	Distribution Transformers	New distribution transformers are required for new or increased load and conversion from 11 kV to 22 kV. The 11 kV to 22 kV conversion work forms a significant proportion of this value and after 2028 will decline significantly.	2022-2031	864k p.a.	All Locations
(G) Various	Subtransmission Lines	This programme includes new 66kV subtransmission lines being necessary if Montalto Zone Substation proceeds and if a second GXP is required.	2029-2031	2 172k p.a.	Rural
(H) 12470, & Others	Ashburton 11kV Core Network	This programme is for additional reliability, resilience, capacity and security within the Ashburton township urban area. It consists of a series of high capacity 11 kV circuits interconnecting zone substations with network centres (circuit-breaker switchboards) which have multiple feeders radiating from them. The goal is to reduce ICP count per feeder circuit-breaker to less than 250 while increasing network resilience to multiple failures.	2022-2030	656k p.a.	Ashburton Township - *Core Network* Layers
(I) Various	General ZSS	Any new or upgraded assets within zone substations are included in this programme. Most of the value in this programme is towards the end of the AMP period and is therefore less certain to proceed – driven by load growth.	2022-2031	598k p.a.	*Zone Substations* Layer
(J) Various	Rural Underground Conversion	The State Highway network in Mid-Canterbury are high traffic volume routes that have historically had a high number of serious crashes on them. A number of these crashes have involved roadside poles and some of these have been fatal. In conjunction with the NZTA EA Networks have been replacing end-of-life overhead distribution lines with underground cable on these routes. The projects included in this programme are mostly on Methven Highway.	2022-2024	771k p.a.	Largely Ashburton-Methven Highway.

Not all of the programmes have specific physical locations that can be readily shown on a map. Those programmes that can be located have been allocated a layer in the pdf document and this can be turned on and off to highlight the location(s) involved.

The capital expenditure projects/programmes identified above:

Status	Situation
Are not	already subject to a contract.
Are	forecast to require the supply of assets or goods or services by a related party.
Are	currently indicated for supply by a related party.

Network or Equipment Constraints Involving Large Operational and/or Capital Projects/Programmes

ID	Name	Description	Project Response	Location
1	Inter-Zone Substation Load Transfer	When operating the distribution network at 11 kV, the ability to transfer load between zone substations (such as during a feeder fault near the start of a feeder) is limited by voltage drop in rural areas and cable capacity in urban areas.	(H), (E) & Others (some not listed above)	*11-22kV Conversion* Layer and *Core Network* Layers
2	Zone Substation Transformer Failure	The failure of a zone substation transformer will either interrupt supply or limit capacity to n-1 levels. Both situations require additional capacity from adjacent zone substations to supply the load that cannot be served from the zone substation with the failed transformer. The availability of an urban Ashburton core 11 kV network and a 22 kV rural network provide this facility while a spare transformer is installed. Some general zone substation work also provides either more transformation or an extra zone substation site (Montalto 66).	(H), (E), (I) & Others (some not listed above)	*11-22kV Conversion* Layer, *Core Network* Layers, *and Zone Substations* Layer.
3	Sub-transmission Circuit Failure	Loss of a single 66 kV circuit will generally not result in loss of supply. It can however cause lower than ideal sub-transmission voltages and the ability to transfer load at 22 kV or 11 kV is beneficial. Loss of more than one 66 kV circuit (or a single radial 33 kV or 66 kV circuit) will potentially cause loss of supply. These scenarios can be mitigated with additional inter-zone substation transfer capacity or additional subtransmission circuits.	(G), (H) & Others (some not listed above)	*11-22kV Conversion* Layer and *Core Network* Layers
4	Civil Infrastructure Support Failure	During seismic and flooding events, the failure of civil infrastructure such as bridges and roads can cause failure of portions of the electrical network. Additional electrical network paths and capacity can help mitigate this to some degree. Well maintained or new assets also resist these forces better than older assets.	(H), (E), & Others (some not listed above)	*11-22kV Conversion* Layer and *Core Network* Layers. Much of the rural area.
5	Urban 11kV Capacity	The interconnected radial design of the existing Ashburton 11 kV underground network is essentially a traditional overhead line configuration that has served well for several decades. The loading of a number of these circuits is close to reaching full capacity and during faults back-feeding can cause slight overload situations. The addition of a layer of larger 11 kV cables that connect to network switching	(B), (H) & Others (some not listed above)	*Urban UG Conversion* Layer, *11-22kV Conversion* Layer and *Core Network* Layers.

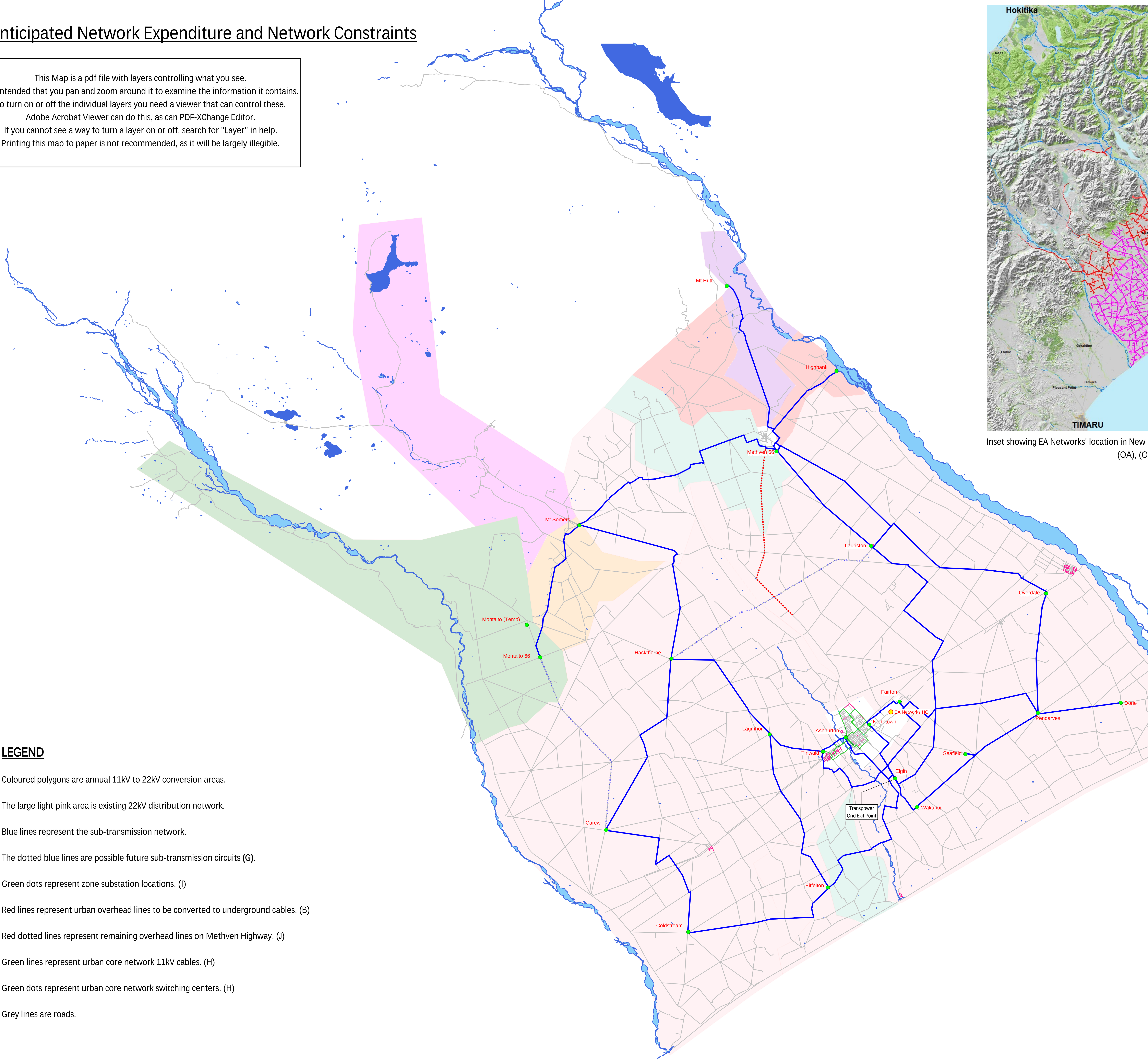
		centres and interconnection to the rural 22 kV network during 11 kV cable faults provides both steady state and contingency capacity to alleviate these limitations.		
6	Urban 11kV ICP Count/Feeder	The number of connections per urban 11 kV feeder exceeds the limit set in the EA Networks security standard (some by a large amount). To reduce this to the required level, additional feeders are needed so that for a single cable fault only a limited number of consumers experience the outage. Adding additional feeders to the zone substations would require excessive amounts of cabling to reach the ICPs as well as extensive zone substation rework. The alternative of large core network 11 kV cables connected in closed rings via network centres (new switchboards with additional feeders within the urban network) is a high benefit/value practical solution and advantageous for other constraints as well.	**(B)** & **(H)**	***Urban UG Conversion*** Layer and ***Core Network*** Layers.
7	GXP Firm Capacity Exceeded	If a time arises that demand on the Ashburton 220/66 kV grid exit point exceeds the 220 MVA firm capacity for an unacceptable length of time each year, then an additional GXP will be required. At this point in time, it seems to be less likely this will occur within the 10 year AMP planning period. There are projects included within the AMP (towards the end of the planning period) that address this potential eventuality. A second GXP comes with overall capacity benefits but does provide several technical and operational disadvantages that are not apparent with one GXP.	**(G)** & **(I)**	Predominantly Located in Rural Areas. Network-wide impacts.
8	Low Voltage Network Capacity	The addition of new or increased load or generation will cause the capacity of LV (low voltage) networks to be tested and in some cases exceeded. The location and timing of this new load on existing cables is unknown. To remedy this, additional LV cables and/or distribution substations will be required. Careful load management using demand management control devices will be able to assist in shifting some of the peak demand, but at some stage additional network assets will still be required.	**(A)**, **(B)**, **(C)**, **(D)**, & **(F)**	Urban Areas.
9	Asset Condition - Potential Failure	All assets deteriorate over time and it is critical to proactively manage the asset's condition to ensure it does not fail unexpectedly or catastrophically before it is removed from service at end-of-life. Prudent maintenance strategies ensure that inspections, testing, and either refurbishment or replacement occur in a timely and safe manner.	**(OA)-(OJ)**, **(B)**, **(D)**, **(E)**, & **(J)**	All Locations - Network-wide.

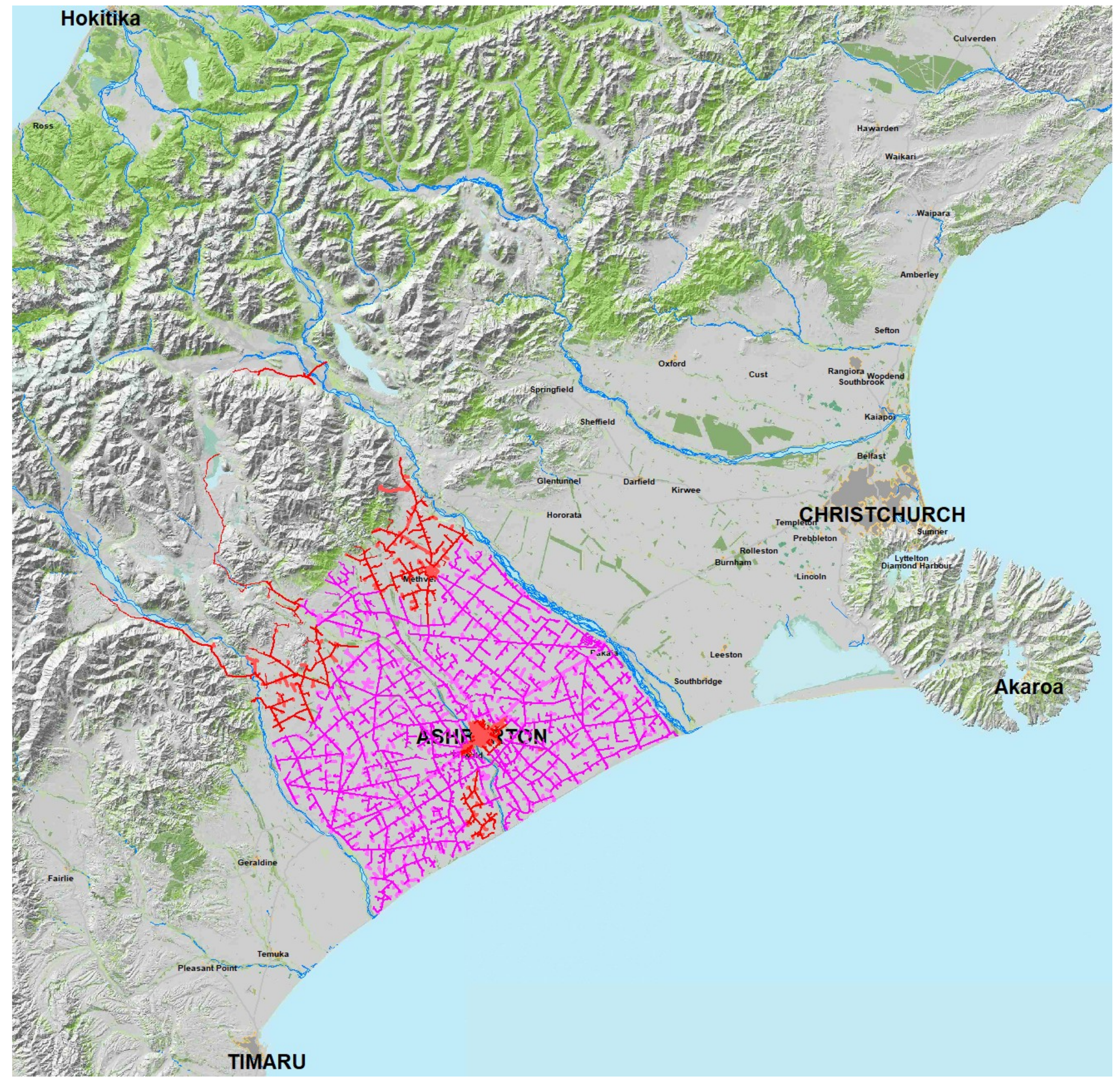
		All the operational expenditure programmes/projects identified above are in some way contributing to the safe and reliable operation of the electricity network – ensuring any failures that do occur are largely unforeseeable or uneconomical to completely mitigate against.		
10	Network Resilience	In order to maintain and increase network resilience there must be both effective maintenance of existing assets to prevent failure in adverse conditions (such as the alpine fault rupturing) and improved/additional assets to assist in recovery from adverse events. All of the projects/programmes identified above contribute in large and small ways to increasing the resilience of the EA Networks electricity network. This ranges from more modern design standards for replacement poles to additional alternative network paths should the primary one be unavailable.	(OA)-(OJ) & (A)-(J)	All Locations - Network-wide.

The constraints detailed above are either explicitly identified in the asset management plan or are alluded to in network development project/programme justifications.

Map of Anticipated Network Expenditure and Network Constraints

This Map is a pdf file with layers controlling what you see.
It is intended that you pan and zoom around it to examine the information it contains.
To turn on or off the individual layers you need a viewer that can control these.
Adobe Acrobat Viewer can do this, as can PDF-XChange Editor.
If you cannot see a way to turn a layer on or off, search for "Layer" in help.
Printing this map to paper is not recommended, as it will be largely illegible.





Inset showing EA Networks' location in New Zealand context and 22kV (magenta) and 11kV (red) distribution network.
(OA), (OB), (OD), (OF), (OI), (A), (C), (E), & (G)

LEGEND

- Coloured polygons are annual 11kV to 22kV conversion areas.
- The large light pink area is existing 22kV distribution network.
- Blue lines represent the sub-transmission network.
- The dotted blue lines are possible future sub-transmission circuits (G).
- Green dots represent zone substation locations. (I)
- Red lines represent urban overhead lines to be converted to underground cables. (B)
- Red dotted lines represent remaining overhead lines on Methven Highway. (J)
- Green lines represent urban core network 11kV cables. (H)
- Green dots represent urban core network switching centers. (H)
- Grey lines are roads.

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