Appendix 4.9: Kingston PJR

Revised regulatory proposal for the ACT electricity distribution network 2019–24

November 2018

evoenergy

Project Justification Report

Project name	**Supply to Kingston**
Expenditure type	Capital Expenditure
Business Group	Asset Strategy
Regulatory Period	1 July 2019 to 30 June 2024
Total Project Cost Estimate	$322,650 excluding corporate overheads, excluding contingency, and excluding GST
Five year total spend 2019-24	$322,650 excluding corporate overheads, excluding contingency, and excluding GST
CAPEX category	ENAA Distribution
Primary driver	Load growth in Kingston Foreshore area
Project Number	20001375

Contents

1. Executive Summary

This Project Justification Report addresses the growth of electricity demand in the Kingston Foreshore area and evaluates options re how Evoenergy can meet these needs.

The maximum demand in the Kingston Foreshore area is forecast to increase steadily over the next five years with major residential, commercial and community developments. The load in this area is typically summer peaking. The new developments are likely to include high energy efficiency and rooftop solar PV generation, and this has been accounted for within the demand forecast.

The forecast load growth will be supplied by existing feeders as much as possible, however these feeders cannot fully meet the forecast demand increase.

This Project Justification Report proposes a new 11 kV feeder from East Lake Zone Substation to the Kingston Foreshore area. Spare conduits will be installed for future feeders to supply the future East Lake development adjacent to the Kingston Foreshore.

The proposed feeder will inter-tie with existing feeders emanating from Telopea Park.

Other options considered include the installation of a feeder from Telopea Park, demand management, and a grid battery. The selected option has the highest (ie least negative) Net Present Cost, and the lowest Capital Cost of all options evaluated.

A preliminary cost estimate for the selected option of installing a new 11 kV feeder from East Lake Zone Substation to Kingston Foreshore is **$322,650 excluding corporate overheads, contingency and GST**.

This Project Justification Report includes the assessment of risk based on probabilistic principles. The conservatively estimated value of avoided risk exceeds cost of investment. Therefore, Evoenergy considers that proposed investment is prudent and economic.

The feeder installation will be carried out to coordinate with the proposed Suburban Land Agency – sponsored 132 kV East Lake to Causeway overhead to underground conversion project (a conduit will be provided and installed by this project). These works will be carried out during the 2019-24 Regulatory Control Period with proposed completion by December 2020.

2. Strategic Context and Expenditure Need

There is significant development underway and proposed for the Kingston Foreshore area, comprising a mixture of multi-storey residential, commercial and community buildings.

2.1. Existing infrastructure in the Kingston Foreshore area

There are several 11 kV feeders supplying the Kingston Foreshore area. These feeders emanate from Telopea Park and East Lake zone substations.

The maximum load supplied by each feeder as a percentage of its firm rating, is shown in Table 1 for summer and winter. Yellow denotes load above 80% of the firm rating, red denotes load above firm rating. Firm rating of an 11 kV feeder is dictated by the number of inter-connections it has to other 11 kV feeders in order to provide full back-up capacity in the event of a contingency. Thus a feeder that is inter-connected to one other feeder may be loaded to 50% of its thermal capacity, and a feeder that is inter-connected to two other feeders may be loaded to 75% of its thermal capacity. 100% firm rating should not be exceeded as this places load at risk in the event of a contingency.

Table 1: Loading of feeders supplying the Kingston area

Feeder Name	Zone Sub	Firm Summer Rating MVA	Thermal Summer Rating MVA	Firm Winter Rating MVA	Thermal Winter Rating MVA	2015		2016		2017		2018
						Summer MD	Winter MD	Summer MD	Winter MD	Summer MD	Winter MD	Summer MD
Mundaring	TP	5.0	6.7	5.7	7.6	7%	8%	8%	8%	17%	22%	19%
Power House	TP	4.1	5.4	4.6	6.1	84%	68%	8%	69%	69%	7%	8%
KF1	TP	4.0	8.0	4.5	8.9	69%	57%	74%	65%	76%	43%	74%
Dairy South	EL	6.1	8.1	6.8	9.1	94%	98%	103%	92%	107%	90%	112%
Strzelecki	TP	5.5	7.3	6.2	8.2	57%	65%	69%	65%	42%	93%	61%
Mildura	TP	3.8	5.0	4.2	5.6	38%	33%	32%	34%	32%	64%	71%
Jardine	TP	4.7	6.4	5.4	7.3	63%	72%	52%	63%	55%	66%	51%
Sturt	TP	4.1	5.4	4.6	6.1	78%	63%	68%	78%	74%	82%	77%
Kelliher	TP	5.0	6.7	5.7	7.6	105%	65%	74%	51%	59%	48%	54%
Monash	TP	5.0	6.7	5.7	7.6	75%	78%	69%	81%	73%	83%	67%

Telopea Park Zone Substation has a continuous summer rating of 100 MVA and is approaching this maximum demand level, so has little spare capacity available for this development. There are no spare 11 kV feeder circuit breakers at Telopea Park.

East Lake Zone Substation, located on the eastern side of Dairy Road, Fyshwick was commissioned in 2013. It currently has one 132/11 kV 30/55 MVA transformer and one 11 kV switchboard. This switchboard has 6 spare feeder circuit breakers available. A second transformer and switchboard are underway and will be installed by 30 June 2019. This will provide ample capacity, security and spare 11 kV feeder circuits for the connection of new feeders. It is a strategic objective of Evoenergy to supply load to proposed and future developments in the Kingston Foreshore area from East Lake Zone Substation and off-load Telopea Park and Fyshwick zone substations.

2.2. Driving need for infrastructure investment

Forecast additional maximum demand in the Kingston Foreshore area for the next five years is indicated in Table 2. This has been based on an assessment of known developments (either at application or Preliminary Network Advice stage) proposed for the area. Some of these developments are either under construction or currently being designed. There is a high degree of certainty (> 80%) that these developments will proceed. In addition there are several potential smaller load increases.

Customer applications or enquiries for the projects listed in Table 2 are included as attachments in Appendix C.

Table 2: Proposed Developments in the Kingston Foreshore area.

Proposed Development and Net Additional Diversified Load in MVA	2019	2020	2021	2022	2023	2024
PN 20004264 B1&2 S14 Kingston Residential development	0.5					
PN 20005072 B2 S67 Commercial development	0.4					
PN 20005802 B50 S 19 Kingston, mixed development	1.0	1.0				
PN 20006063 B4 S 25 Griffith Residential development	0.3					
PN 20006282 B5 S1 Kingston, Aged care facility		0.8				
Kingston Foreshore Residential development, 3,850 units over 6 years	1.5	1.5	1.5	1.5	1.5	1.5
Kingston Foreshore Commercial development and Community development (school)			0.5	0.5	0.5	0.5
Kingston Arts Centre Precinct S49 East Lake Parade, Commercial development			0.5	0.5	0.5	
Canberra Metro Traction Power Station TPS9						1.9
Additional Load (MVA)	**3.7**	**3.3**	**2.5**	**2.5**	**2.5**	**3.9**
Cumulative Additional Forecast Load (MVA)	**3.7**	**7.0**	**9.5**	**12.0**	**14.5**	**18.4**

Table 2 shows that cumulative forecast diversified additional load in the area by 2024 will be approximately 18.4 MVA. The existing feeders (as listed in Table 1) will be configured and spare capacity utilised to supply these additional loads as much as possible. However due to the geographical locations of some loads and high forecast loading of feeders in specific areas, additional feeders will be required.

The Kingston Foreshore area is undergoing a major redevelopment by the ACT Government's Suburban Land Agency (SLA). The vision for the Kingston Foreshore is stated on the SLA's website as follows:

"The Kingston Foreshore area at the eastern end of Lake Burley-Griffin is being developed by the ACT Government's Suburban Land Agency (SLA) as a mixed use waterfront precinct with a strong arts, cultural, tourism and leisure theme. The overall vision for Kingston Foreshore is to rejuvenate an under-utilized industrial area and to create a mix of retail, commercial, residential and recreational areas while preserving its overall historical significance. Kingston Foreshore will be the leading arts, recreation, cultural and community location in Canberra."

Redevelopment of the Kingston Foreshore area commenced 5 years ago and is continuing with the construction of multi-storey apartment buildings, commercial and retail. More apartment buildings are proposed and the carpark area near the Glassworks is to be redeveloped as an Arts Precinct. The area is planned to include 20 apartment buildings, 50 shops and restaurants, and recreational facilities such as gyms.

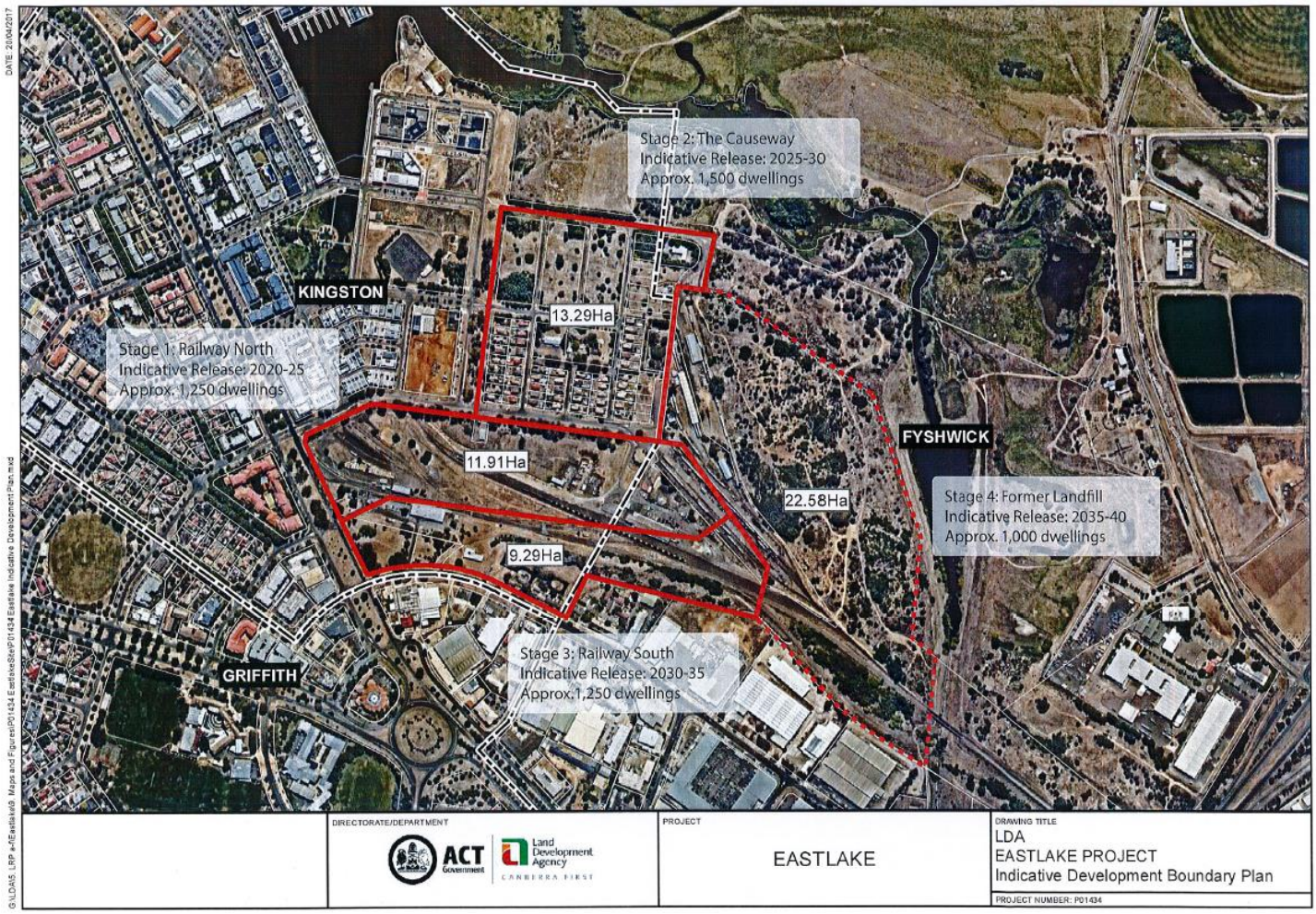
Modern apartment buildings have tended to be all-electric and built without solar PV or battery energy storage facilities. Although the buildings themselves and installed appliances (reverse cycle heat pumps, LED lighting etc) are energy efficient, an after diversity maximum demand (ADMD) figure of 2.5 kVA per unit has been assumed. This allows for current energy efficiency measures and will allow for the expected uptake of electric vehicle charging facilities and instantaneous hot-water heating systems in the future. A concerted effort is proposed by Evoenergy as part of its Demand Side Management initiative, to work with developers and their designers at an early stage, to consider alternative energy sources such as gas and solar PV, and to increase energy efficiency by installing building management systems, centralised gas hot-water heating systems, and gas-powered evaporative cooling systems etc.

Figure 1 shows the Kingston Foreshore development master plan (source SLA).

Figure 1: Kingston Foreshore master plan (source SLA)

Figure 2 illustrates the SLA's future development plan for the East Lake area (adjacent to Kingston Foreshore).

Figure 2: Kingston – East Lake long term development plan (source SLA)



The *Electricity Distribution (Supply Standards) Code* issued by the ACT Independent Competition and Regulatory Commission (ICRC) sets out certain performance standards for the distribution network in the ACT. A Distribution Network Service Provider (DNSP) is required to "take all reasonable steps to ensure that its Electricity Network will have sufficient capacity to make an agreed level of supply available". The processes defined in these criteria serve to limit network augmentation expenditure to instances where the increase in demand is clear and above the secure or firm capacity.

2.3. Other proposals associated with the Kingston Foreshore development

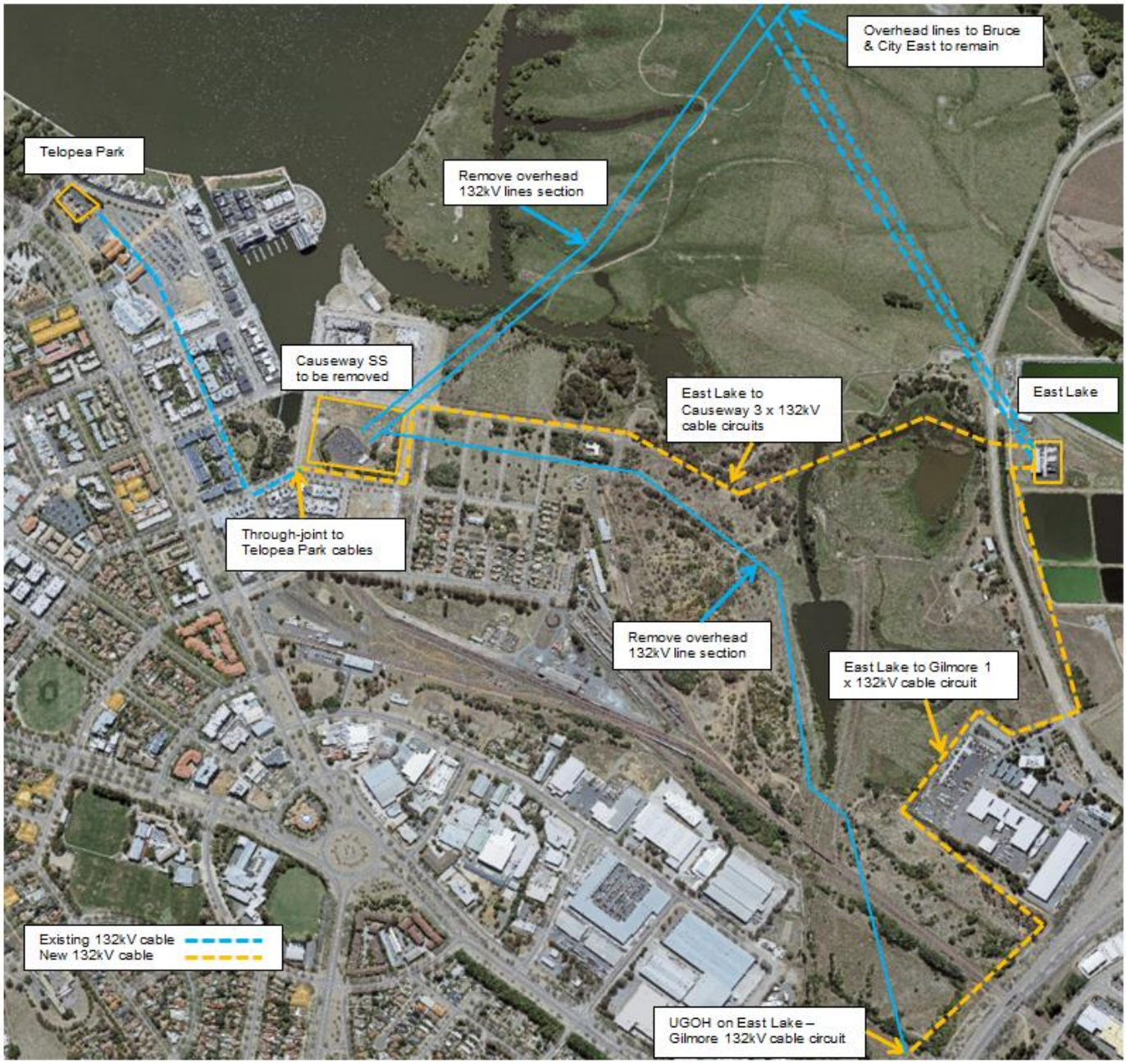
Evoenergy's Causeway Switching Station located in the Kingston suburb at the eastern end of Lake Burley-Griffin, provides a point of 132 kV interconnection between City East, East Lake, Telopea Park and Gilmore zone substations.

Connections to Causeway Switching Station comprise three 132 kV underground cable circuits to Telopea Park Zone Substation, a single circuit 132 kV overhead line to Gilmore Zone Substation, a single circuit 132 kV overhead line to City East Zone Substation, and a single circuit 132 kV overhead line to East Lake Zone Substation. Sections of these latter two lines traverse the Jerrabomberra wetlands nature reserve.

The SLA has requested Evoenergy to convert the 132 kV overhead lines in the vicinity of Causeway Switching Station to underground cables and decommission the switching station. The switching station site will then be redeveloped for residential use. The proposed scope of works is illustrated in Figure 3. These works are proposed to be carried out by December 2020.

Trenching and directional drilling will be undertaken from East Lake Zone Substation to Causeway Switching to enable the installation of 132 kV power cables. It is proposed to install spare 150mm diameter conduits in these trenches for the installation of 11 kV feeder cables as proposed in this Project Justification Report. This will significantly reduce the works and costs associated with this 11 kV feeder project.

Figure 3: Decommissioning of Causeway Switching Station – Proposed Works



3. Objectives

3.1. Corporate, asset management and key project objectives

The corporate, asset management and related key project objectives are shown in Table 3 below. These objectives are used to assess the relative risk of options.

Table 3: Corporate, asset management and key project objectives

Corporate objectives	Asset management objectives	Key project objectives
Responsible	• Achieve zero deaths or injuries to employees or the public. • Maintain a good reputation within the community. • Minimise environmental impacts, for example bushfire mitigation. • Meet all requirements of regulatory authorities, such as the AER as outlined in the NER, and the ACT Utilities (Technical Regulations) Act 2014.	The selected option must ensure environment and safety standards will be met.
Reliable	• Tailor maintenance and renewal programs for each asset class based on real time modelling of asset health and risk. • Meet network SAIDI and SAIFI KPIs. • Record failure modes of the most common asset failures in the network. • Successfully deliver the asset class Program of Work (PoW) to ensure that the protection operates correctly to disconnect faulty sections in accordance with the NER.	Options evaluations to consider the value of customer reliability (VCR). In accordance with regulated requirements, the selected option must ensure access to an electricity supply.
Sustainable	• Enhance asset condition and risk modelling to optimise and implement maintenance and renewal programs tailored to the assets' needs. • Make prudent commercial investment decisions to manage assets at the lowest lifecycle cost. • Integrate primary assets with protection and automation systems in accordance with current and future best practice industry standards • Deliver the asset class PoW within budget.	Options evaluations to consider the cost effectiveness of the solution. In accordance with regulated requirements, the selected option must be the most prudent and efficient. Non-network options will be evaluated on equal merit with network solutions.
People	• Proactively seek continual improvement in asset management capability and competencies of maintenance personnel.	A post implementation review to incorporate learnings through the asset management system.

The project objectives are consistent with Evoenergy's regulatory requirements described below.

3.2. Regulatory Compliance

3.2.1. National Electricity Law and National Electricity Rules

Evoenergy is subject to the National Electricity Law (NEL) and the National Electricity Regulations (NER) which regulate the National Electricity Market (NEM). Evoenergy operates in the NEM as both a Transmission Network Service Provider (TNSP) and a Distribution Network Service Provider (DNSP).

The National Electricity Objective (NEO), as stated in the NEL is to:

"…promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to:

a) *price, quality, safety, reliability and security of supply of electricity; and*
b) *the reliability, safety and security of the national electricity system."*

This objective requires Registered NEM participants to balance the costs and risks associated with electricity supply.

The planning and development process for distribution and transmission networks is carried out in accordance with the National Electricity Rules (NER) Chapter 5 Part B Network Planning and Expansion.

The primary objective of planning is to ensure that customers are able to receive a sufficient and reliable supply of electricity now and into the future.

3.2.2. Capital Expenditure Objectives and Criteria

The NER provides further guidance in terms of allowable capital expenditure via the capital expenditure objectives and criteria for standard control services. These capital expenditure objectives, specified in clause 6.5.6(a) and 6.5.7(a) of the NER describe the outcomes or outputs to be achieved by the expenditure. The objectives include:

1) *Meet or manage the expected demand for standard control services*
2) *Comply with all applicable regulatory obligations or requirements associated with the provision of standard control services*
3) *To the extent that there is no applicable regulatory obligation or requirement in relation to the quality, reliability or security of supply of standard control services; or the reliability or security of the distribution system through the supply of standard control services, to the relevant extent:*
    a) *Maintain the quality, reliability and security of supply of standard control services*
    b) *Maintain the reliability and security of the distribution system through the supply of standard control services*
4) *Maintain the safety of the distribution system through the supply of standard control services.*

The expenditure criteria, set out in Section 6.5.6(c) and Section 6.5.7(c) of the NER, further outline requirements for the way in which expenditure must be set to achieve the objectives above. These include:

1) *The efficient costs of achieving the expenditure objectives*
2) *The costs that a prudent operator would require to achieve the expenditure objectives; and*
3) *A realistic expectation of the demand forecast and cost inputs required to achieve the expenditure objectives.*

The above criteria therefore imply that the capital expenditure, determined in line with the expenditure objectives, must be met via prudent and efficient expenditure, is to be achieved at least cost.

3.2.3. Regulatory Investment Test

Section 5.16 of the NER describes the Regulatory Investment Test for Transmission (RIT-T) and Section 5.17 describes the Regulatory Investment Test for Distribution (RIT-D). These tests must be carried out for any proposed investment where the augmentation or replacement cost of the most expensive credible option exceeds $5 million.

The regulatory investment tests provide the opportunity for external parties to submit alternative proposals to the Network Service Provider, who is obliged to consider any credible proposal objectively.

The most expensive credible option does not exceed $5 million so this project will not be subject to the RIT-D.

3.2.4. Utilities Act 2000 (ACT)

Evoenergy has an obligation to comply with the Utilities Act 2000 (ACT) which imposes specific technical, safety and reliability obligations via the Management of Electricity Network Assets Code and the Electricity Distribution Supply Standards Code.

The Electricity Distribution Supply Standards Code (August 2013) sets out performance standards for Evoenergy's distribution network. Evoenergy is required to take all reasonable steps to ensure that its Electricity Network will have sufficient capacity to make an agreed level of supply available.

This local jurisdictional code specifies reliability standards that Evoenergy must endeavour to meet when planning, operating and maintaining the distribution network. It also specifies power quality parameters that must be met including limits on voltage flicker, voltage dips, switching transients, earth potential rise voltage unbalance, harmonics and direct current content.

The Management of Electricity Network Assets Code requires electricity distributors to protect integrity and reliability of the electricity network and to ensure the safe management of the electricity network without injury to any person or damage to property and the environment.

3.2.5. Evoenergy's Distribution Network Augmentation Standards

Evoenergy's distribution network augmentation standards are set to ensure compliance with the relevant regulatory instruments as described above. System planning studies are undertaken to assess the adequacy of the distribution network to meet current and forecast demands whilst meeting the quality of supply criteria stipulated in the NER. The key performance criteria that are addressed are: thermal overloading, voltage performance, supply security and supply reliability. Studies are conducted using Evoenergy's medium growth, 50% PoE demand forecast, plus known customer-initiated point load requests and applications (copies of these point load connection applications are attached in Appendix C).

As a **first step,** Evoenergy applies deterministic planning criteria to identify where existing or emerging constraints exist on the network. The deterministic approach can lead to uneconomic outcomes. For that reason further analysis is performed to confirm whether the investment proposal is justified economically.

Therefore, as a **second step,** Evoenergy applies probabilistic assessment of risk to determine whether network investment is justified. The value of avoided risk is estimated using probabilistic methodology.

Thus, benefit is expressed as avoided risk. The risk may include other components, but typically unserved energy is the dominant risk component for augmentation projects. If avoided risk exceeds the cost of the proposed augmentation, the investment is considered economic. The assessment of risk is based on the probability of a credible contingency event occurring sufficiently frequently, and with such consequences as to justify Evoenergy to take prudent action to mitigate against it. The probability of a credible contingency event occurring at a time when load exceeds firm capacity, is used to calculate unserved energy.

The value of unserved energy compared with the cost of the investment, determines the prudency of the augmentation.

The value of Unserved Energy identified in this PJR (refer Appendix B2) is high due to the fact that forecast demand exceeds the thermal capacity of the existing network.

To meet the forecast demand under the Do Nothing option (ie connecting all new loads to existing feeders only),

would require operating some feeders above their thermal ratings. Operating an 11 kV distribution feeder at or above its thermal rating is extremely risky as overheating can lead to conductor annealing and failure, or cause failure of jumpers, clamps, connectors, conductor joints, or other hardware. On overhead lines the conductors may sag below their statutory ground clearance (resulting from a combination of ambient and conductor temperature).

In addition, non-network solutions and demand side management solutions are considered when evaluating project options. To inform Evoenergy's position, as part of this assessment, Evoenergy models various load forecast outcomes using Monte Carlo methodology to select the preferred option. This modelling allows Evoenergy to consider whether a demand side solution is a viable option and should be explored further.

This proposed new feeder to the Kingston area has been selected as the preferred option taking into account the available capacity (Table 1), forecast load (Table 2) and the corresponding reduction of risk. It is considered to be a prudent investment, because the avoided risk is higher than the cost of investment. Furthermore, at the time of investment the risk value exceeds the annualized cost of investment.

3.2.6. Cost compliance

Cost compliance is achieved by proactively pursuing the philosophy of compliance with the National Electricity Objective by fully exploring and evaluating all options technically and commercially so as to seek approval for a solution that provides sound grounds for an efficient investment while meeting the long term interests of consumers.

The investment value has been determined using 2016-17 market prices. The methodology and estimated costs used for this project are developed through the application of industry knowledge and Good Engineering Operating Practices based on historical similar projects. This approach complies with paragraphs 6 & 7 of the National Electricity Law (NEL).

It is noted that the National Electricity Law, Rules, Objectives, Criteria, and the ACT Distribution Code, do not require an assessment of unserved energy to be included in the cost evaluation of major augmentation projects.

4. Options Assessment

Evoenergy has considered five options to provide additional capacity to the Kingston Foreshore area as listed in Table 4.

Table 4: Options considered for provision of additional capacity to the Kingston Foreshore area

Option	Option type	Description	Evaluation
0	Network	Do nothing	Not selected as does not meet minimum requirements
1	**Network**	**Construct new 11 kV cable feeder from East Lake Zone Substation to Kingston Foreshore**	**Selected as higher NPC**
2	Network	Construct new 11 kV cable feeder from Telopea Park Zone Substation to Kingston Foreshore	Not selected due to lower NPC
3	Non-network	Demand side management	Not selected as does not meet minimum requirements and lower NPC
4	Mixed	Delayed preferred network option using grid battery	Not selected as cost of delay exceeded benefits
5	Non-network	Grid battery only	Not selected due to lower NPC

4.1. Options Description

4.1.1. Do Nothing Option

The 'Do Nothing' option requires connecting all new loads to existing feeders in the Kingston Foreshore area. This would require operating most feeders above their firm rating and operating some feeders up to their thermal limits.

The 'Do Nothing' option would result in insufficient network capacity in the area as some feeders would be forced to operate beyond their thermal rating (and would consequently be tripped by over-current protection), and thus would result in Evoenergy breaching its obligations to provide a reliable and secure power supply. This option is not a prudent or acceptable solution as all new loads could not be supplied and would place considerable load at risk in the event of a feeder contingency.

The value of energy at risk under the Do Nothing option is high based on the probability of a contingency event occurring at the same time as demand exceeds firm capacity (refer Appendix B2).

4.1.2. Option 1: Construct new 11 kV feeder from East Lake Zone Substation to Kingston Foreshore

Option 1 considers the installation of a new 11 kV cable feeder from East Lake Zone Substation to the Kingston Foreshore area to meet the growing load demand. The new feeder would provide up to 5.5 MVA firm capacity (summer). The feeder would be connected to a spare circuit breaker at East Lake Zone Substation.

It is proposed that the new feeder to Kingston would be installed in association with the proposed East Lake – Causeway 132 kV underground cabling project. This is a customer-driven project (SLA), currently scheduled for completion by late 2020. Cable route is approximately 1.4 km. Spare 150mm conduits for 11 kV feeder cables will be installed by the SLA as part of this project. Cable to be 11 kV 3c/400mm^2 AL XLPE.

Figure 4 illustrates the proposed cable route.

Figure 4: Proposed 11 kV feeder cable route East Lake Zone Substation to Kingston Foreshore

A preliminary estimated cost of Option 1, for the installation of a new 11 kV feeder from East Lake Zone Substation to Kingston Foreshore is **$322,650 excluding corporate overheads, contingency and GST.** Refer to cost estimates, cash flows and NPC comparison in Appendices A and B.

Option 1 is selected due to its higher (ie least negative) net present cost (NPC). The new feeder would be named **Eyre feeder**.

4.1.3. Option 2: Construct three new 11 kV feeders from Telopea Park Zone Substation to Kingston Foreshore

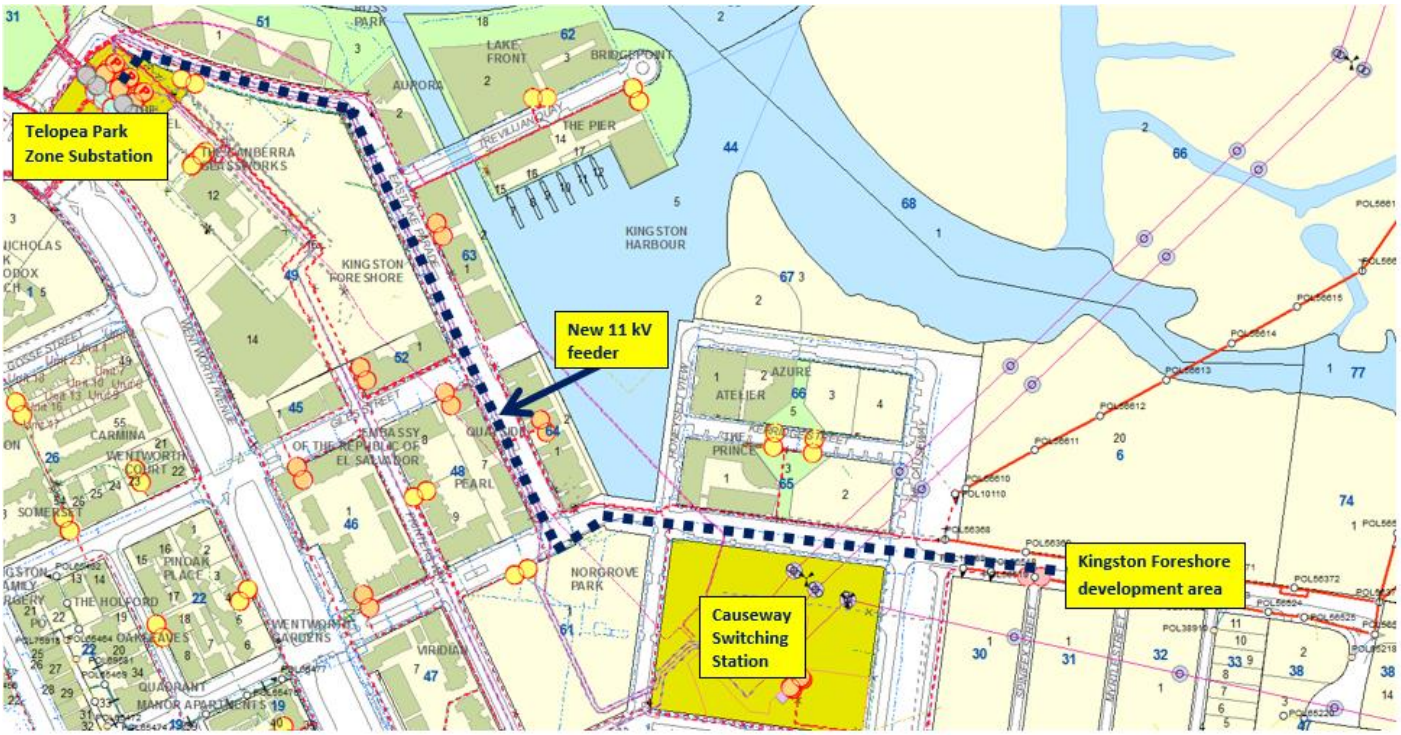
Option 2 considers the installation of a new 11 kV cable feeder from Telopea Park Zone Substation to the Kingston Foreshore area to meet the growing load demand. The new feeder would provide up to 5.5 MVA firm capacity (summer).

There are no spare feeder circuit breakers available at Telopea Park Zone Substation so this feeder cable would be doubled-up with a lightly loaded feeder to a common circuit breaker.

The cable route length would be approximately 2.0 km and due to the heavily built up nature of the area, the cable would need to be installed full length via directional drilling. Cable to be 11 kV 3c/400mm^2 AL XLPE.

Figure 5 illustrates the proposed cable route.

Figure 5: Proposed 11 kV feeder cable route Telopea Park Zone Substation to Kingston Foreshore



A preliminary cost estimate for Option 2, for the installation of three new feeders from Telopea Park Zone Substation to Kingston Foreshore is **$1,648,750 excluding corporate overheads, contingency and GST**. Refer to cost estimates, cash flows and NPC comparison in Appendices A and B.

Option 2 is not selected due to its lower NPC. It is also not good industry practice to connect two feeder cables to one circuit breaker.

4.1.4. Option 3: Demand Management

Option 3 considers non-network initiatives including:

- Incentives to realise the potential of latent demand management within the customer base.
- Incentives to encourage the uptake of additional demand management within the customer base.

These options are discussed further within the Demand Management Paper.

To defer the Kingston feeders to the next Regulatory Control Period (ie beyond 2024), it is estimated that non-network solutions would need to provide a maximum demand of approximately 7.1 MVA.

Latent demand management within the existing customer base was investigated, with a maximum estimated capacity of 0.78 MVA. This does not meet the minimum capacity required to enable the new feeder to be deferred.

These non-network options are summarised in Table 5.

Table 5: Summary of latent demand management

Non-network Option	Total
Customer – owned embedded generation	0.70 MVA
Customer – owned energy storage	0.07 MVA
Load curtailment	0.01 MVA
Totals	0.78 MVA

In summary, a maximum demand reduction of 0.78 MVA could be achieved if all the above non-network options were implemented. This is not sufficient to defer the new feeder.

Third party non-network proposals will be requested in Evoenergy's 2018 Annual Planning Report and via Evoenergy's website demand management portal and may identify additional opportunities.

Where there is insufficient latent demand management within the customer base, there is further opportunity to incentivise customers to adopt additional technologies to reduce demand. This includes opportunities to permanently reduce demand (such as energy efficiency technology or power factor correction) as well as opportunities to adopt technology to enable participation in demand response markets (such as embedded generation, battery storage, building management systems). For the purposes of the evaluation, it is assumed that no more than 30% of demand growth can be offset using additional demand management.

For Kingston it was determined that more than 40% of demand growth would need to be offset by demand management to enable the project to be deferred, implying that new demand management is unlikely to defer investment.

4.1.5. Option 4: Grid battery to defer Option 1

This option utilises a grid battery to enable Option 1 to be deferred. This option has the advantage of deferring the investment until greater certainty in future demand is known. However, given the relatively high certainty of future demand for this area and the relatively high cost of the grid battery, this option was assessed as higher cost than the network Option 1 with a preliminary cost estimate of **$1,184,879 excluding corporate overheads, contingency and GST.** Refer to cost estimates, cash flows and NPV comparison in Appendices A and B.

4.1.6. Option 5: Grid battery only

This option utilises a grid battery only. A grid battery, although more expensive that a traditional network solution on a per MVA basis, has advantages over a traditional network solution. A grid battery is modular and is able to be redeployed, meaning it can represent a more economic option in an environment of demand uncertainty or where demand is expected to increase for a short period and then decline.

In the case of Kingston Foreshore however, the grid battery is not economic due to the relative certainty of demand with a preliminary cost estimate of **$20,241,155 excluding corporate overheads, contingency and GST**. Refer to cost estimates, cash flows and NPV comparison in Appendices A and B.

4.1.7. Options Analysis

Table 7 lists the forecast new loads (as per Table 2) and states which feeder Evoenergy proposes to connect and supply each load from. This includes the proposed three new feeders from East Lake Zone Substation (nominally called Feeder 1, Feeder 2 and Feeder 3).

It should be noted that it is not feasible to utilise all available spare capacity of existing feeders due to their geographic location, inter-connectivity and proximity to new loads. These forecast loads make allowance for predicted penetration of rooftop solar PV and battery storage systems.

Table 6 shows that to meet the forecast load demands through to June 2024, all existing feeders plus the proposed three new feeders from East Lake Zone Substation are required.

Table 6: Forecast Loads and Proposed Feeder Supplies

Kingston Foreshore Forecast Load Growth							
Proposed Development and Net Additional Diversified Load in MVA	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**Total**
PN 20004264 B1&2 S14 Kingston Residential development	0.5						0.5
Proposed feeder to supply above load	Strzelecki						
PN 20005072 B2 S67 Commercial development	0.4						0.4
Proposed feeder to supply above load	Mundaring						
PN 20005802 B50 S 19 Kingston, mixed development	1.0	1.0					2.0
Proposed feeder to supply above load	Jardine						
PN 20006063 B4 S 25 Griffith Residential development	0.3						0.3
Proposed feeder to supply above load	Sturt						
PN 20006282 B5 S1 Kingston. Aged care facility		0.8					0.8
Proposed feeder to supply above load	Jardine						
Kingston Foreshore High-density residential developments, 3,850 units over 6 years	1.5	1.5	1.5	1.5	1.5	1.5	9.0
Proposed feeder to supply above load	New Eyre feeder plus Mundaring, Strzelecki & Power House						
Kingston Foreshore Commercial development and Community development (school)			0.5	0.5	0.5	0.5	2.0
Proposed feeder to supply above load	Mildura and KF1						
Kingston Arts Centre Precinct S49 East Lake Parade, Commercial development			0.5	0.5	0.5		1.5
Proposed feeder to supply above load	Monash						
Canberra Metro Traction Power Station TPS9						1.9	1.9
Proposed feeder to supply above load	Mundaring						
Forecast Additional Load pa (MVA)	**3.7**	**3.3**	**2.5**	**2.5**	**2.5**	**3.9**	
Cumulative Forecast Additional Load (MVA)	**3.7**	**7.0**	**9.5**	**12.0**	**14.5**	**18.4**	

Table 7 lists the existing and proposed feeders to the Kingston Foreshore area with their existing maximum demand and forecast maximum demand at 2024.

Table 7: Kingston area feeders load forecasts (including proposed new feeder)

Feeder	Zone Substation	Firm rating MVA (summer)	Thermal rating MVA (summer)	Existing max demand MVA (summer)	Forecast max demand MVA (summer 2024)
Mundaring	**Telopea Park**	5.0	6.7	1.0	4.7
Power House	**Telopea Park**	4.1	5.4	2.8	4.4
KF1	**Telopea Park**	4.0	8.0	3.0	4.0
Dairy South	**East Lake**	6.1	8.1	6.8	6.8
Strzelecki	**Telopea Park**	5.5	7.3	3.4	5.6
Mildura	**Telopea Park**	3.8	5.0	2.7	3.7
Jardine	**Telopea Park**	4.7	6.4	2.4	5.1
Sturt	**Telopea Park**	4.1	5.4	3.2	3.5
Kelliher	**Telopea Park**	5.0	6.7	2.7	4.3
Monash	**Telopea Park**	5.0	6.7	3.4	4.9
Eyre	**East Lake**	5.5	7.3	-	4.8

Yellow denotes feeder loaded above its firm rating. Orange denotes proposed new feeder or extended feeder.

Loading of feeders to their thermal rating would risk large amounts of unserved energy in the event of a contingency.

4.1.8. Summary of Options Analysis

A summary of the options considered is presented in Table 8.

Table 8: Summary of Options

Option	Description	Total Capital Cost 2019-39	Capital Cost 2019-24	20 year Net Present Cost	Outcome
0	Do nothing	$0	$0	$0	Not selected as does not meet need
1	**Construct new 11 kV cable feeder from East Lake Zone substation to Kingston Foreshore**	**$322,650**	**$322,650**	**-$306,747**	**Selected due to higher NPC**
2	Construct new 11 kV cable feeder from Telopea Park Zone Substation to Kingston Foreshore	$1,648,750	$1,648,750	-$1,567,486	Not selected due to lower NPC
3	Demand side management	N/A	N/A	N/A	Not selected as does not meet need
4	Delayed preferred network option using grid battery	$1,184,879	$1,184,879	-$1,023,935	Not selected as deferral not economic
5	Grid battery only	$20,241,155	$4,092,050	-$9,421,884	Not selected due to lower NPC

4.2. Recommendation

The selected option is Option 1, the construction of a new 11 kV cable feeder from East Lake Zone Substation to the Kingston Foreshore area. Cable to be 11 kV 3c/400mm^2 AL XLPE and to be installed in conjunction with the proposed 132 kV overhead to underground conversion project by December 2020. Spare conduits for 11 kV feeders will be installed as part of this project, significantly reducing the risks and costs to Evoenergy associated with civil works.

Financial analysis shows Option 1 to be the best option due to its higher (ie least negative) NPC. It also has the lowest capital cost. Refer to cost estimates, cash flows and NPC comparison in Appendices A and B. It can be implemented in time to meet the project needs as identified and will add to Evoenergy's regulated asset base. The major assets will have an economic life of 50 years.

The new feeder will provide capacity and security of supply to the new developments proposed for the Kingston Foreshore area.

Timing is scheduled for completion by December 2020.

The preliminary cost estimate for the selected option is **$322,650 excluding overheads, contingency and GST**.

The proposed 11 kV feeder will provide ties to existing feeders from Telopea Park, Fyshwick and Woden zone substations, and thus provide some backup supply capability and load transfer capability in the future

Appendix A – Cost Estimates

A.1 Cost Estimate – Option 1: 11 kV Feeders from East Lake Zone Substation to Kingston Foreshore

Kingston Foreshore supply from East Lake Zone Substation via a new 11 kV feeders 1.4 km. Assume conduit provided full length by SLA as part of 132 kV OHUG project.					
Preliminary Estimate ± 30% Accuracy					
Description	**Notes**	**Unit**	**$/Unit**	**Quantity**	**Cost**
Trenching and drilling					$20,500
Clearing of route where required	Allowance	m2	$10	0	$0
Directional drilling	Assume drilling with no rock. Assume three 150mm conduits per drill.	m	$600	0	$0
Open trenching and backfilling	Assume excavation with no rock. Backfill with bedding sand and native soil. Assume two or three cables per trench.	m	$300	0	$0
Cable jointing and haulage pits	Assume every 500m	ea	$3,000	4	$12,000
Traffic management		m	$5	100	$500
Reinstatement incl revegetation as required	Excavation, no rock (minor boulders only). Site is mostly flat .	m3	$40	200	$8,000
Cabling works					$114,400
11 kV 3c/400mm2 XLPE cable		m	$56	1400	$78,400
Throughjoints	Assume every 500m	ea	$1,000	2	$2,000
Terminations		ea	$1,500	2	$3,000
Conduit and marker tape	Assume all cables installed in conduit	m	$10	0	$0
Cable installation labour and plant		m	$20	1400	$28,000
HV Cables and connections Test & Commissioning	Allowance	ea	$3,000	1	$3,000
11 kV Switchgear					$2,000
11 kV feeder CB double-ups		ea	$25,000	0	$0
11kV Test & Commissioning	per CB	lot	$2,000	1	$2,000
Electrical (Secondary System)					$11,750
Protection & Control					$4,750
P&C Secondary Cabling	per feeder panel	ea	$2,250	1	$2,250
P&C Test & Commission	Allowance	ea	$2,500	1	$2,500
DC Supply System					$7,000
DC Cabling	per switchgear panel/bay	ea	$5,000	1	$5,000
DC Test & Commission	Allowance	ea	$2,000	1	$2,000
SCADA					$4,000
SCADA connections for new feeder panels		ea	$2,000	1	$2,000
Test & Commissioning	Allowance	ea	$2,000	1	$2,000
Indirect Costs					$170,000
Development Application	Allowance	ea	$20,000	1	$20,000
Contractor's Preliminaries, site establishment and disestablishment	Allowance	ea	$50,000	1	$50,000
Project management and administration	Allowance	ea	$100,000	1	$100,000
Project Sub Total without overheads					**$322,650**
Overheads					
Overall average overhead rate	Allowance	27%	$87,116	1	$87,116
Project Sub Total with overheads					**$409,766**
Contingency					
All project works	Preliminary allowance	15%	$61,465	1	$61,465
Project budget total					**$471,230**

A.2 Cost Estimate – Option 2: 11 kV Feeders from Telopea Park Zone Substation to Kingston Foreshore

Kingston Foreshore supply from Telopea Park Zone Substation via new 11 kV feeder 2 km. Assume directional drilling full length.					
Preliminary Estimate ± 30% Accuracy					
Description	**Notes**	**Unit**	**$/Unit**	**Quantity**	**Cost**
Trenching and drilling					$1,235,000
Clearing of route where required	Allowance	m2	$10	200	$2,000
Directional drilling	Assume drilling with no rock. Assume three 150mm conduits per drill.	m	$600	2000	$1,200,000
Open trenching and backfilling	Assume excavation with no rock. Backfill with bedding sand and native soil. Assume two or three cables per trench.	m	$300	0	$0
Cable jointing and haulage pits	Assume every 500m	ea	$3,000	5	$15,000
Traffic management		m	$5	2000	$10,000
Reinstatement incl revegetation as required	Excavation, no rock (minor boulders only). Site is mostly flat .	m3	$40	200	$8,000
Cabling works					$181,000
11 kV 3c/400mm2 XLPE cable		m	$56	2000	$112,000
Throughjoints	Assume every 500m	ea	$1,000	3	$3,000
Terminations		ea	$1,500	2	$3,000
Conduit and marker tape	Assume all cables installed in conduit	m	$10	2000	$20,000
Cable installation labour and plant		m	$20	2000	$40,000
HV Cables and connections Test & Commissioning	Allowance	ea	$3,000	1	$3,000
11 kV Switchgear					$27,000
11 kV feeder CB double-ups	Assume CBs able to accommodate two cables	ea	$25,000	1	$25,000
11kV Test & Commissioning	per CB	lot	$2,000	1	$2,000
Electrical (Secondary System)					$11,750
Protection & Control					$4,750
P&C Secondary Cabling	per feeder panel	ea	$2,250	1	$2,250
P&C Test & Commission	Allowance	ea	$2,500	1	$2,500
DC Supply System					$7,000
DC Cabling	per switchgear panel/bay	ea	$5,000	1	$5,000
DC Test & Commission	Allowance	ea	$2,000	1	$2,000
SCADA					$4,000
SCADA connections for new feeder panels		ea	$2,000	1	$2,000
Test & Commissioning	Allowance	ea	$2,000	1	$2,000
Indirect Costs					$190,000
Development Application	Allowance	ea	$40,000	1	$40,000
Contractor's Preliminaries, site establishment and disestablishment	Allowance	ea	$50,000	1	$50,000
Project management and administration	Allowance	ea	$100,000	1	$100,000
Project Sub Total without overheads					**$1,648,750**
Overheads					
Overall average overhead rate	Allowance	27%	$445,163	1	$445,163
Project Sub Total with overheads					**$2,093,913**
Contingency					
All project works	Preliminary allowance	15%	$314,087	1	$314,087
Project budget total					**$2,407,999**

Appendix B – Financial Analysis

B.1 Capital Expenditure Cash Flow for Each Option

Financial Year	Option 1	Option 2	Option 3	Option 4	Option 5
2019-20					
2020-21	$322,650	$1,648,750	N/A	$862,229	$862,229
2021-22				$322,650	$1,076,607
2022-23					$1,076,607
2023-24					$1,076,607
2024-25					$1,076,607
2025-26					$1,076,607
2026-27					$1,076,607
2027-28					$1,076,607
2028-29					$1,076,607
2029-30					$1,076,607
2030-31					$1,076,607
2031-32					$1,076,607
2032-33					$1,076,607
2033-34					$1,076,607
2034-35					$1,076,607
2035-36					$1,076,607
2036-37					$1,076,607
2037-38					$1,076,607
2038-39					$1,076,607
Total Cost (20 years)	**$322,650**	**$1,648,750**	**N/A**	**$1,184,879**	**$20,241,155**
2019-24 Regulatory Control Period Cost	**$322,650**	**$1,648,750**	**N/A**	**$1,184,879**	**$4,092,050**

B.2 NPC Analysis

The amount of load and duration above the firm rating of each existing feeder has been calculated using the actual historical load profile curve for each feeder plus the expected load profile curves of forecast new loads. New loads have been allocated to existing feeders where possible in the most optimal manner to utilise available spare capacity and minimise unserved energy. It is not always possible to utilise available spare capacity because the geographical location of some new loads do not match the geographical location of existing feeders and it is not cost effective to extend such feeders.

Investment within the simulation is dynamic – investment decisions change based on the randomly selected growth rates from previous years. Investment occurs automatically when the firm rating is breached so the value of energy at risk is always zero. In options where multiple investments are available the cheapest is selected.

Summary Financial Analysis Results for Supply to Kingston Foreshore

The summary below shows the average values for the selected characteristics after 50 simulations.

Options:

One – One new 11 kV feeder from East Lake Zone Substation to Kingston Foreshore
Two – One new 11 kV feeder from Telopea Park Zone Substation to Kingston Foreshore
Four – Defer Option 1 with grid battery.
Five – Grid battery only.

RESULTS (Average over 50 simulations):

Option:	One	Two	Four	Five
NPC (2019-2024)	-$278,917	-$1,425,275	-$977,677	-$2,921,699
NPC (2019-2039)	-$306,747	-$1,567,486	-$1,023,935	-$9,421,884
Network Option total Capital Cost	$322,650	$1,648,750	$322,650	-
Option Capital Cost (2019-2024)	$322,650	$1,648,750	$1,575,179	$4,092,050
Option Capital Cost (2019-2039)	$322,650	$1,648,750	$1,575,179	$20,241,155

Unserved Energy:

The following table estimates the volume of unserved energy (USE) under the Do Nothing scenario.

USE Exceeding	FY 18/19	FY 19/20	FY 20/21	FY 21/22	FY 22/23	FY 23/24
Firm (kWh)	1	8	18	18	18	28
Thermal (kWh)	0	4,579	4,579	4,579	4,579	4,579
Total USE	1	4,587	4,597	4,597	4,597	4,606
Value of USE	$27	$123,529	$123,796	$123,796	$123,798	$124,057

Notes:

The amount of load and duration above the firm (or thermal) rating of each feeder has been calculated using the actual historical load duration curve for each feeder plus the expected load profile curves of forecast new loads.

Unserved energy = (load above feeder firm rating x probability of an outage occurring at the time of such exceedance x outage duration) + all load above feeder thermal rating (ie when the load exceeds the thermal rating of the feeder, all such energy is assumed to be unserved).

Value of Unserved Energy assumes:

- Value of Customer Reliability = $26.93/kWh. This is the figure published by AEMO in 2014 for Residential Customers. This is a very conservative figure to use as approximately 20% of load in the Kingston Foreshore area is supplied to Business Customers – AEMO's published VCR for this category of customer is $44.72/kWh.
- CPI = 2% pa.
- Probability of failure of supply to a customer = 6% (= 3% probability of zone transformer failure + 3% probability of feeder failure).
- Probability of failure in any given hour = 6% / (24 x 365).
- Outage duration = 8 hours. This is a conservative figure as cable faults can often take longer than 8 hours to locate and repair.
- Value of unserved energy = Volume of unserved energy x VCR.
- All energy above the thermal rating is not served. This is equivalent to assuming a 100% outage probability for energy above this level.

At the time of investment the value of unserved energy exceeds the annualised cost of this proposed augmentation, so the proposed new feeder to the Kingston Foreshore area is considered to be economically justified.

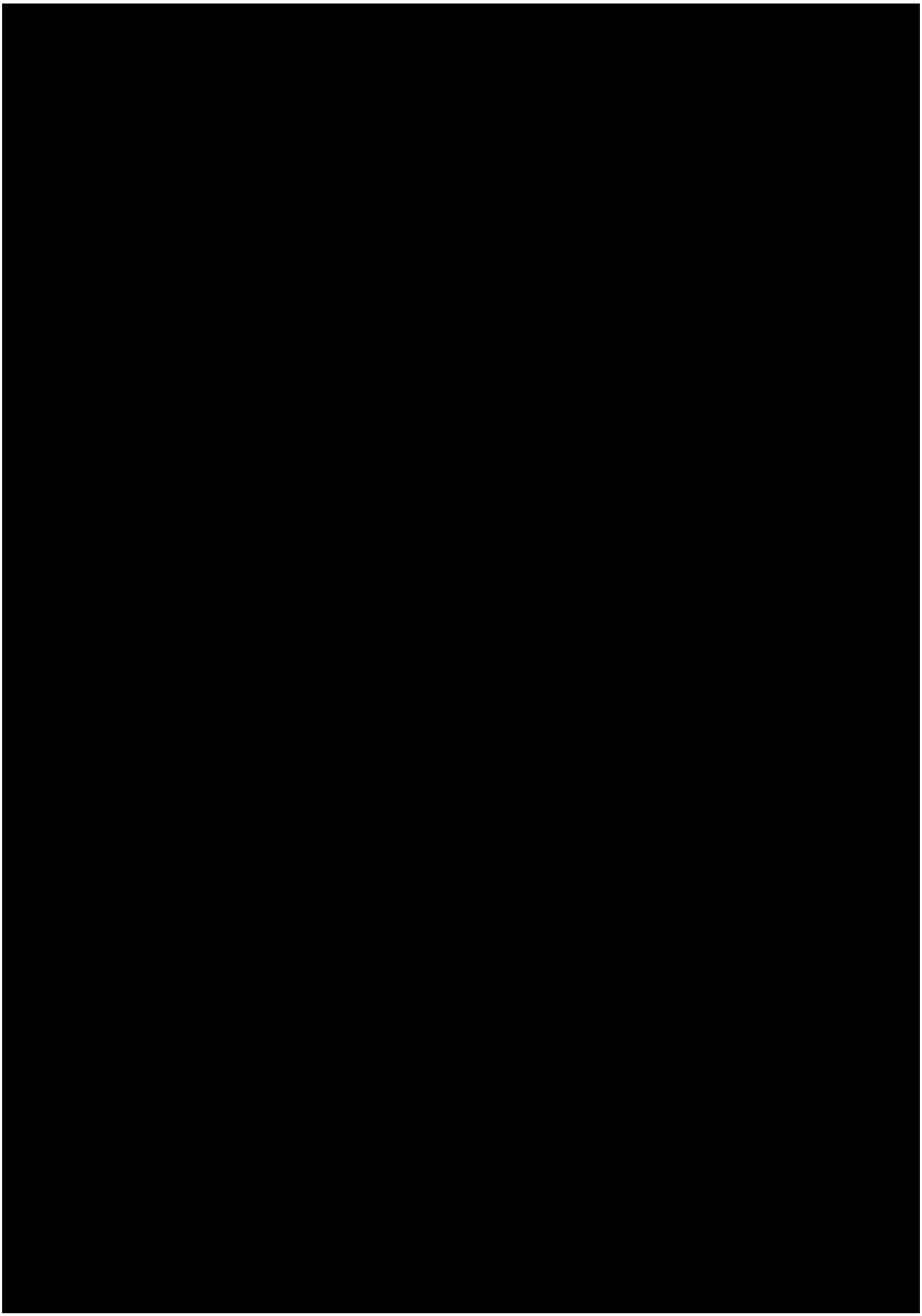
In addition to the value of unserved energy, there are litigation, reputational and other financial risks to be added to the overall risk cost as follows:

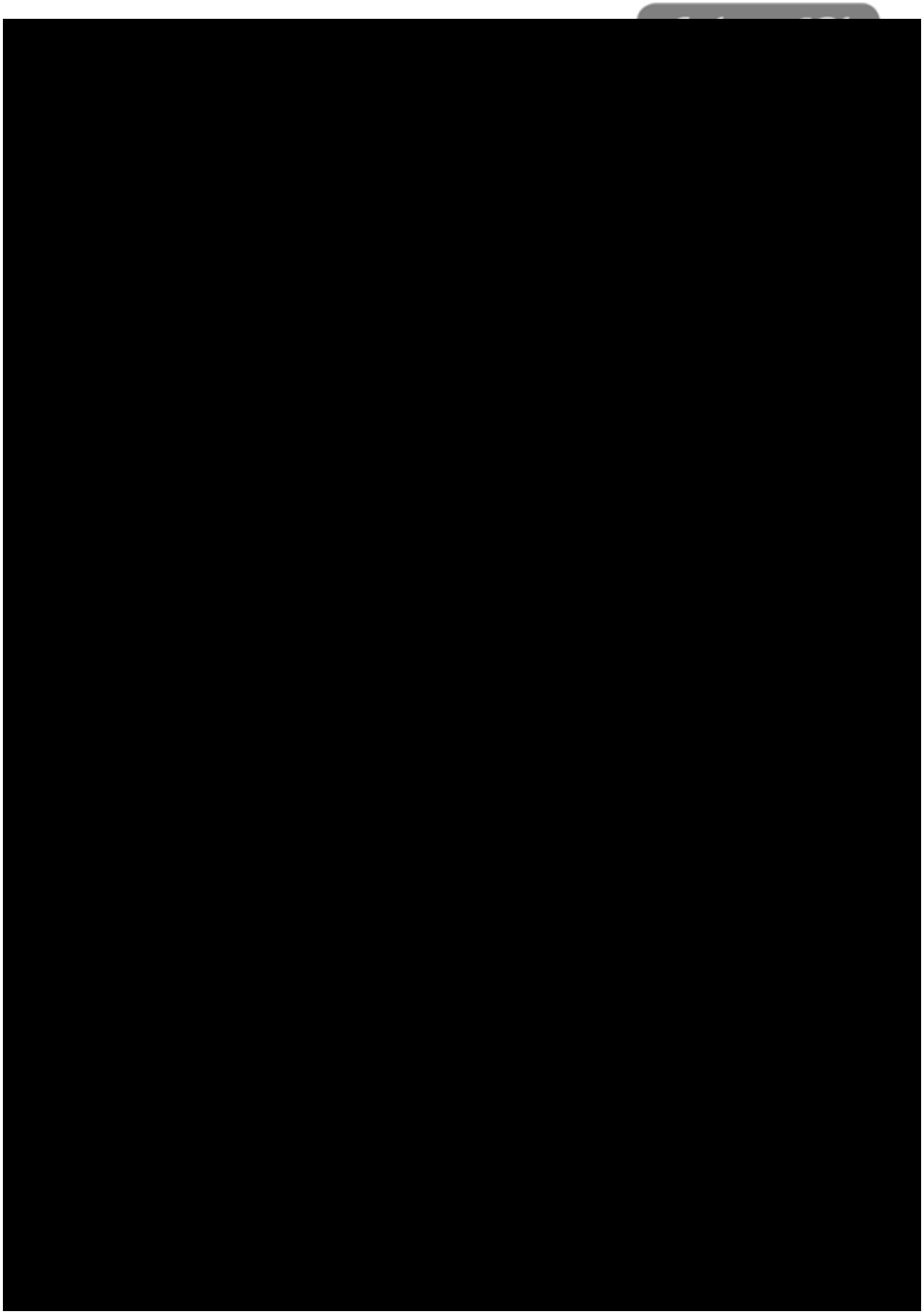
Litigation costs = $100,000 / event
Reputational risk cost = external consultations and communications costs = $10,000 / event.
Financial risk cost = internal investigation costs = $10,000 / event.

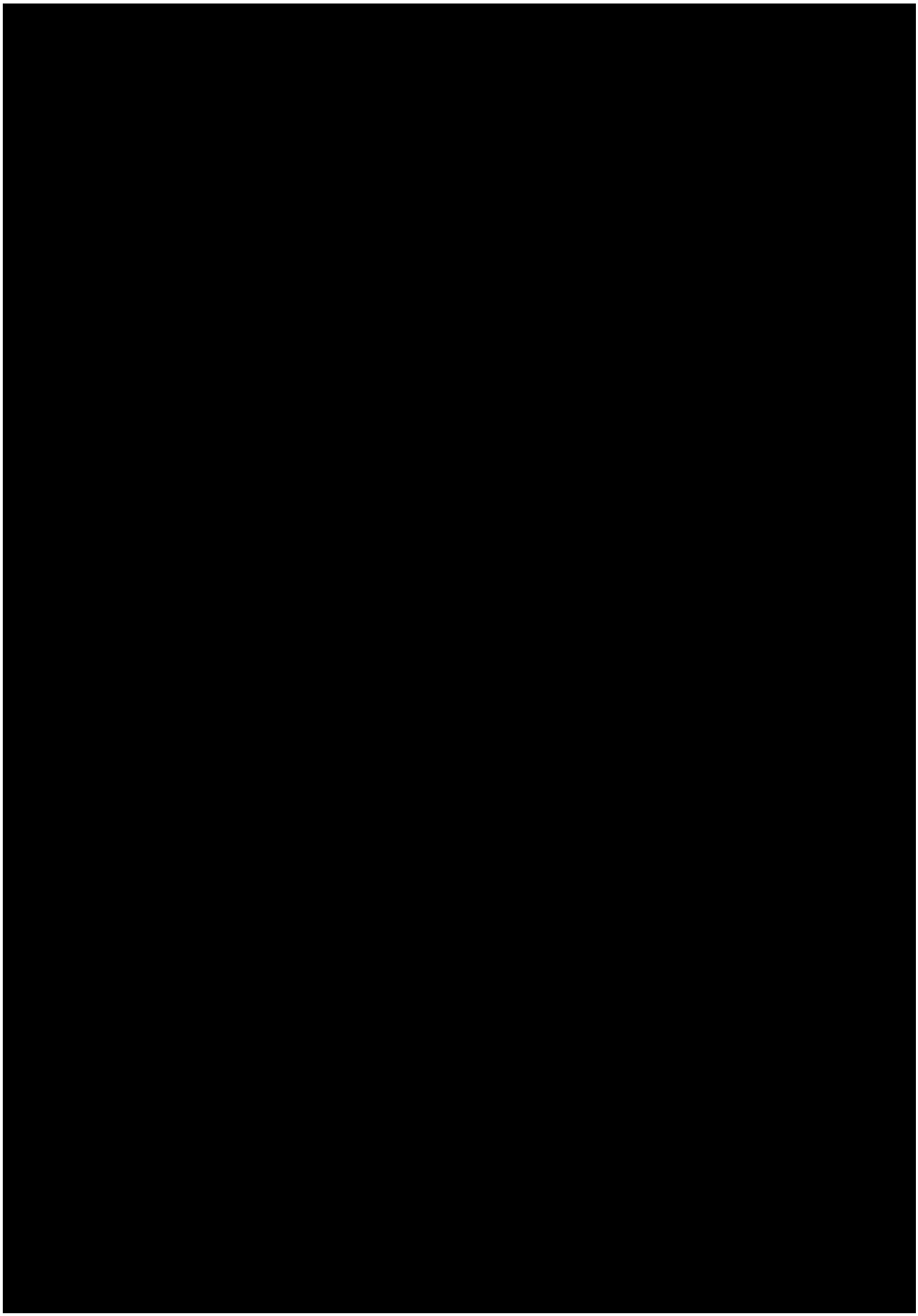
Total risk cost = Reliability risk cost + Litigation + Reputational risk cost + Financial risk cost
= Value of unserved energy + $120,000 / event.

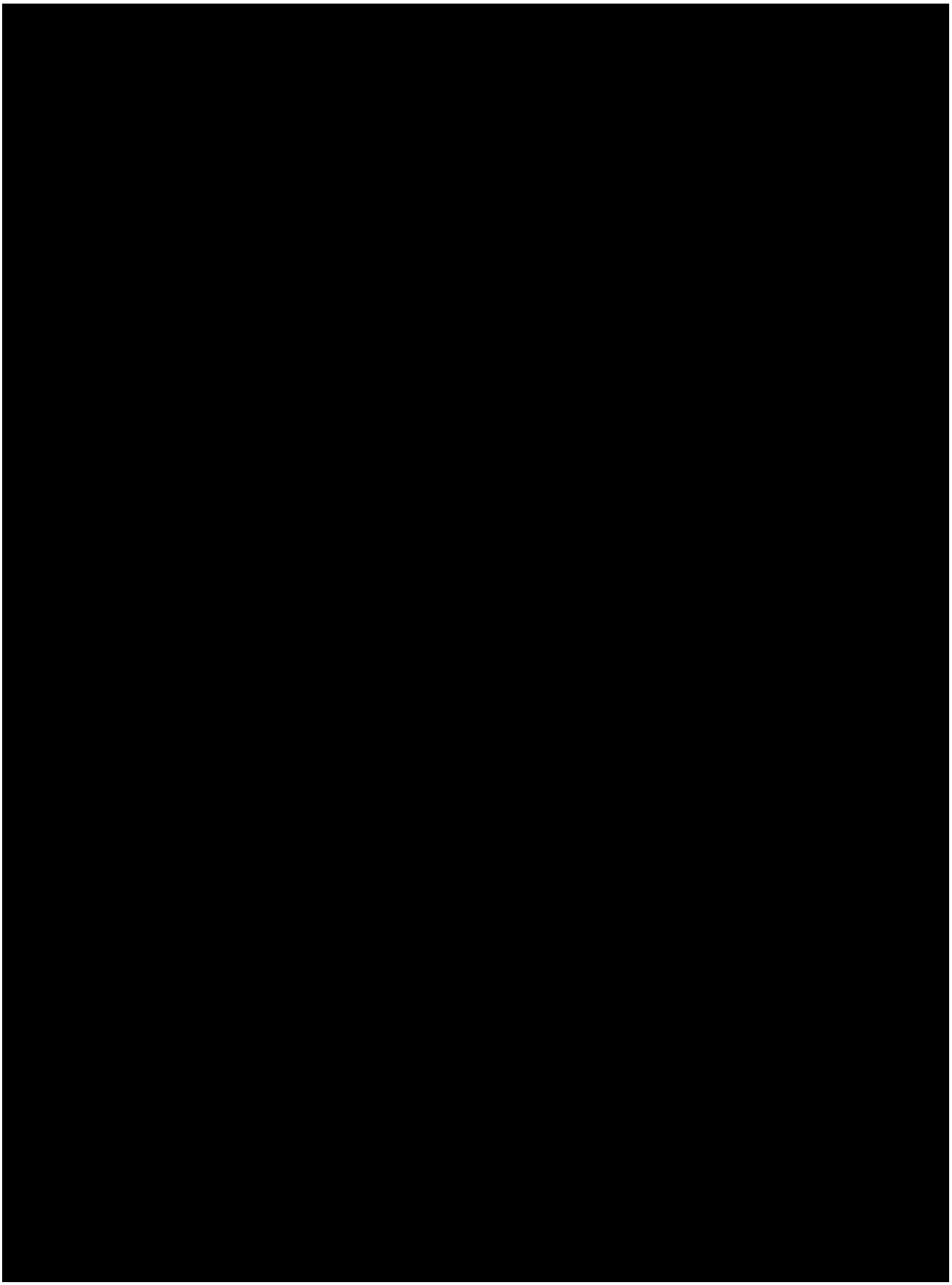
The following table and attachments detail the customer applications and enquiries received by Evoenergy that have provided the inputs to the load forecast for the Kingston area.

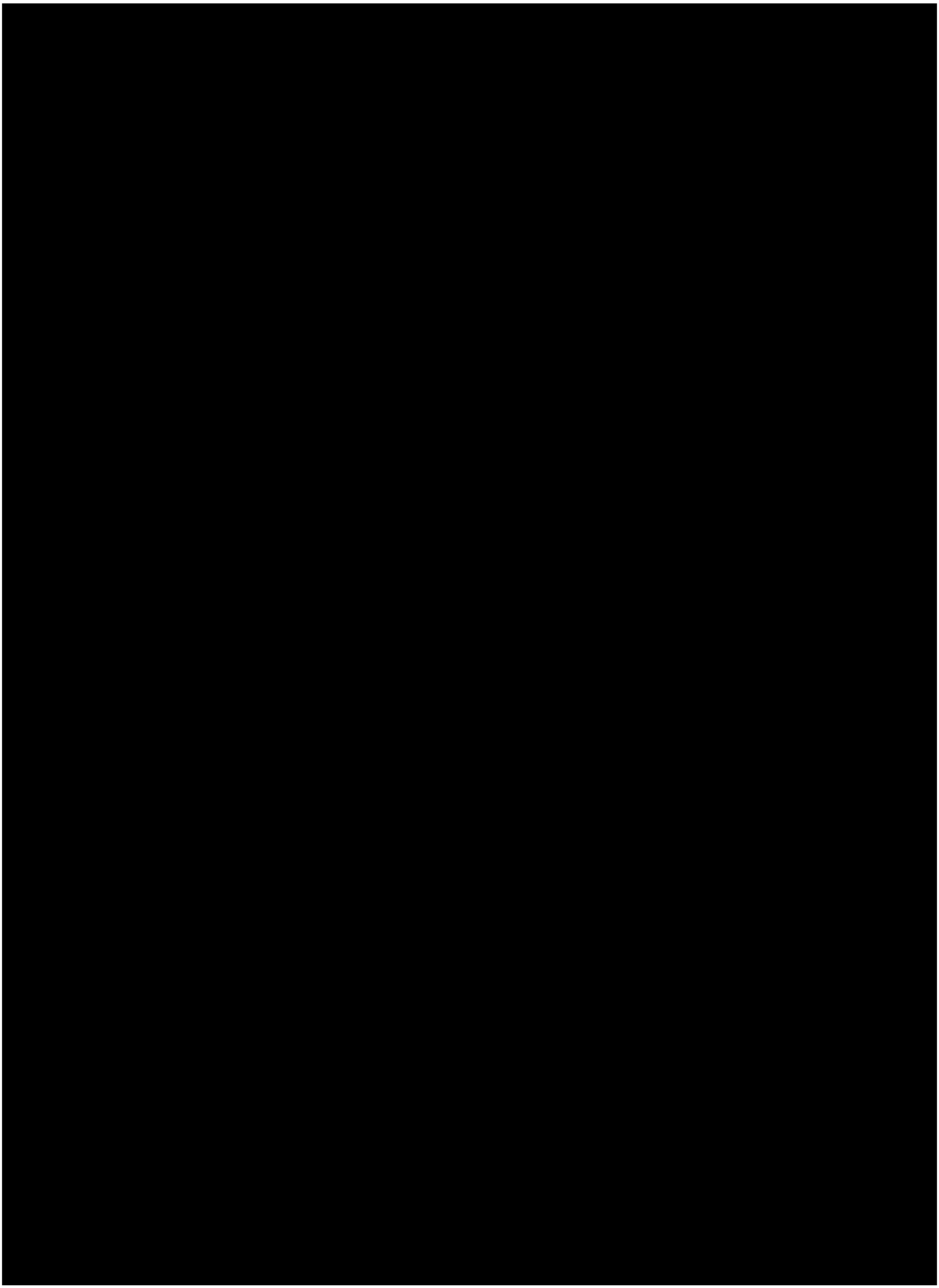
Kingston Foreshore Residential development, 3,850 units over 6 years	6
Kingston Foreshore Commercial development and Community development (school)	7
Kingston Arts Centre Precinct S49 East Lake Parade, Commercial development	8

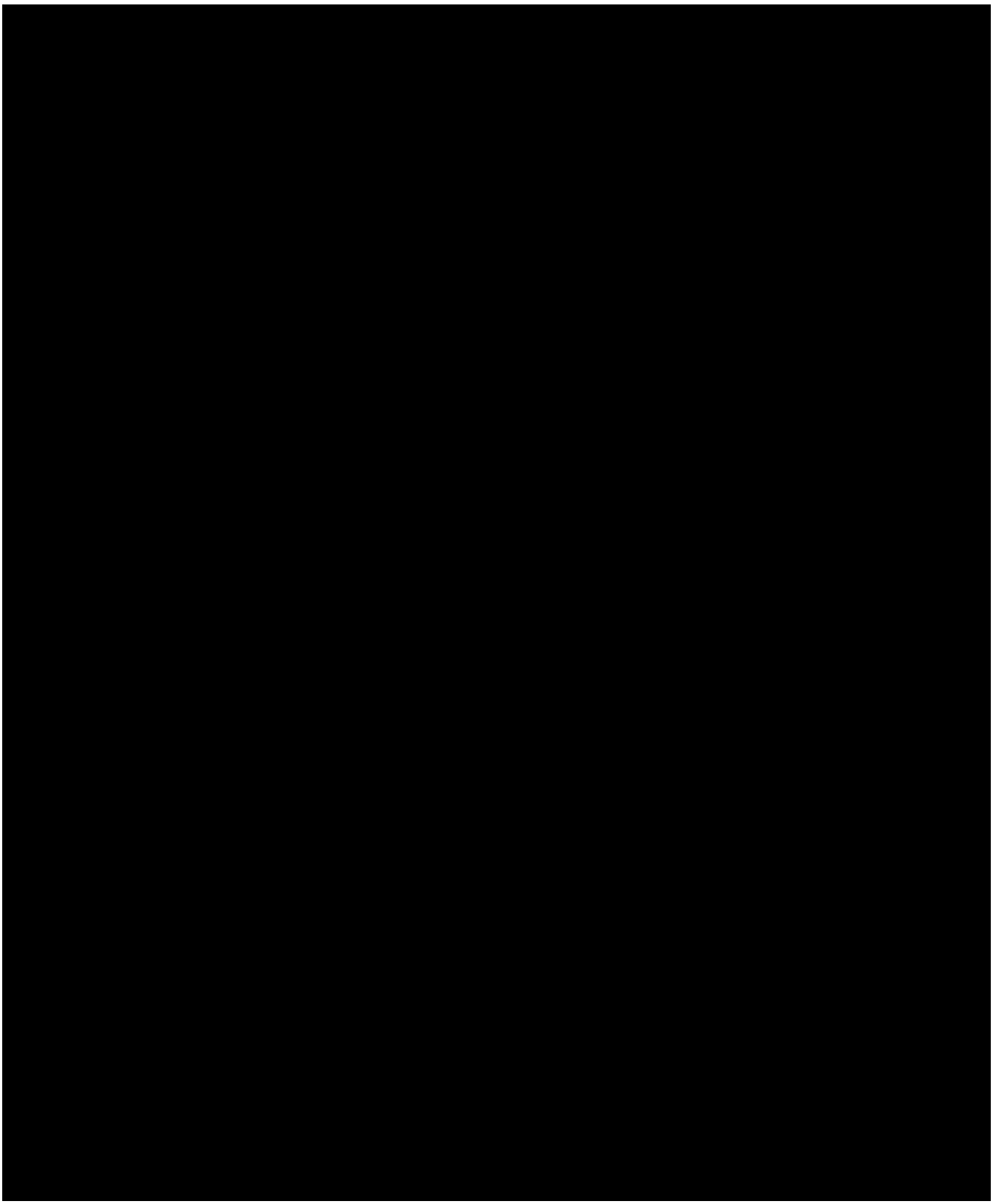


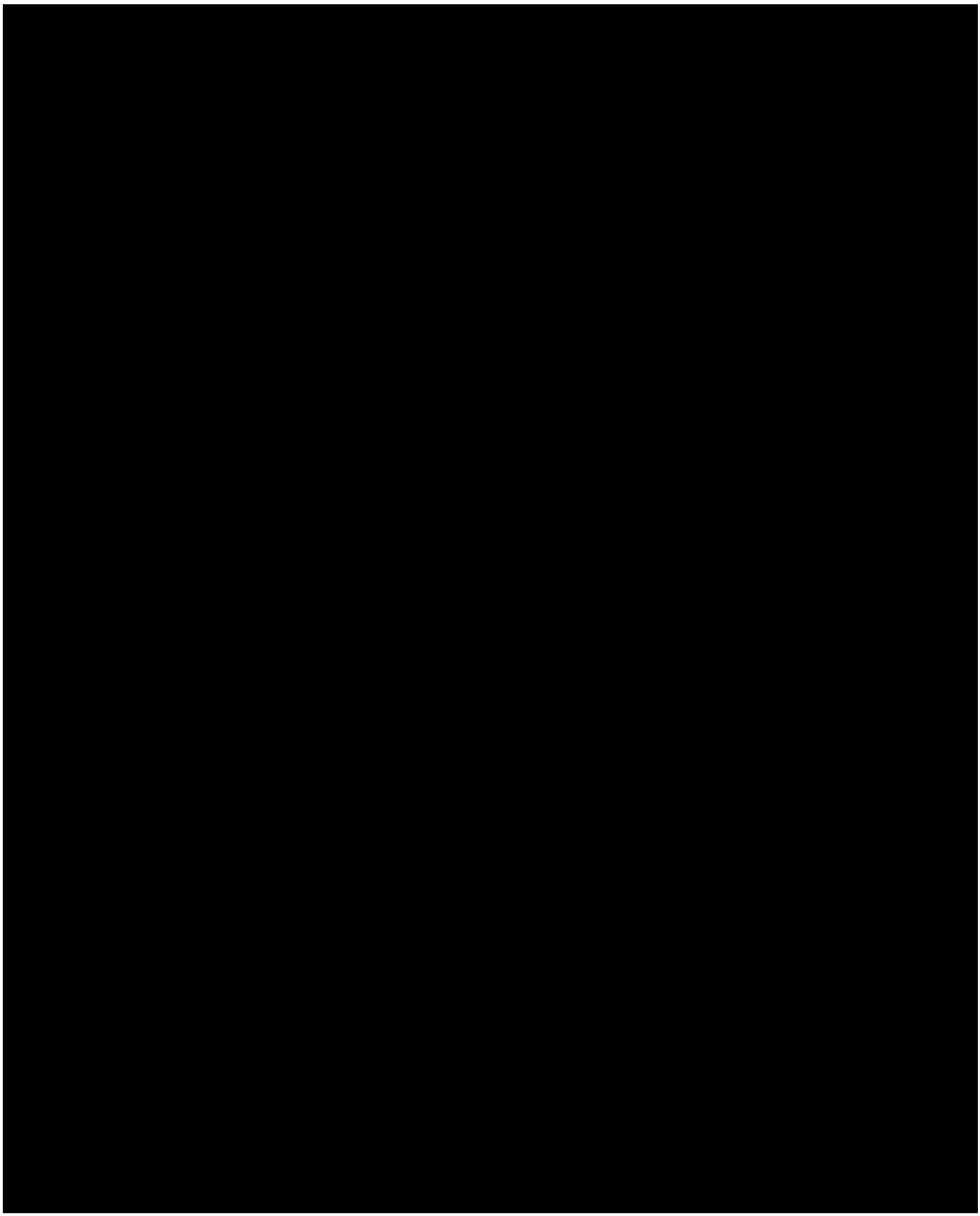


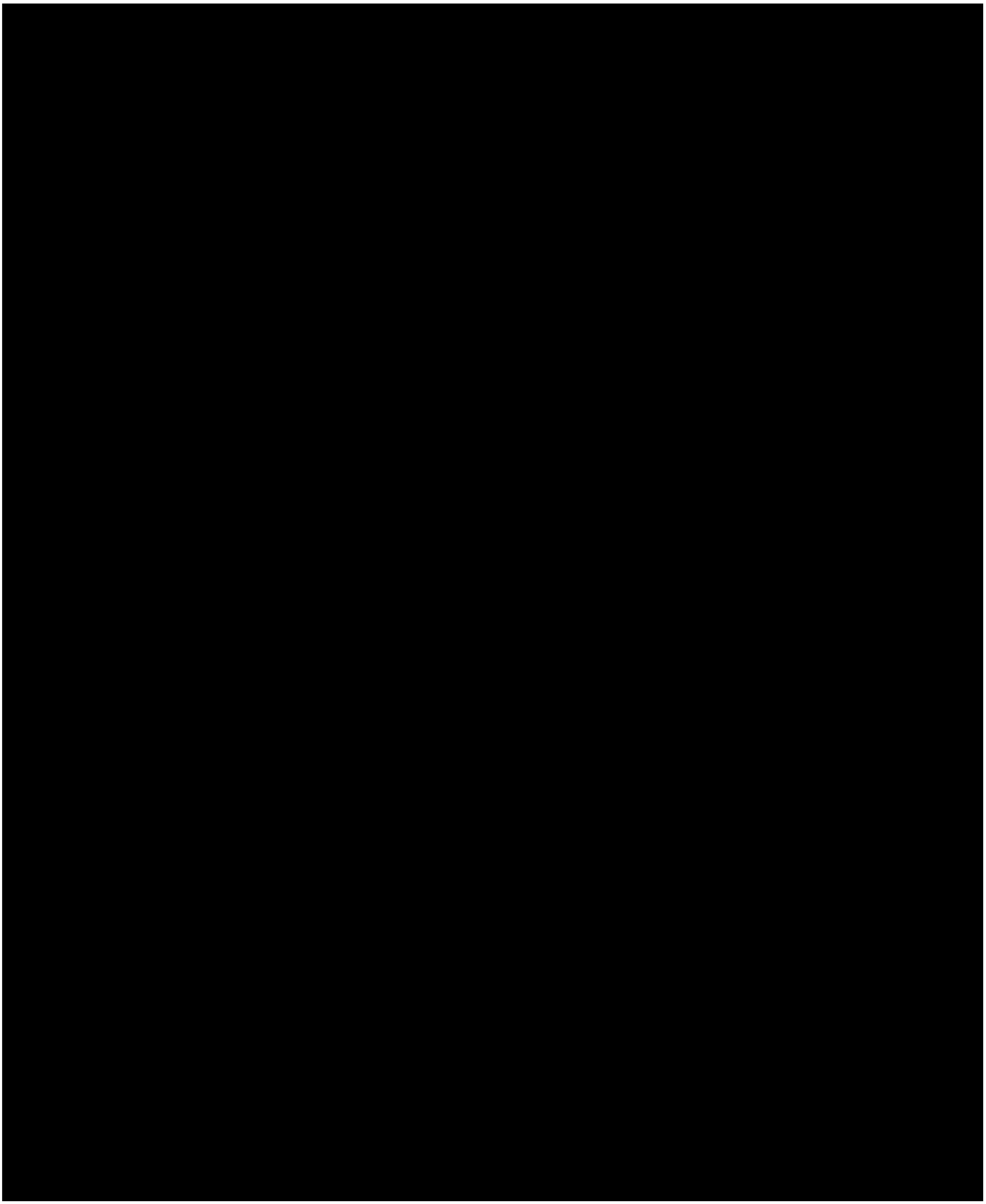


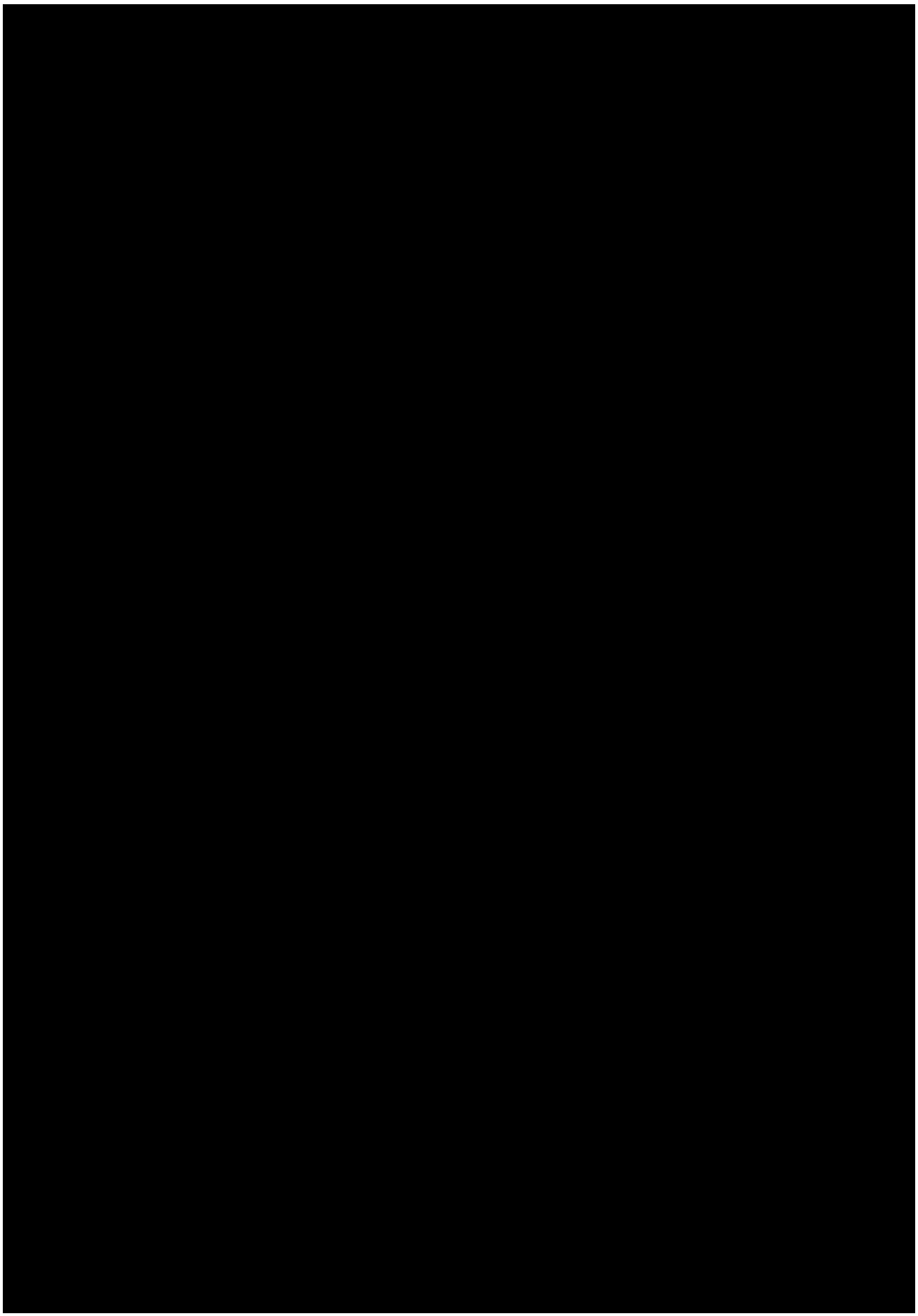












Attachments 6 and 7:

Kingston Foreshore development master plan (source SLA)

Attachment 8:

Kingston Arts Precinct Development (extact from ACT Government Kingston Section 49 Master Plan):

Planning Principles

The planning principles are:

- Retain the heritage of the place – respect and reinforce the significant heritage of the area including the built form, the spaces between and the social history of the area;
- Respect the height of the heritage buildings – ensure that new development does not dominate or screen the Power House;
- Activate the precinct – an inviting destination night and day that appeals to a wide cross-section of the community;
- Provide a diversity of activities – a mix of community and small-scale commercial spaces;
- Develop an arts hub – as the basis for a vibrant and creative precinct;
- Limit residential development in the precinct – in order to encourage an active area and minimise potential conflict between uses;
- Include adequate open space – to encourage people to visit and provide a place to recreate for all age groups;
- Ensure connectivity – with surrounding areas;
- Retain available views – retain local views of the heritage buildings and views to and from the lake and Wentworth Avenue;
- Provide sufficient parking – maximise opportunities for shared use;
- Discourage through traffic – minimise the need for external traffic to enter the area; and
- Create an attractive public domain – create external public spaces that are well integrated with internal spaces.

The master plan addresses each of these principles and includes flexibility for different land use mixes to be achieved. Its implementation could deliver:

- 1.6 ha or 30% of the area as open space distributed throughout Section 49;
- An arts hub that consists of purpose-built buildings and adaptive re-use of heritage buildings;
- 6,000m^2 of ground floor space to be used to create an active precinct and located along the major pedestrian movement routes (including retail and arts-related activities);
- A residential mixed use site located adjacent to existing residential uses with capacity for around 150 units;
- Additional residential units to complement the primary arts, commercial and car park uses throughout the precinct;
- Office space in several small developments that will assist to activate the area during weekdays by providing opportunities for more employment within the Foreshore area; and
- Parking structure for about 500 cars.

The master plan will be implemented progressively over time. Initial actions will include release of the site for the purpose-built arts buildings and residential development.

Section 49 Kingston Indicative Master Plan