Appendix 4.6: Pialligo PJR

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

November 2018

evoenergy

Project Justification Report

Project name	**Supply to Pialligo**
Expenditure type	Capital Expenditure
Business Group	Asset Strategy
Regulatory Period	1 July 2019 to 30 June 2024
Total Project Cost Estimate	$2,992,500 excluding corporate overheads, excluding contingency, and excluding GST
Five year total spend 2019-24	$2,992,500 excluding corporate overheads, excluding contingency, and excluding GST
CAPEX category	ENAA Distribution
Primary driver	Load growth in Pialligo area
Project Number	20001380

Contents

1. Executive Summary

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

The maximum demand in the Pialligo area near Canberra Airport is forecast to increase due to commercial development in the area including the Brindabella Business Park, Macquarie Telecom Data Centre, Australian Defence Force expansion and light industrial development in the Beard Industrial Estate. The maximum demand of the area is forecast to increase by 8 MVA over the next 5 years.

The Pialligo area is currently supplied by the Aero Park feeder from City East Zone Substation, the Airport and Pialligo 11 kV feeders from Fyshwick Zone Substation, and the Dairy North 11 kV feeder from East Lake Zone Substation.

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 due to be installed by 30 June 2019. This will provide ample capacity, security and spare 11 kV circuit breakers for the connection of new feeders.

It is a strategic objective of Evoenergy to supply load to proposed and future developments in the Pialligo area from East Lake Zone Substation and off-load Fyshwick Zone Substation. It is also proposed to convert Fyshwick Zone Substation to an 11 kV switching station supplied by three express 11 kV feeders from East Lake Zone Substation. This is the subject of a separate Project Justification Report.

This project proposes two new 11 kV cable feeders to be installed from East Lake Zone Substation. One feeder from East Lake is proposed to the Brindabella Business Park to meet the growing customer demand. The length of the feeder is approximately 3.2 km. The second feeder from East Lake will enable the overloaded Dairy North feeder to be split into two separate feeders – Dairy North and Dairy East. The proposed Dairy East feeder will supply the forecast demand of the Fairbairn Business Park. Additionally it is proposed to link the Dairy North and Abattoir feeders via a new 1.2 km long cable feeder tie. This will improve backup security to these two feeders and enable some load transfer from Dairy North to Abattoir feeder. Spare conduits will be installed along all new feeder routes to provide for future developments and load growth.

The proposed feeders will inter-tie with existing feeders emanating from Fyshwick and City East zone substations, and thus improve the security of this meshed part of the network.

Other options considered include the installation of additional feeders from Fyshwick Zone Substation, demand management, and a grid battery. The feeders from Fyshwick were excluded due to a high net present cost (compared to the preferred option). Demand management was not considered feasible due to the insufficient existing capacity such that there is a requirement for 60% of new demand to be offset. The grid battery was excluded due to a higher net present cost and the relative certainty of the demand increase (noting grid batteries and other modular solutions deliver a higher options value in the context of uncertain demand).

A preliminary cost estimate for the selected option is **$2,992,500 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.

These works will be carried out during the 2019-24 Regulatory Control Period, with project completion scheduled by June 2022.

2. Strategic Context and Expenditure Need

There is significant commerce and light industrial development underway and proposed for the Pialligo / Brindabella Park area which is located near Canberra Airport. Existing infrastructure has insufficient capacity to cater for the additional demand associated with the development.

2.1. Existing infrastructure in the Pialligo area

There are currently four 11 kV feeders supplying the Pialligo area. These are Aero Park feeder from City East Zone Substation, Airport and Pialligo feeders from Fyshwick Zone Substation, and Dairy North feeder from East Lake Zone Substation.

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 Pialligo 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
Aero Park	CE	5.0	6.6	5.6	7.5	79%	53%	93%	61%	95%	61%	89%
Airport	FW	5.0	6.7	5.6	7.5	80%	44%	79%	53%	84%	50%	97%
Pialligo	FW	5.2	6.9	5.9	7.8	85%	44%	39%	56%	61%	66%	55%
Dairy North	EL	5.3	7.1	5.9	7.9	61%	55%	84%	73%	90%	67%	87%

2.2. Driving need for infrastructure investment

Forecast additional maximum demand in the Pialligo area 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 Pialligo area.

Proposed Development and Net Additional Diversified Load in MVA	2019	2020	2021	2022	2023	2024
PN 20003829 Brindabella Business Park	1.0	1.0	1.0	1.6		
PN 20003913 Macquarie Telecom Data Centre, Pearce Ave Fairbairn Park		1.4	0.5	0.3	0.5	0.7
PN 20003493 Majura Defence Facility	0.8					
PN 20003770 Pialligo Horticulture Expansion	1.0					
PN 20005330 Supply to Alpha catering building	0.3					
PN 20005116 Supply to Airport building	1.1					
Additional Load (MVA)	**4.2**	**2.4**	**1.5**	**1.9**	**0.5**	**0.7**
Cumulative Additional Forecast Load (MVA)	**4.2**	**6.6**	**8.1**	**10.0**	**10.5**	**11.2**

Table 2 shows that cumulative forecast diversified additional load in the area by 2024 will be approximately 11.2 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.

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.

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.

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.

These proposed new feeders to the Pialligo area have 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 and security to the Pialligo, Brindabella Park and Fairbairn Park areas as listed in Table 4.

Table 4: Options considered for provision of additional capacity and security to the Pialligo, Brindabella Park and Fairbairn Park areas

Option	Option type	Description	Evaluation
0	Network	Do nothing	Not selected as does not meet minimum requirements
1	**Network**	**Construct two new 11 kV feeders from East Lake Zone Substation, and link Dairy North and Abattoir feeders**	**Selected as higher NPC**
2	Network	Construct one new 11 kV feeder from Fyshwick Zone Substation, one new 11 kV feeder from East Lake Zone Substation, and link Dairy North and Abattoir feeder	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

The installation of a second 132/11 kV 30/55 MVA transformer and 11 kV switchboard at East Lake Zone Substation is underway and will be completed by June 2019.

4.1.1. Do Nothing Option

The ‘Do Nothing’ option requires connecting all new loads to existing feeders in the Pialligo, Brindabella Park and Fairbairn Park areas. 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 two new 11 kV feeders from East Lake Zone Substation, and link Dairy North feeder to Abattoir feeder

Option 1 includes three components. It considers the installation of a new 11 kV feeder from East Lake Zone Substation to Brindabella Park and alterations to the existing Dairy North and Abattoir feeders as follows:

Part 1: New 11 kV feeder to Brindabella Park:

It is proposed to install a new 11 kV 3c/400mm^2 AL XLPE cable feeder from a spare circuit breaker at East Lake Zone Substation to distribution substation S9411 at Pialligo Ave, Brindabella Park. This cable would be through-jointed to the proposed cable to be installed between S9411 and S9330. Note S9411 is temporary only and will be removed. This would provide 5.5 MVA firm capacity (summer) to meet the growing load demand of the Brindabella Business Park.

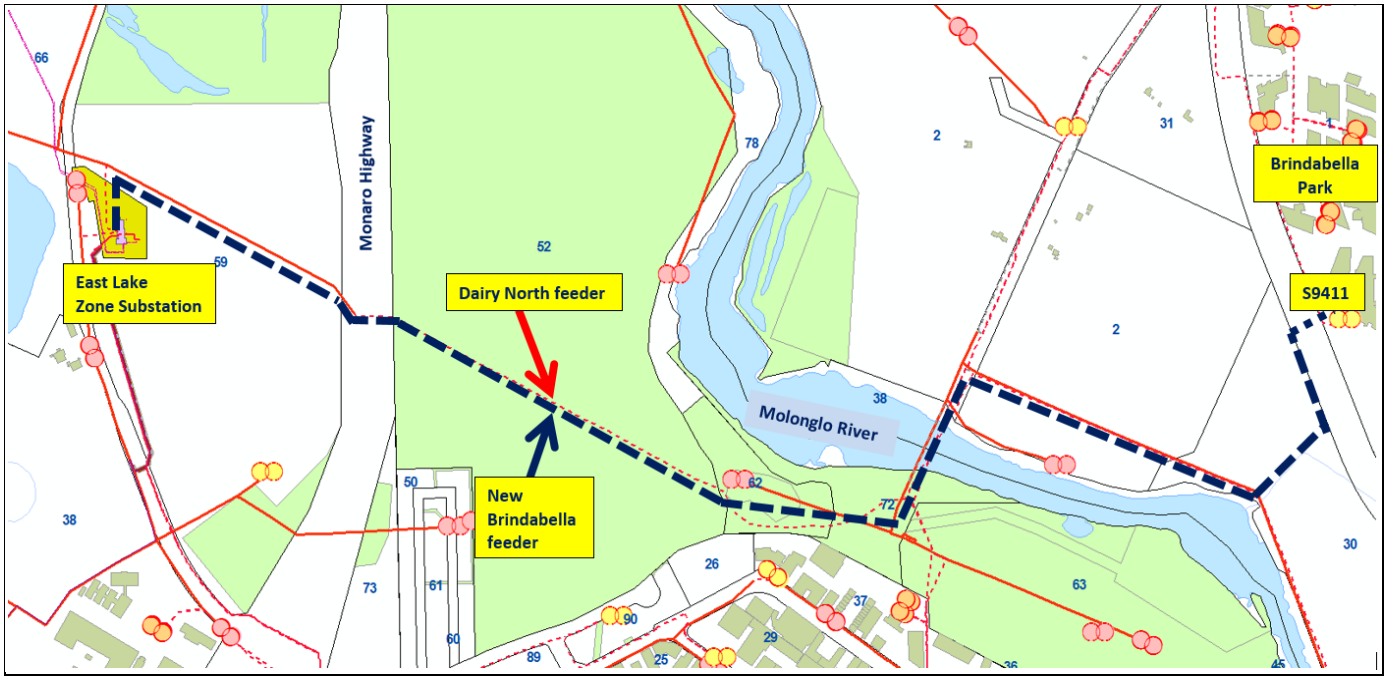
The cable route length would be approximately 3.2 km and would follow the same route as the existing Dairy North feeder from East Lake Zone Substation south-eastwards to Monaro Highway and across the farmland to the east (alongside the Dairy North feeder cable) to near pole 56484 on the southern side of the Molonglo River. At this point the cable would be directional drilled beneath the Molonglo River (approx 100m wide) to a point near pole 25174. From there the cable route would be eastwards alongside the existing overhead Gladstone feeder to near pole 38338 then northwards across farmland to Pialligo Ave and S9411.

The cable would be installed full length in 150mm diameter PVC conduit. Two spare conduits would be installed full length for future use.

Sections of this feeder would cross private property so would be subject to obtaining the appropriate approvals and/or easements. It is noted that 11 kV cables or overhead lines currently occupy most of this route, so it is assumed that approvals would be granted.

Figure 3 illustrates this feeder route. The new feeder would be named **Brindabella**.

Figure 3: Proposed new 11 kV feeder from East Lake Zone Substation to Brindabella Park

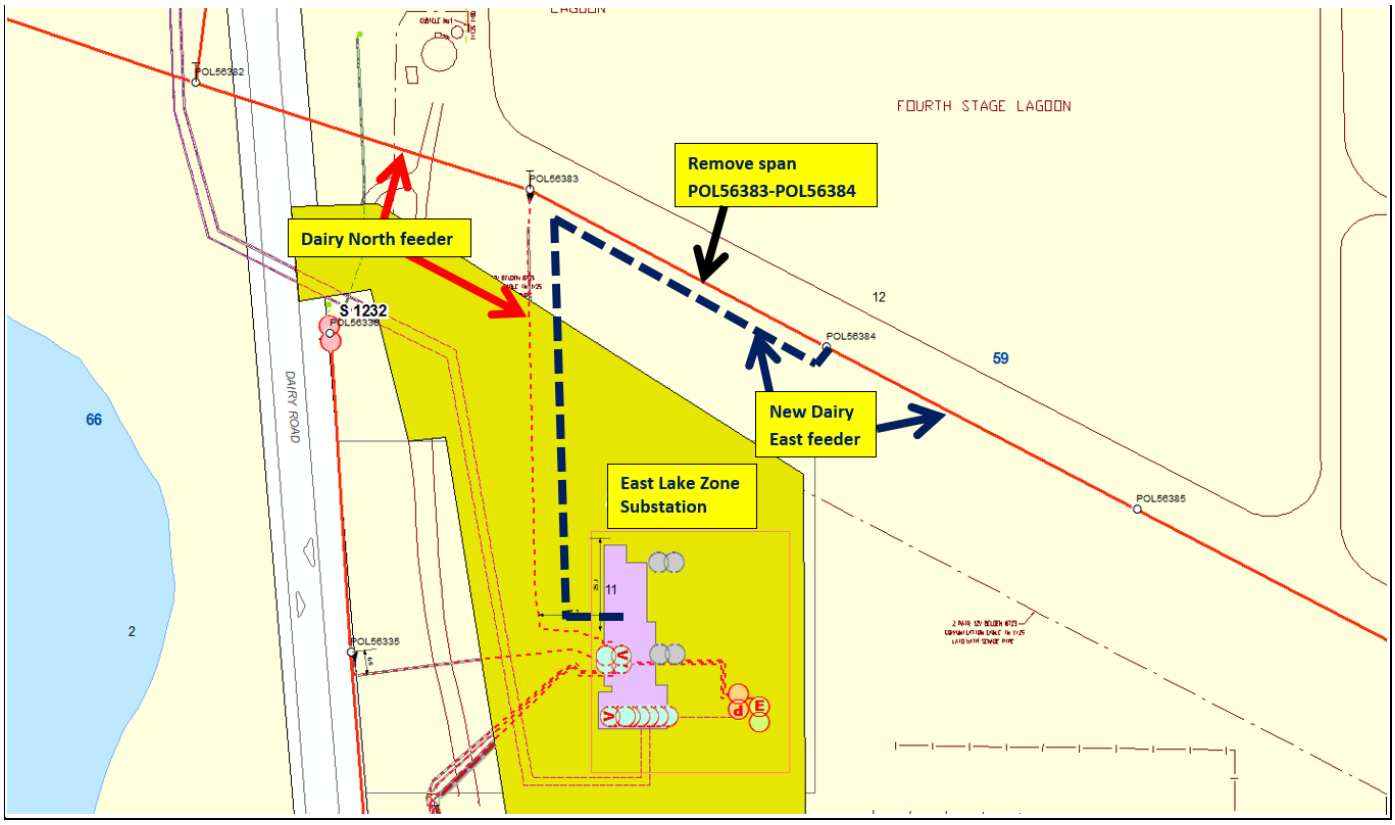


Part 2: New 11 kV Dairy East feeder:

It is proposed to run a new 11 kV feeder tail from a spare circuit breaker at East Lake Zone Substation to connect to the Dairy North feeder at a new pole-mounted gas switch on pole 56384, one span east of the existing connection point at gas switch GS11003. The Dairy North feeder would then be split between these two gas switches. The "new" feeder which will supply the Fairburn Park area would be named **Dairy East**.

Figure 4 illustrates this feeder route.

Figure 4: Proposed new 11 kV Dairy East feeder



Part 3: Construct link between Dairy North and Abattoir feeders:

The existing Dairy North feeder supplies some small distribution substations (S839, S840 and S4988) via a long section of overhead two phase line. It is proposed to extend the Abattoir feeder approximately 1.3 km north along Sutton Rd from pole 16394 to pole 15288 with 11 kV 3c/240mm^2 AL XLPE cable to link to the Dairy North feeder and transfer these distribution substations to the Abattoir feeder. This link and load transfer will ease some of the voltage stability issues being experienced on the Dairy North feeder with the recent connection of the Mt Majura solar farm and improve the quality of supply to these remote rural customers.

It is anticipated that most of this cable route would be installed by open trenching along the Sutton Rd verge.

A preliminary cost estimate for Option 1 is **$2,992,500 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). It also aligns with Evoenergy's strategic objective to convert Fyshwick 66/11 kV Zone Substation to an 11 kV switching station.

4.1.3. Option 2: Construct new 11 kV feeder from Fyshwick Zone Substation, new 11 kV feeder from East Lake Zone Substation, and link Dairy North feeder to Abattoir feeder

Option 2 includes three components. It considers the installation of a new 11 kV feeder from Fyshwick Zone Substation to Brindabella Park and alterations to the existing Dairy North and Abattoir feeders as follows:

Part 1: New 11 kV feeder to Brindabella Park:

It is proposed to install a new 11 kV 3c/400mm^2 AL XLPE cable feeder from Fyshwick Zone Substation to distribution substation S9411 at Pialligo Ave, Brindabella Park. There is no spare 11 kV circuit breaker at Fyshwick Zone Substation so the switchboard would need to be extended to accommodate an additional feeder circuit breaker panel. This cable would be through-jointed to the proposed cable to be installed between S9411 and S9330. Note S9411 is temporary only and will be removed. This would provide 5.5 MVA firm capacity (summer) to meet the growing load demand of the Brindabella Business Park.

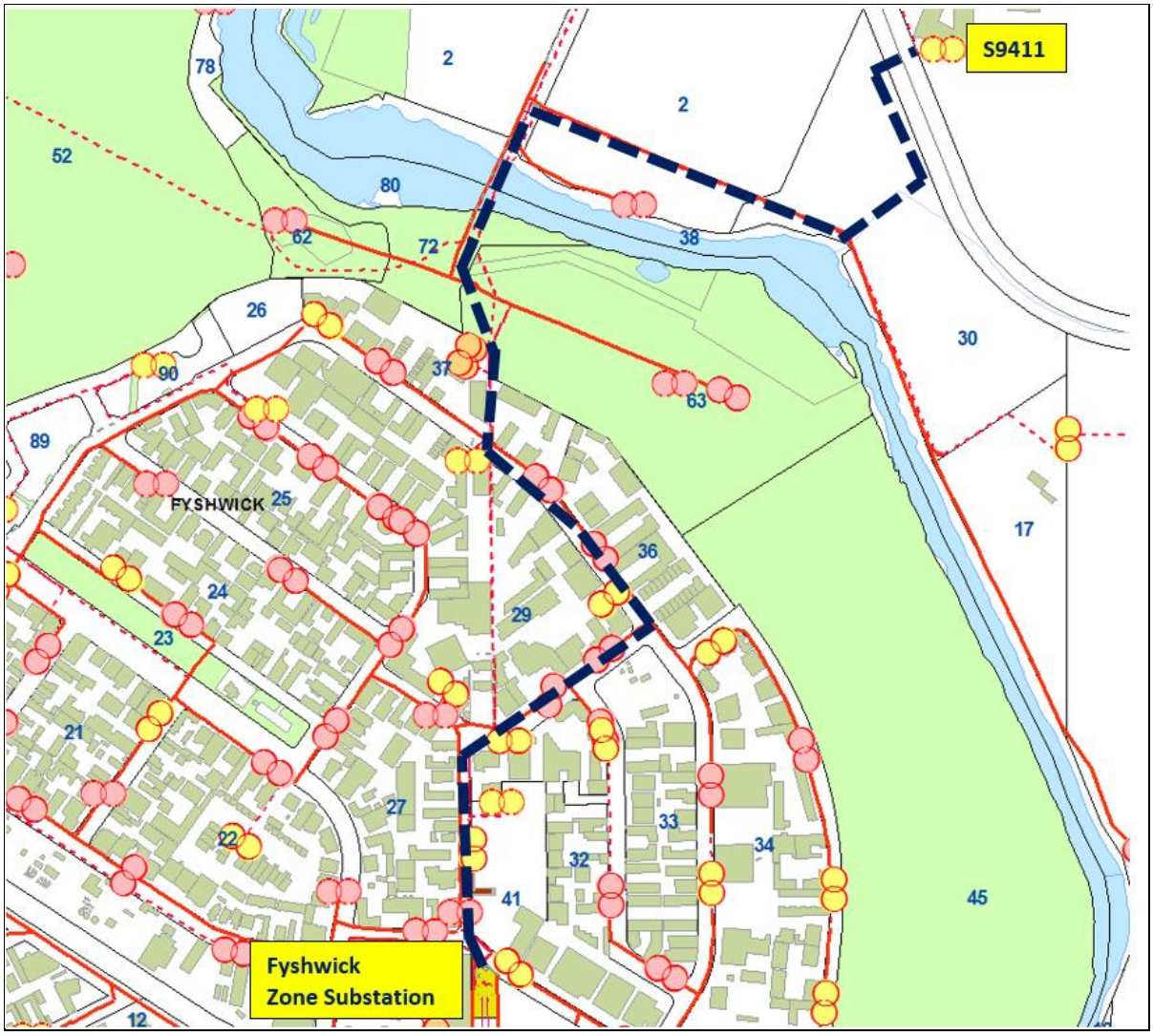
The cable route length would be approximately 3.1 km and would run from Fyshwick Zone Substation via Tennant St, Collie St, Albany St, Gladstone St, and then northwards to near pole 56484 on the southern side of the Molonglo River. At this point the cable would be directional drilled beneath the Molonglo River (approx 100m wide) to a point near pole 25174. From there the cable route would be eastwards alongside the existing overhead Gladstone feeder to near pole 38338 then northwards across farmland to Pialligo Ave and S9411.

The cable would be installed full length in 150mm diameter PVC conduit. Two spare conduits would be installed full length for future use.

Sections of this feeder would cross private property so would be subject to obtaining the appropriate approvals and/or easements. It is noted that 11 kV cables or overhead lines currently occupy most of this route, so it is assumed that approvals would be granted.

Figure 5 illustrates this feeder route.

Figure 5: Proposed new 11 kV feeder from Fyshwick Zone Substation to Brindabella Park



Part 2: New 11 kV Dairy East feeder:

This is described under Option 1 above.

Part 3: Construct link between Dairy North and Abattoir feeders:

This is described under Option 1 above.

A preliminary cost estimate for Option 2 is **$3,053,900 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.

This option does not align with Evoenergy's strategic objective to convert Fyshwick 66/11 kV Zone Substation to an 11 kV switching station.

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 proposed supply upgrade to Pialligo 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 4.8 MVA pa.

Latent demand management within the existing customer base was investigated, with a maximum estimated capacity of 0.84 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	Airport Feeder	Pialligo Feeder	Dairy Nth Feeder	Total
Customer – owned embedded generation	0.20 MVA	0.15 MVA	0.20 MVA	**0.55 MVA**
Customer – owned energy storage	0.04 MVA	0.03 MVA	0.05 MVA	**0.12 MVA**
Load curtailment	0.06 MVA	0.04 MVA	0.08 MVA	**0.18 MVA**
Totals	**0.30 MVA**	**0.22 MVA**	**0.33 MVA**	**0.85 MVA**

In summary, a maximum demand reduction of 0.85 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 Pialligo it was determined that more than 60% 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 project 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 **$4,124,880 excluding corporate overheads, contingency and GST.** Refer to cost estimates, cash flows and NPC 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 network battery is modular and also 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 Pialligo however, the grid battery was not economic due to the relative certainty of demand with a preliminary cost estimate of **$16,149,106 excluding corporate overheads, contingency and GST**. Refer to cost estimates, cash flows and NPC 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 new Brindabella feeder from East Lake Zone Substation, and the proposed feeder split to create Dairy East feeder.

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 new feeders from East Lake Zone Substation are required.

Table 6: Forecast Loads and Proposed Feeder Supplies

Pialligo Area Forecast Load Growth							
Proposed Development and Net Additional Diversified Load in MVA	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**Total**
PN 20003829 Brindabella Business Park	1.0	1.0	1.0	1.6			4.6
Proposed feeder to supply above load	New Brindabella feeder						
PN 20003913 Macquarie Telecom Data Centre, Pearce Ave Fairbairn Park		1.4	0.5	0.3	0.5	0.7	3.4
Proposed feeder to supply above load	New Dairy East feeder						
PN 20003493 Majura Defence Facility	0.8						0.8
Proposed feeder to supply above load	Dairy North						
PN 20003770 Pialligo Horticulture Expansion	1.0						1.0
Proposed feeder to supply above load	Dairy North						
PN 20005330 Supply to Alpha catering building	0.3						0.3
Proposed feeder to supply above load	Aero Park						
PN 20005116 Supply to Airport building	1.1						1.1
Proposed feeder to supply above load	Pialligo						
Forecast Additional Load pa (MVA)	**4.2**	**2.4**	**1.5**	**1.9**	**0.5**	**0.7**	
Cumulative Forecast Additional Load (MVA)	**4.2**	**6.6**	**8.1**	**10.0**	**10.5**	**11.2**	

Table 7 lists the existing and proposed feeders to the Pialligo area with their existing maximum demand, forecast maximum demand at 2024 and forecast maximum demand at 2028.

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

Feeder	Zone Substation	Firm rating MVA (summer)	Thermal rating MVA (summer)	Existing max demand MVA (summer)	Forecast max demand MVA (summer 2024)	Forecast max demand MVA (summer 2028)
Aero Park	**City East**	5.0	6.6	4.5	4.8	4.8
Airport	**Fyshwick**	5.0	6.7	4.9	4.9	4.9
Pialligo	**Fyshwick**	5.2	6.9	3.3	5.1	5.1
Dairy North	**East Lake**	5.3	7.1	4.6	4.9	4.9
Dairy East	**East Lake**	5.3	7.1	–	5.1	5.1
Brindabella	**East Lake**	5.5	7.3	–	4.6	4.6

Orange denotes proposed new feeder.

4.1.8. Summary of Options Analysis

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

Table 8: Summary of Options Analysis

Option	Description	Total Capital Cost 2019-2039	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 two new 11 kV cable feeders from East Lake Zone Substation, and link Dairy North feeder to Abattoir feeder**	**$2,992,500**	**$2,992,500**	**-$3,031,657**	**Selected due to higher NPC**
2	Construct new 11 kV cable feeder from Fyshwick Zone Substation, new 11 kV cable feeder from East Lake Zone Substation, and link Dairy North feeder to Abattoir feeder	$3,053,900	$3,053,900	-$3,093,861	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	$4,123,880	$4,123,880	-$3,845,700	Not selected as deferral not economic
5	Grid battery only	$16,149,100	$4,037,275	-$9,254,197	Not selected due to lower NPC

4.2. Recommendation

The selected option is Option 1, the construction of two new 11 kV cable feeders from East Lake Zone Substation: one to Brindabella Park, and the other to enable the Dairy North feeder to be split into two (Dairy North and Dairy East feeders); and link Dairy North feeder to Abattoir feeder. All new feeder cables to be 11 kV 3c/400mm^2 AL XLPE.

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 feeders will provide capacity and security of supply to the new developments proposed for the Pialligo, Brindabella Park and Fairbairn Park areas.

The project will be carried out in three stages with completion by June 2022.

The preliminary cost estimate for the selected option is **$2,992,500 excluding overheads, contingency and GST**.

The proposed 11 kV feeders will provide ties to existing feeders from City East and East Lake 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: Construct two new feeders from East Lake Zone Substation, and link Dairy North feeder to Abattoir feeder

Construct two new 11 kV cable feeders from East Lake Zone Substation, and link Dairy North to Abbatoir feeders.					
Preliminary Estimate ± 30% Accuracy					
Description	**Notes**	**Unit**	**$/Unit**	**Quantity**	**Cost**
Trenching and drilling					$2,331,500
Clearing of route where required	Allowance	m2	$10	6400	$64,000
Directional drilling	Assume drilling with no rock. Assume three 150mm conduits per drill.	m	$600	2500	$1,500,000
Open trenching and backfilling	Assume excavation with no rock. Backfill with bedding sand and native soil. Assume three conduits per trench.	m	$300	2200	$660,000
Cable jointing and haulage pits	Assume every 500m	ea	$3,000	20	$60,000
Traffic management		m	$5	1500	$7,500
Reinstatement incl revegetation as required	Excavation, no rock (minor boulders only). Site is mostly flat .	m3	$40	1000	$40,000
Cabling works					$369,000
11 kV 3c/400mm2 XLPE cable		m	$56	3500	$196,000
11 kV 3c/240mm2 XLPE cable		m	$35	1200	$42,000
Throughjoints	Assume every 500m	ea	$1,000	13	$13,000
Terminations		ea	$2,500	6	$15,000
Conduit and marker tape	Assume all cables installed in conduit	m	$10		$0
Cable installation labour and plant		m	$20	4700	$94,000
HV Cables and connections Test & Commissioning	Allowance	ea	$3,000	3	$9,000
11 kV Switchgear					$2,000
11 kV feeder CB	Extend switchboard and add feeder CB panel	ea	$120,000		$0
11kV Test & Commissioning	per CB	lot	$2,000	1	$2,000
Electrical (Secondary System)					$0
Protection & Control					$0
P&C Secondary Cabling	per feeder panel	ea	$2,250		$0
P&C Test & Commission	Allowance	ea	$2,500		$0
DC Supply System					$0
DC Cabling	per switchgear panel/bay	ea	$5,000		$0
DC Test & Commission	Allowance	ea	$2,000		$0
SCADA					$0
SCADA connections for new feeder panels		ea	$2,000		$0
Test & Commissioning	Allowance	ea	$2,000		$0
Indirect Costs					$290,000
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	$200,000	1	$200,000
Project Sub Total without overheads					**$2,992,500**
Overheads					
Overall average overhead rate	Allowance	27%	$807,975	1	$807,975
Project Sub Total with overheads					**$3,800,475**
Contingency					
All project works	Preliminary allowance	15%	$570,071	1	$570,071
Project budget total					**$4,370,546**

A.2 Cost Estimate – Option 2: Construct new feeder from Fyshwick Zone Substation, new feeder from East Lake Zone Substation, and link Dairy North feeder to Abattoir feeder

Construct new 11 kV cable feeder from Fyshwick Zone Substation, new 11 kV cable feeder from East Lake Zone Substation, and link Dairy North feeder to Abbatoir feeder.					
Preliminary Estimate ± 30% Accuracy					
Description	**Notes**	**Unit**	**$/Unit**	**Quantity**	**Cost**
Trenching and drilling					$2,271,000
Clearing of route where required	Allowance	m2	$10	6400	$64,000
Directional drilling	Assume drilling with no rock. Assume three 150mm conduits per drill.	m	$600	2400	$1,440,000
Open trenching and backfilling	Assume excavation with no rock. Backfill with bedding sand and native soil. Assume three conduits per trench.	m	$300	2200	$660,000
Cable jointing and haulage pits	Assume every 500m	ea	$3,000	20	$60,000
Traffic management		m	$5	1400	$7,000
Reinstatement incl revegetation as required	Excavation, no rock (minor boulders only). Site is mostly flat .	m3	$40	1000	$40,000
Cabling works					$361,400
11 kV 3c/400mm2 XLPE cable		m	$56	3400	$190,400
11 kV 3c/240mm2 XLPE cable		m	$35	1200	$42,000
Throughjoints	Assume every 500m	ea	$1,000	13	$13,000
Terminations		ea	$2,500	6	$15,000
Conduit and marker tape	Assume all cables installed in conduit	m	$10		$0
Cable installation labour and plant		m	$20	4600	$92,000
HV Cables and connections Test & Commissioning	Allowance	ea	$3,000	3	$9,000
11 kV Switchgear					$122,000
11 kV feeder CB	Extend switchboard and add feeder CB panel	ea	$120,000	1	$120,000
11kV Test & Commissioning	per CB	lot	$2,000	1	$2,000
Electrical (Secondary System)					$9,500
Protection & Control				1	$2,500
P&C Secondary Cabling	per feeder panel	ea	$2,250		$0
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					$0
SCADA connections for new feeder panels		ea	$2,000		$0
Test & Commissioning	Allowance	ea	$2,000		$0
Indirect Costs					$290,000
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	$200,000	1	$200,000
Project Sub Total without overheads					**$3,053,900**
Overheads					
Overall average overhead rate	Allowance	27%	$824,553	1	$824,553
Project Sub Total with overheads					**$3,878,453**
Contingency					
All project works	Preliminary allowance	15%	$581,768	1	$581,768
Project budget total					**$4,460,221**

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					
2021-22	$2,992,500	$3,053,900	N/A	$1,131,380	$807,455
2022-23				$2,992,500	$807,455
2023-24					$807,455
2024-25					$807,455
2025-26					$807,455
2026-27					$807,455
2027-28					$807,455
2028-29					$807,455
2029-30					$807,455
2030-31					$807,455
2031-32					$807,455
2032-33					$807,455
2033-34					$807,455
2034-35					$807,455
2035-36					$807,455
2036-37					$807,455
2037-38					$807,455
2038-39					$807,455
Total Cost (20 years)	**$2,992,500**	**$3,053,900**	**N/A**	**$4,123,880**	**$16,149,100**
2019-24 Regulatory Control Period Cost	**$2,992,500**	**$3,053,900**	**N/A**	**$4,123,880**	**$4,037,275**

B.2 NPC Analysis

The Net Present Cost (NPC) was calculated using a Monte-Carlo simulation model. The simulation randomly selects a peak demand growth rate for each year that is within ± 10% of the forecasted spot loads expected in the Pialligo area. The use of a Monte-Carlo simulation results in selection of the best option that is robust to uncertain peak demand growth forecasts.

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 Pialligo

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

Options:

One – Two new 11 kV feeders from East Lake Zone Substation.
Two – One new 11 kV feeder from East Lake Zone Substation and one new feeder from Fyshwick Zone Substation.
Four – Defer Option 1 with grid battery.
Five – Grid battery only.

RESULTS (Average over 50 simulations):

Option:	One	Two	Four	Five
NPC (2019-2024)	-$2,773,542	-$2,830,449	-$3,583,278	-$4,338,425
NPC (2019-2039)	-$3,031,657	-$3,093,861	-$3,846,690	-$10,120,357
Network Option total Capital Cost	$2,992,500	$3,053,900	$2,992,500	-
Option Capital Cost (2019-2024)	$2,992,500	$3,053,900	$4,123,880	$4,037,275
Option Capital Cost (2019-2039)	$2,992,500	$3,053,900	$4,123,880	$16,149,100

Unserved Energy:

The following table estimates the volume of unserved energy (USE) in KWh 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)	3	32	67	126	171	247
Thermal (kWh)	0	6,314	36,508	213,814	305,861	523,359
Total USE	**3**	**6,346**	**36,575**	**213,939**	**306,031**	**523,607**
Value of USE	$81	$170,898	$984,965	$5,761,377	$8,241,415	$14,100,737

Notes:

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.

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 60% of load in the Pialligo 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 feeders to the Pialligo area are 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.

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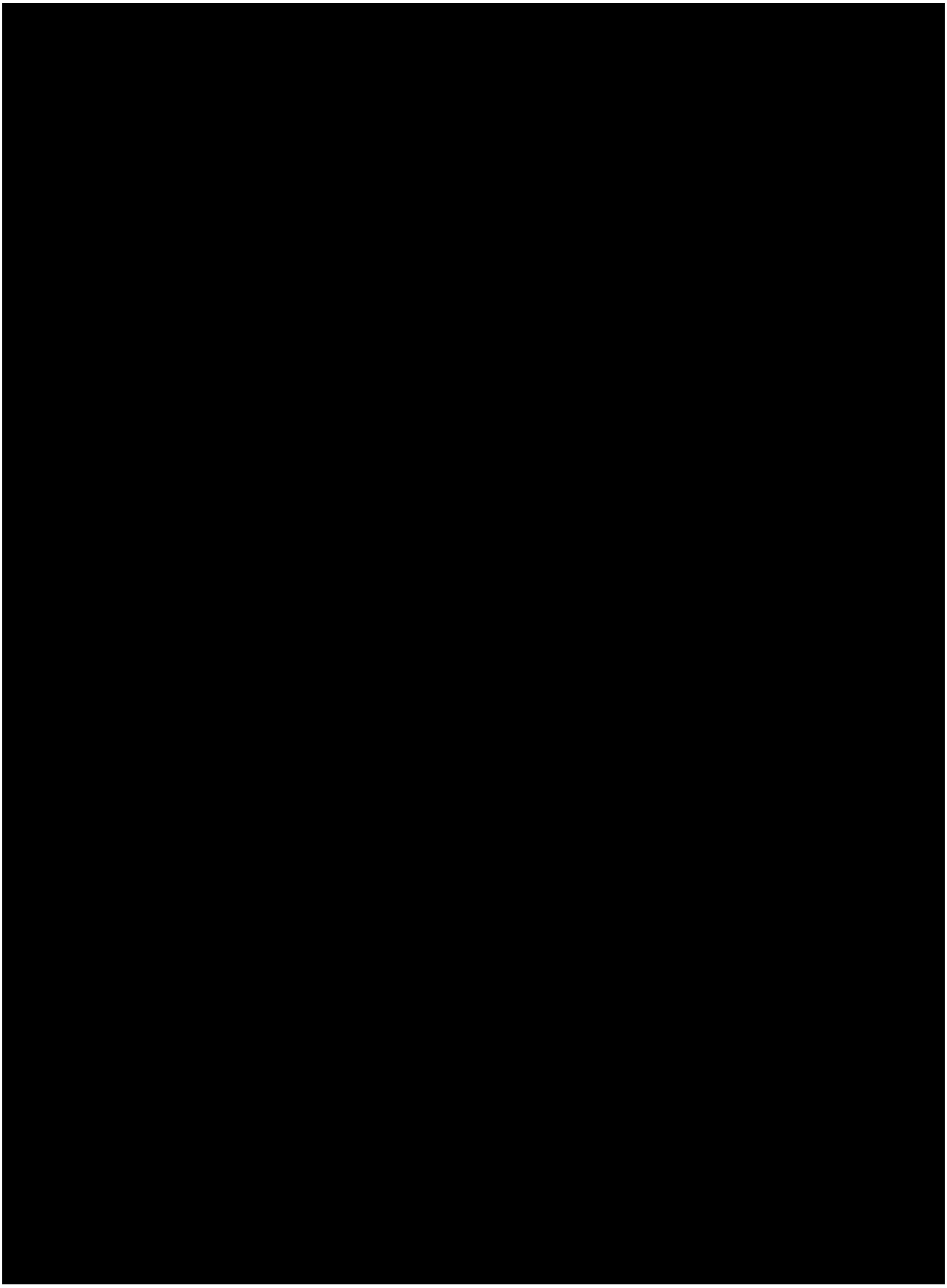

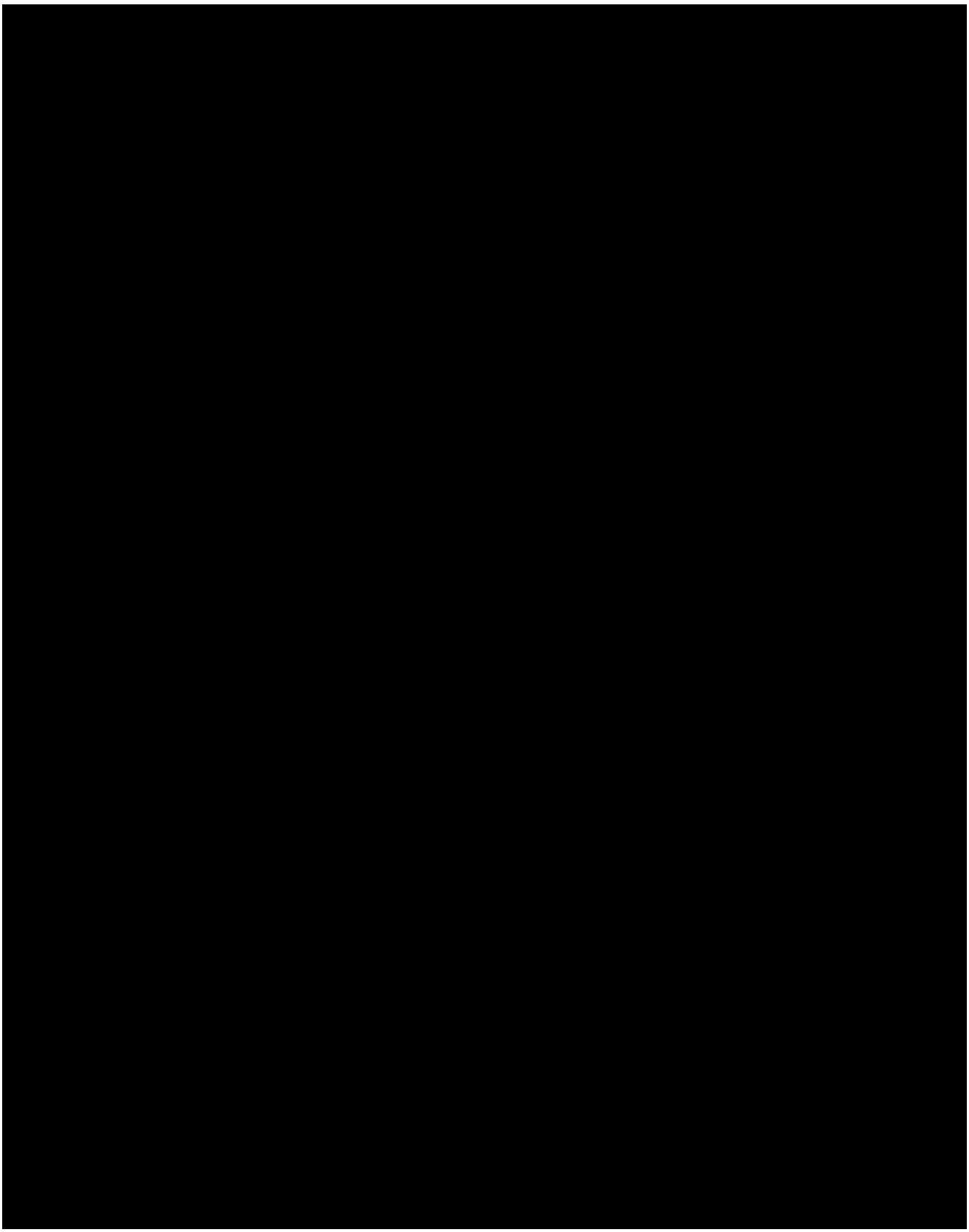

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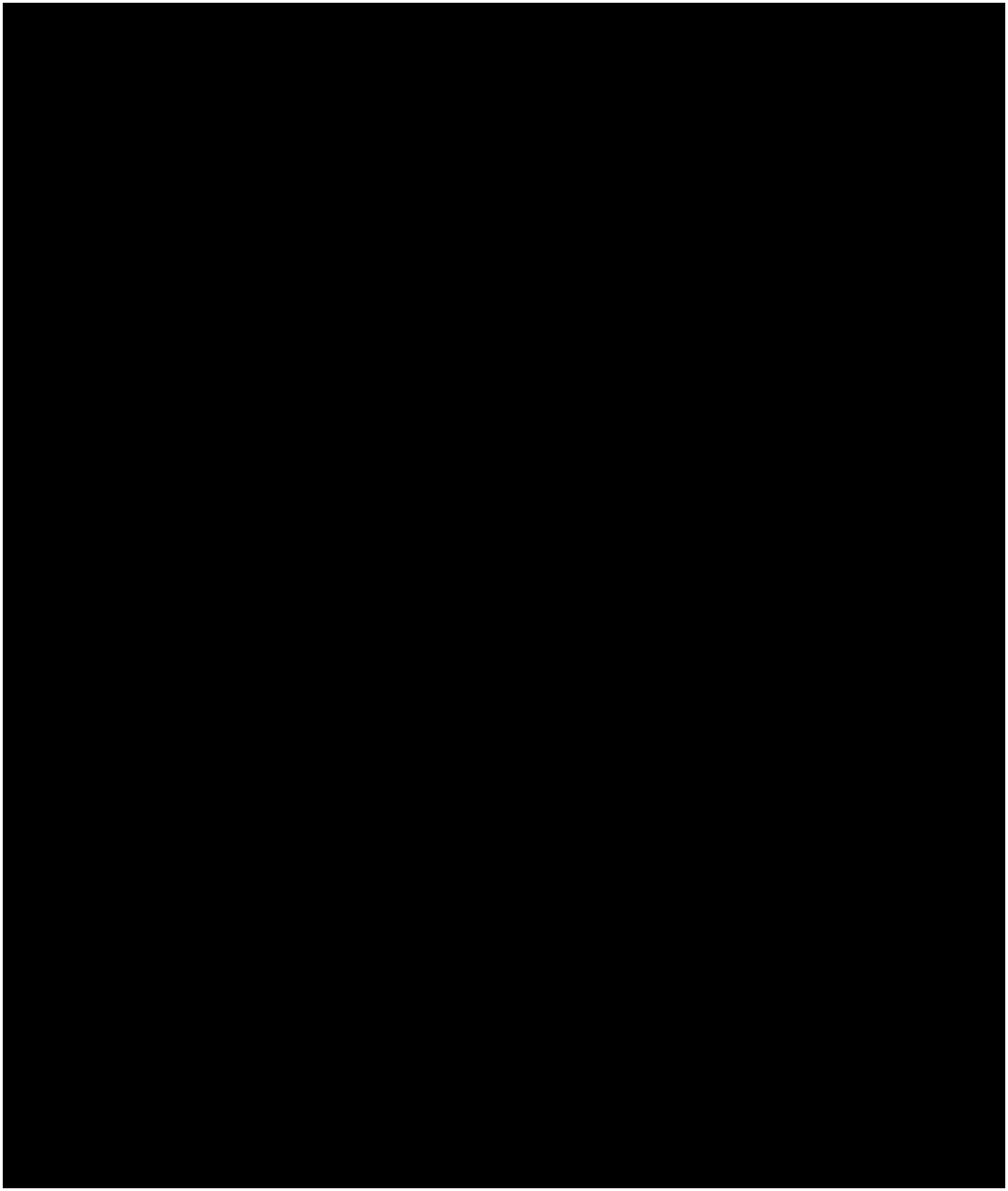
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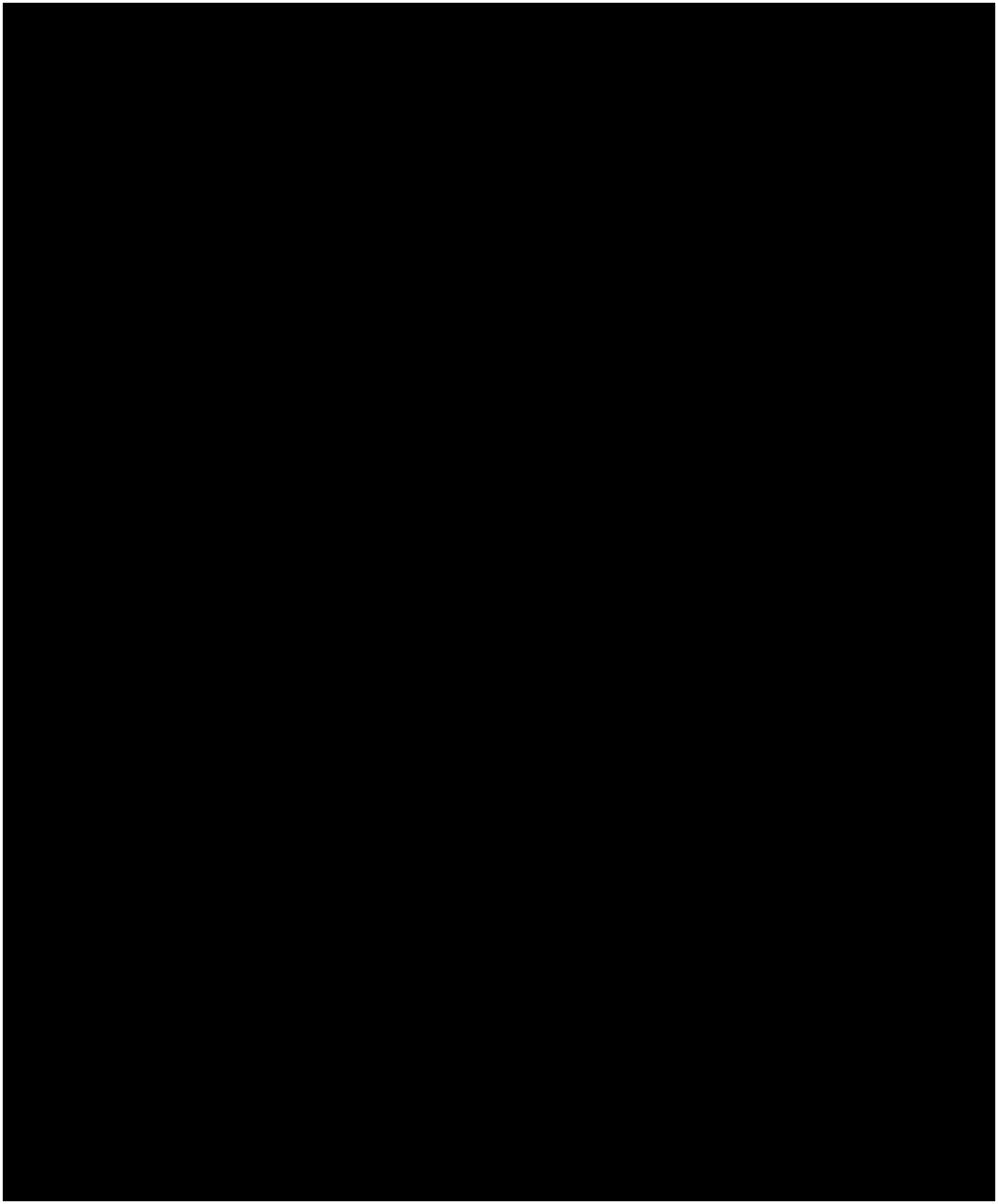

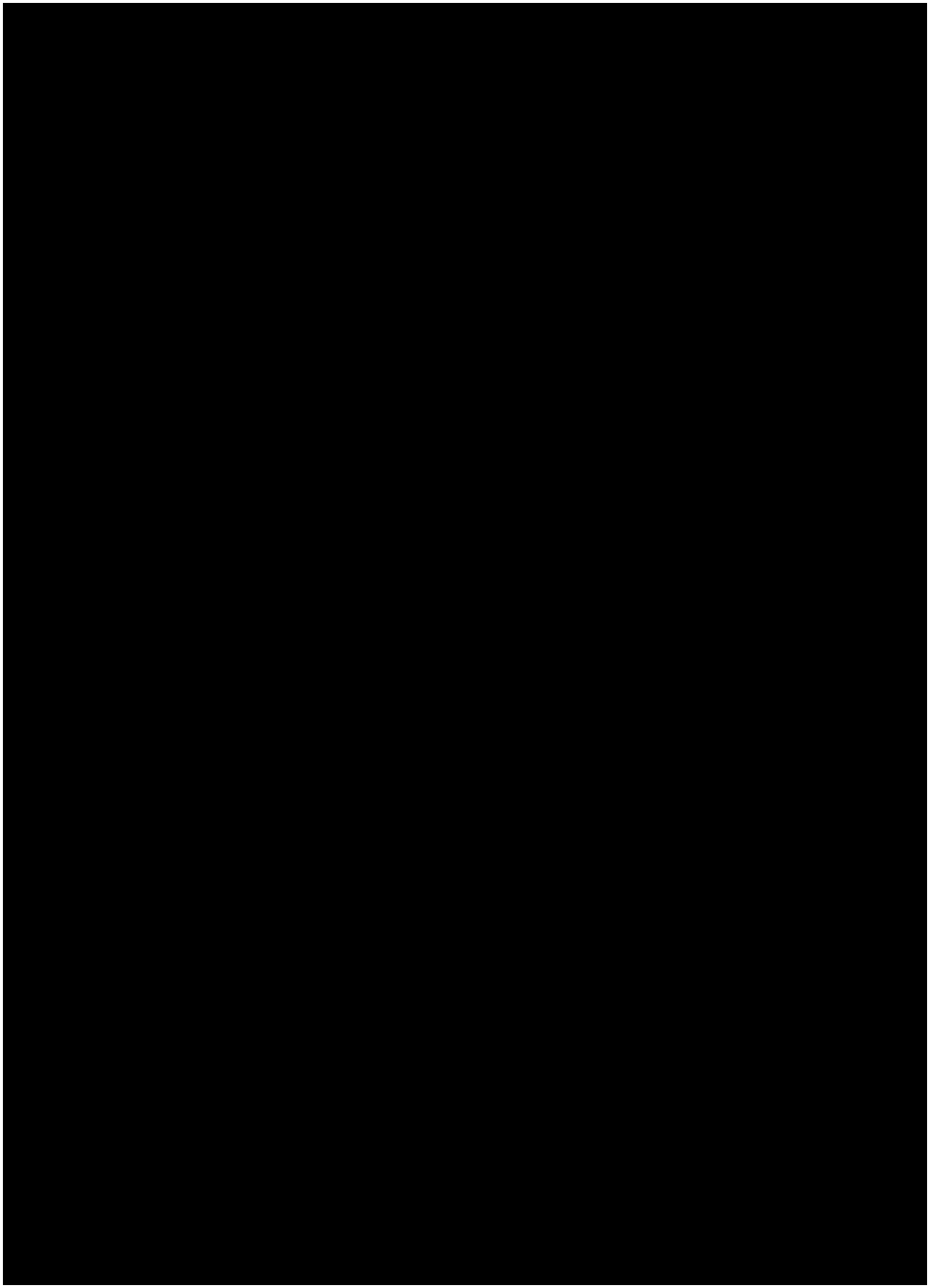

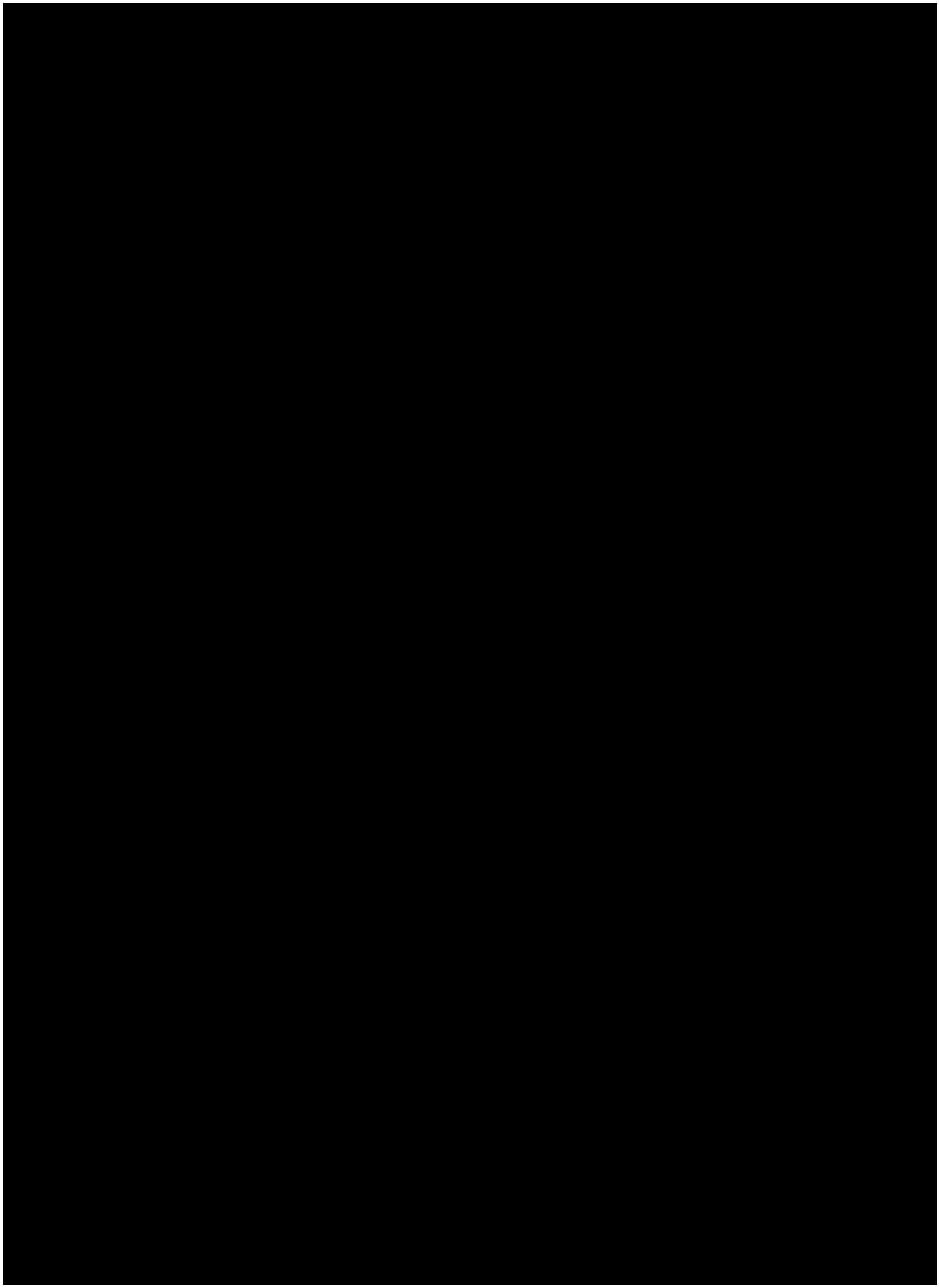

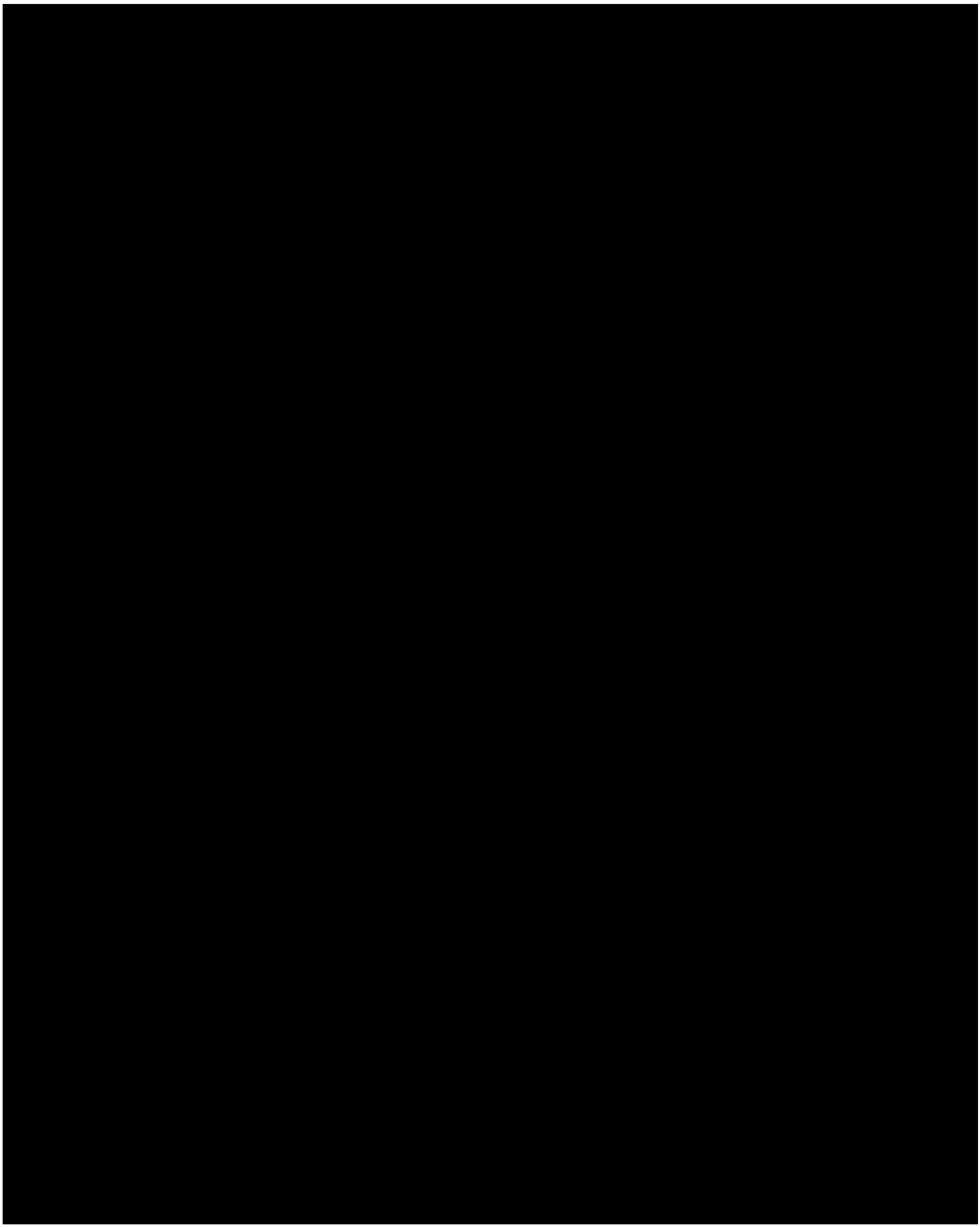

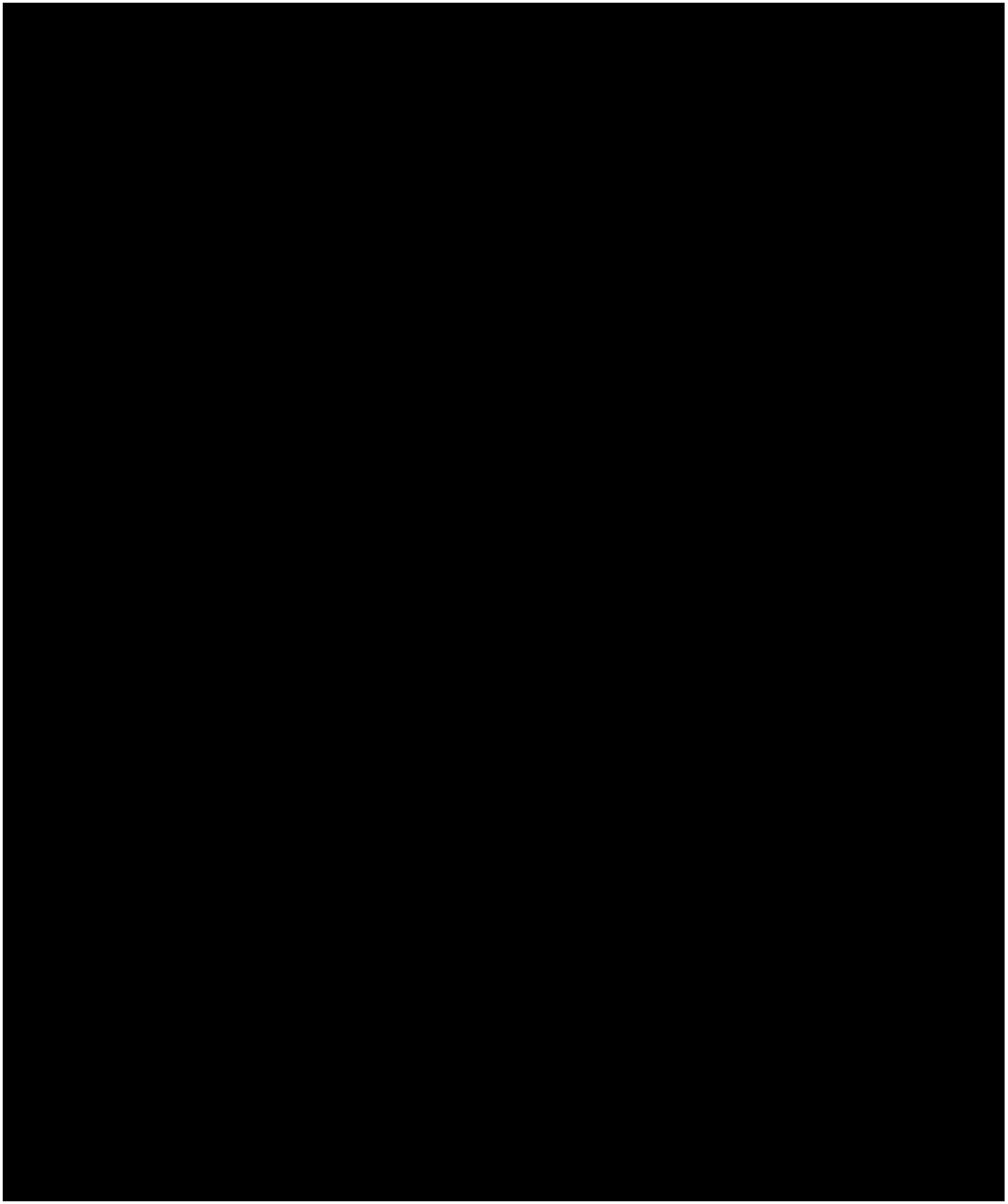

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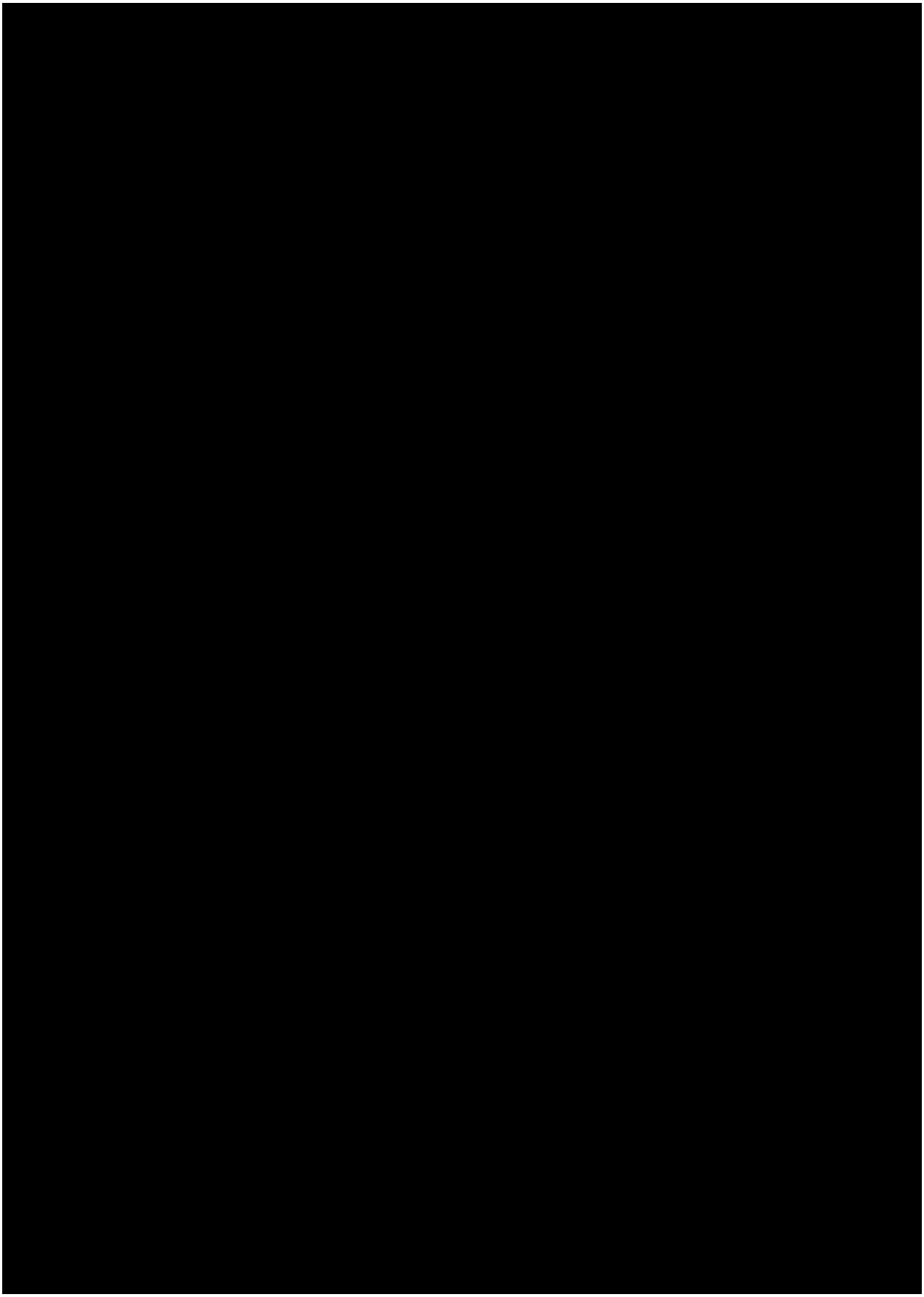

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