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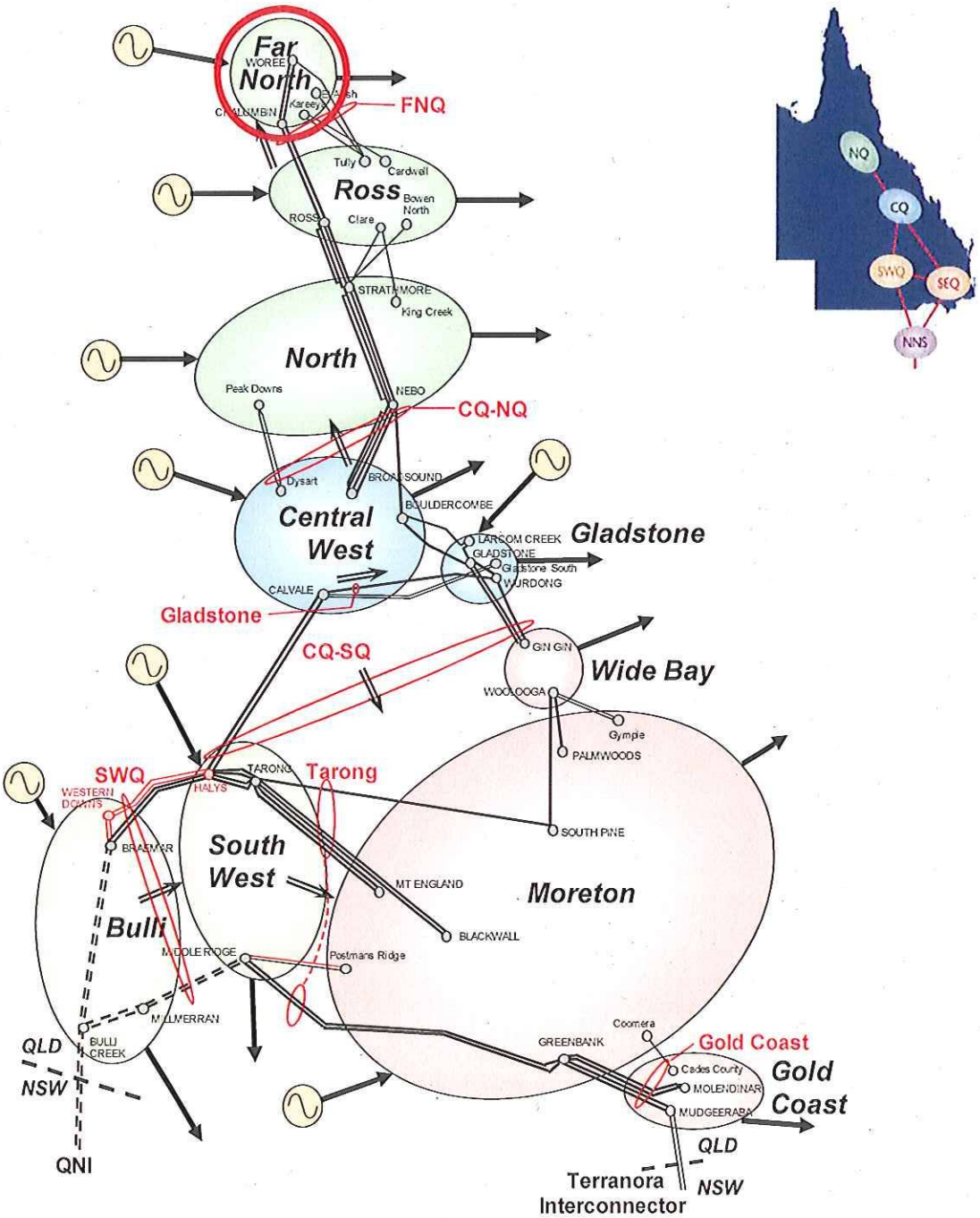
2010 GRID PLAN

VOLUME 2 SECTION 1

Network Development

Far North Area



Far North Area

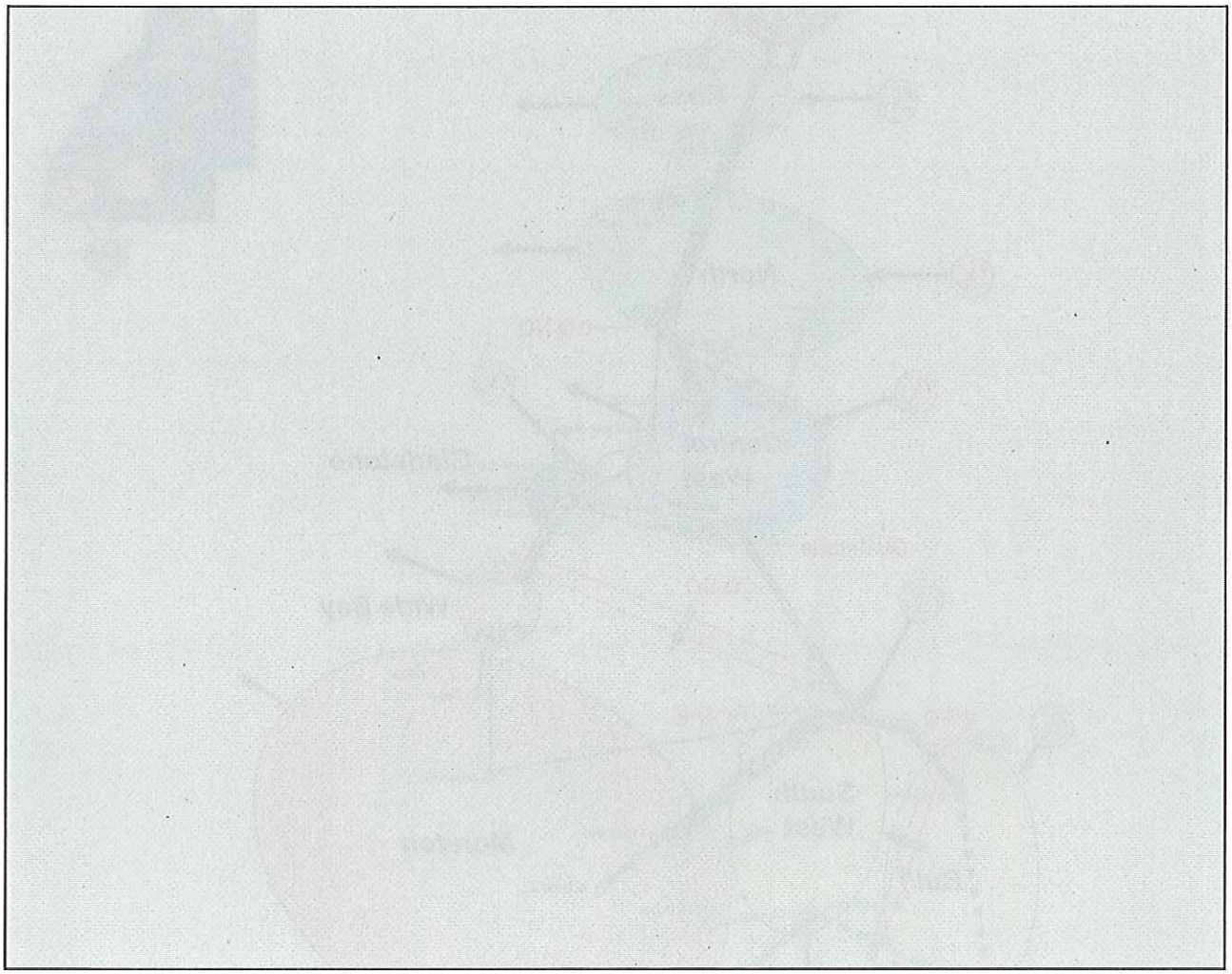
1. Network Description

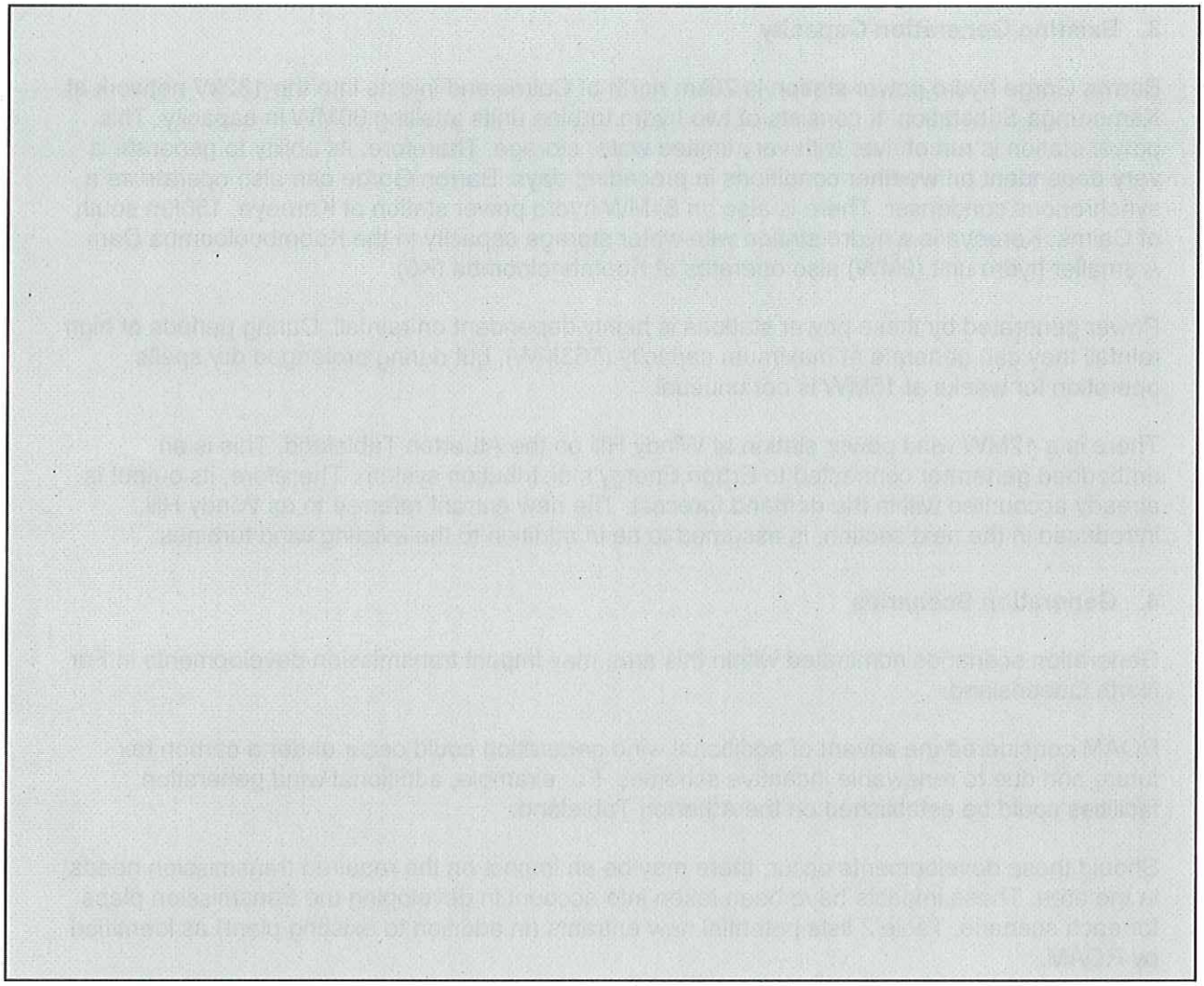
Far North Queensland (FNQ) is a net importer of electricity. Only the hydro generators at Barron Gorge and Kareeya generate within this zone. Therefore, FNQ relies heavily on transmission for its electricity supply. Large amounts of electricity from power stations elsewhere in the state are transferred to FNQ via Powerlink's 275kV and 132kV transmission network. Large levels of the energy supplied are generated in Central Queensland some 800km to the south.

Supply to FNQ is predominantly via the 275kV network from Ross to Chalumbin and Chalumbin to Woree (380km). In 2005, a static VAr compensator (SVC) was commissioned at Woree to address reliability of supply limitations.

The 132kV lines along the coast via Ingham, Tully, Innisfail and Edmonton provide additional transfer capacity. These coastal lines are in the process of being replaced due to condition, with the remaining sections south of Tully expected to be completed by 2013.

The electricity supply system to FNQ is shown in Figure 1. Figure 2 shows a one line diagram representation of the existing transmission system.





2. Description of Committed Projects

The coastal 132kV transmission lines from Townsville to Edmonton (via Ingham, Cardwell, Tully, Kareeya and Innisfail) are approaching 55 years old and must be replaced due to deteriorated condition and reliability. The approved replacement strategy constructs a 275/132kV dual voltage transmission line between Townsville and Edmonton via Ingham, Cardwell, Tully and Innisfail. Both circuits are initially operated at 132kV. The existing Kareeya to Tully lines are to be decommissioned and recovered. The section between Tully and Edmonton has been replaced. Table 1 lists the committed projects assumed in the Grid Plan for this zone.

Table 1: Committed projects assumed in the 2010 Grid Plan in FN

Project ID	Project Description	Expected Commissioning
CP.02095	Chalumbin No.1 Bus Reactor	Summer 2012/13
CP.00880	Tully – Cardwell 132kV Transmission Line Replacement	Summer 2012/13
CP.00882	Ingham – Cardwell 132kV Transmission Line Replacement	Summer 2013/14
CP.01475	Kareeya – Tully 132kV Transmission Line Recovery	Summer 2013/14

3. Existing Generation Capacity

Barron Gorge hydro power station is 20km north of Cairns and injects into the 132kV network at Kamerunga Substation. It consists of two hydro turbine units totalling 60MW in capacity. This power station is run of river with very limited water storage. Therefore, its ability to generate is very dependent on weather conditions in preceding days. Barron Gorge can also operate as a synchronous condenser. There is also an 84MW hydro power station at Kareeya, 150km south of Cairns. Kareeya is a hydro station with water storage capacity in the Koombooloomba Dam. A smaller hydro unit (9MW) also operates at Koombooloomba (K5).

Power generated by these power stations is highly dependent on rainfall. During periods of high rainfall they can generate at maximum capacity (153MW), but during prolonged dry spells operation for weeks at 15MW is not unusual.

There is a 12MW wind power station at Windy Hill on the Atherton Tableland. This is an embedded generator connected to Ergon Energy's distribution system. Therefore, its output is already accounted within the demand forecast. The new entrant referred to as Windy Hill, introduced in the next section, is assumed to be in addition to the existing wind turbines.

4. Generation Scenarios

Generation scenarios nominated within this area may impact transmission developments in Far North Queensland.

ROAM considered the advent of additional wind generation could occur under a carbon tax future and due to renewable incentive schemes. For example, additional wind generation facilities could be established on the Atherton Tableland.

Should these developments occur, there may be an impact on the required transmission needs in the area. These impacts have been taken into account in developing the transmission plans for each scenario. Table 2 lists potential new entrants (in addition to existing plant) as identified by ROAM.

Table 2: ROAM new entrants in FN

Generator	Capacity (MW)	Assumed Point of Connection	Cumulative Probability of Proceeding by 2021/22
Archer Point Wind	120	Turkinje 132kV	62%
Windy Hill Wind	12	Turkinje 132kV	1%
High Road Wind	50	Turkinje – Chalumbin 132kV line	73%
Arriga Wind	130	Chalumbin – Woree 275kV line	15%

5. Description of Transmission Limitations

Main Grid

The FNQ transmission system is characterised by long transmission distances, large electrical angles, voltage sensitivity and significant demand for reactive power for changes in real power transmitted. As a result, maximum power transfer into FNQ is mostly limited by the occurrence of unstable voltage levels following critical contingencies. Load growth, particularly at Cairns, Innisfail and Townsville, erodes the available reactive capability from the dynamic sources (hydro generators and SVCs).

The critical Main Grid contingencies include:

- Chalumbin to Woree 275kV circuit;
- Chalumbin to Ross 275kV circuit; or
- Woree SVC.

Local hydro generation reduces transfer capability but allows more demand to be securely supported in the area. This is because reduction in grid section transfer capability is more than offset by reduction in power transfers resulting from increased local generation.

Regional Grid

Solid growth within the region will require additional capacitor banks (at Turkinje and Innisfail) to prop up the system voltages under future contingency events. Strong load growth to the north of Cairns (between Smithfield and Palm Cove) will exceed the capacity of Ergon's 22kV network. Joint planning studies with Ergon Energy have indicated that two 132kV feeder bays will be required at Powerlink's Kamerunga substation to supply Ergon's new 132/22kV substation at Smithfield.

The critical Regional Grid Contingencies include:

- Kamerunga 132/22kV transformer;
- Woree to Edmonton 132kV transmission line; or
- Chalumbin to Turkinje 132kV transmission line.

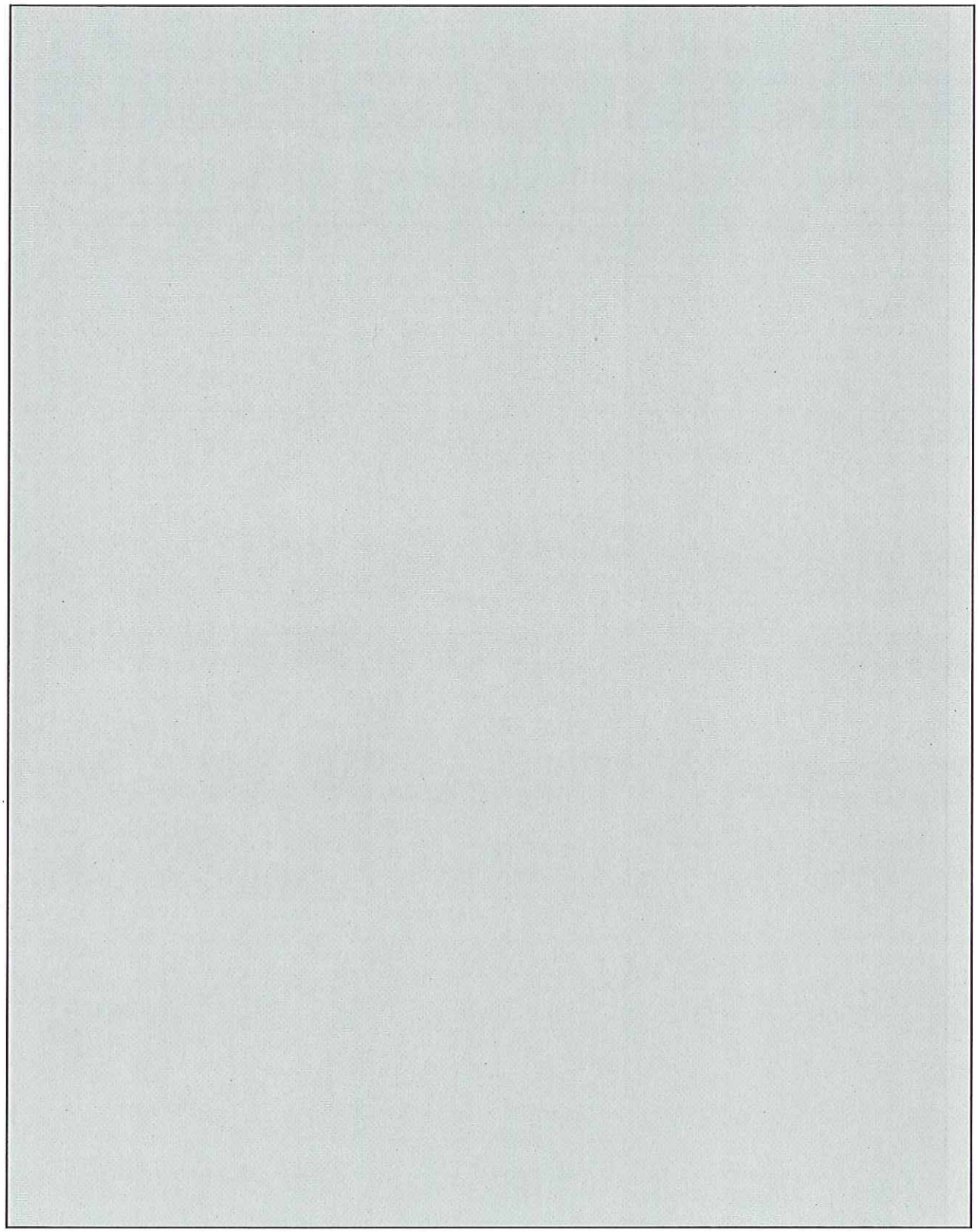
Powerlink has also identified that in the case of a severe weather event resulting in loss of the 275kV double circuit transmission line supplying Far North Queensland, it would not be possible to support the load in Far North Queensland, and access for restoration may be delayed. Requirements placed on Powerlink to ensure that it can restore supply to Far North Queensland may require that Powerlink energise one side of the coastal transmission lines at 275kV, and Powerlink has included a contingent project to address these limitations in accordance with the requirements of the Rules.

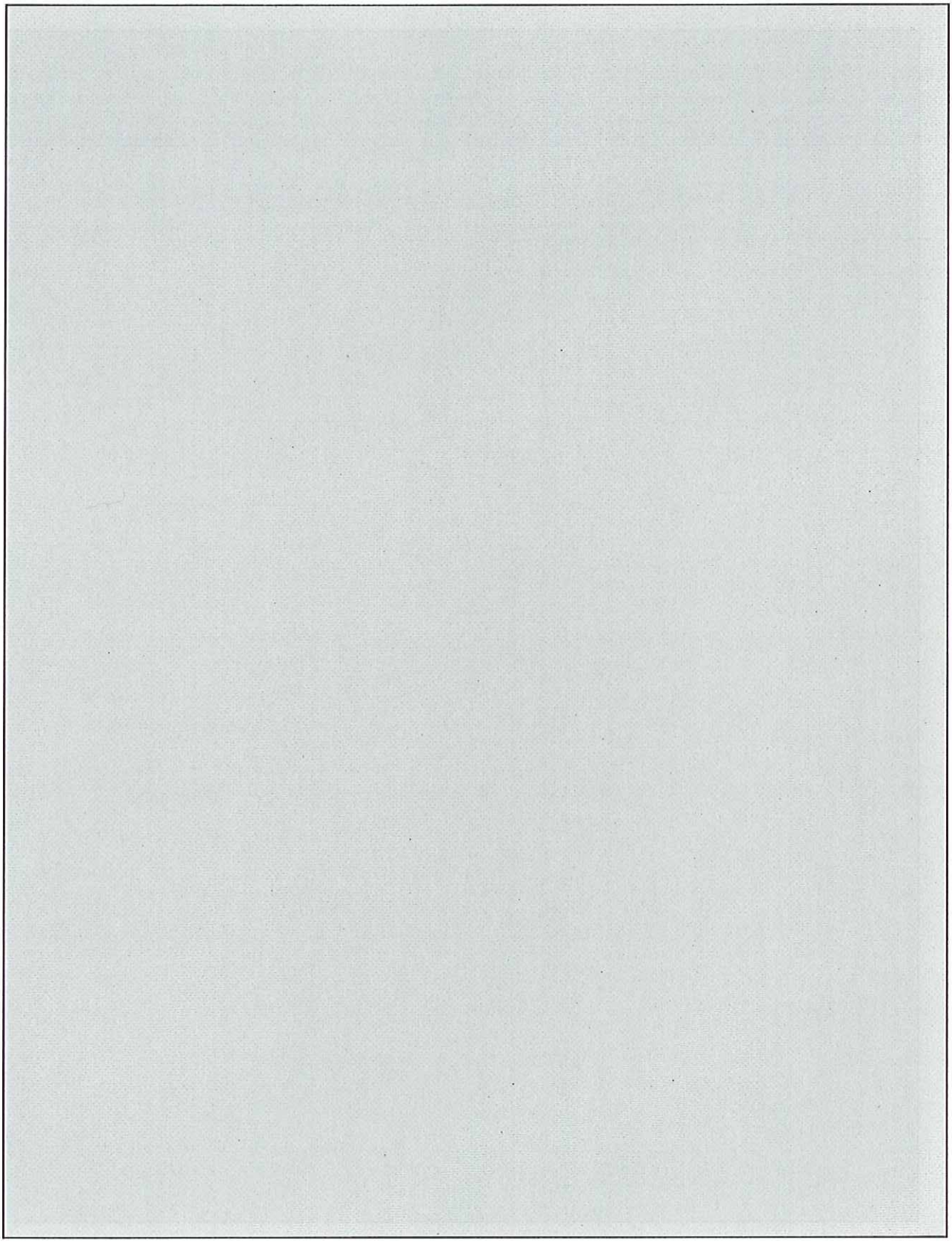
6. Relevant Planning Criteria

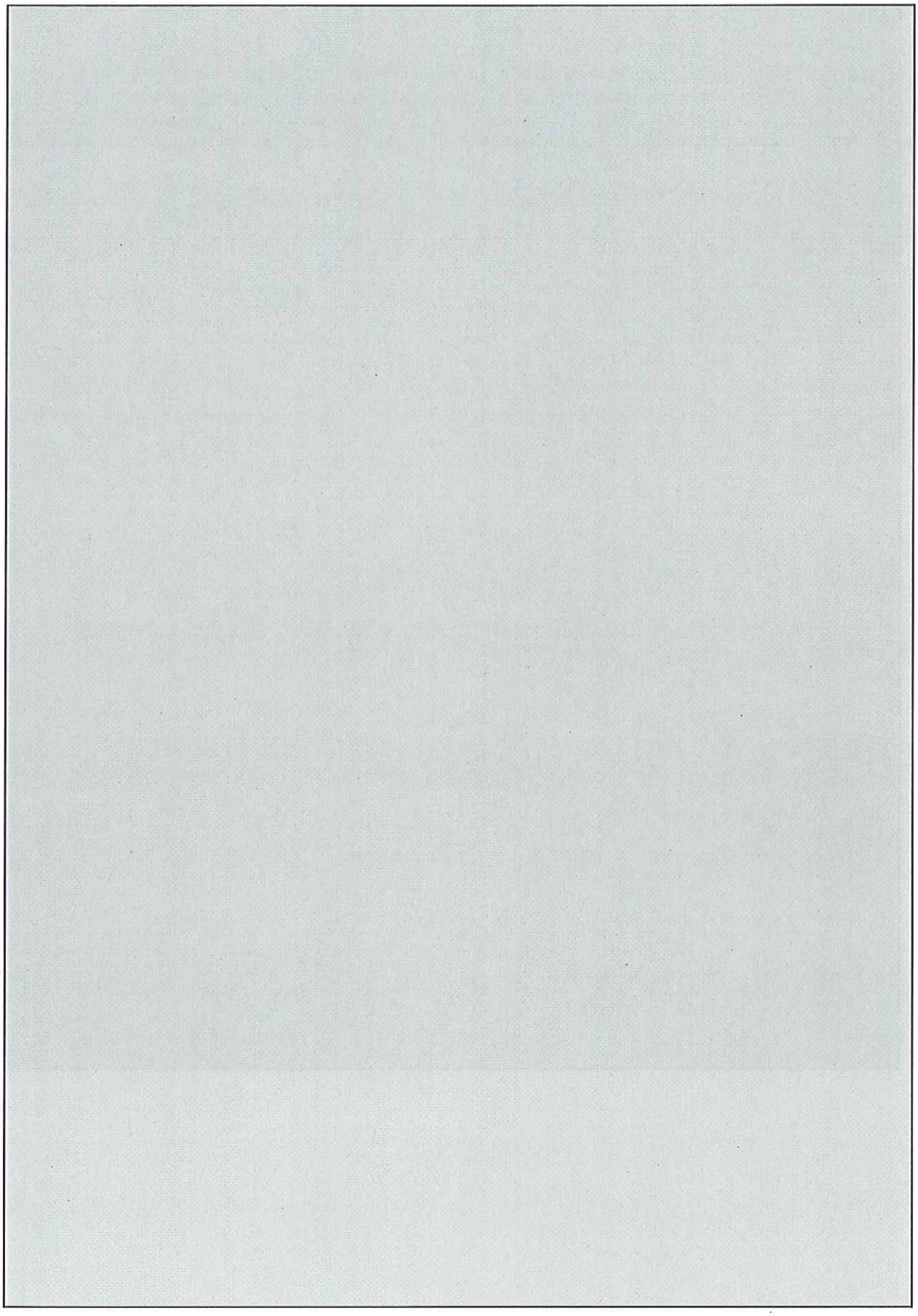
Powerlink's planning criteria, as it applies to this section, is summarised in Table 3.

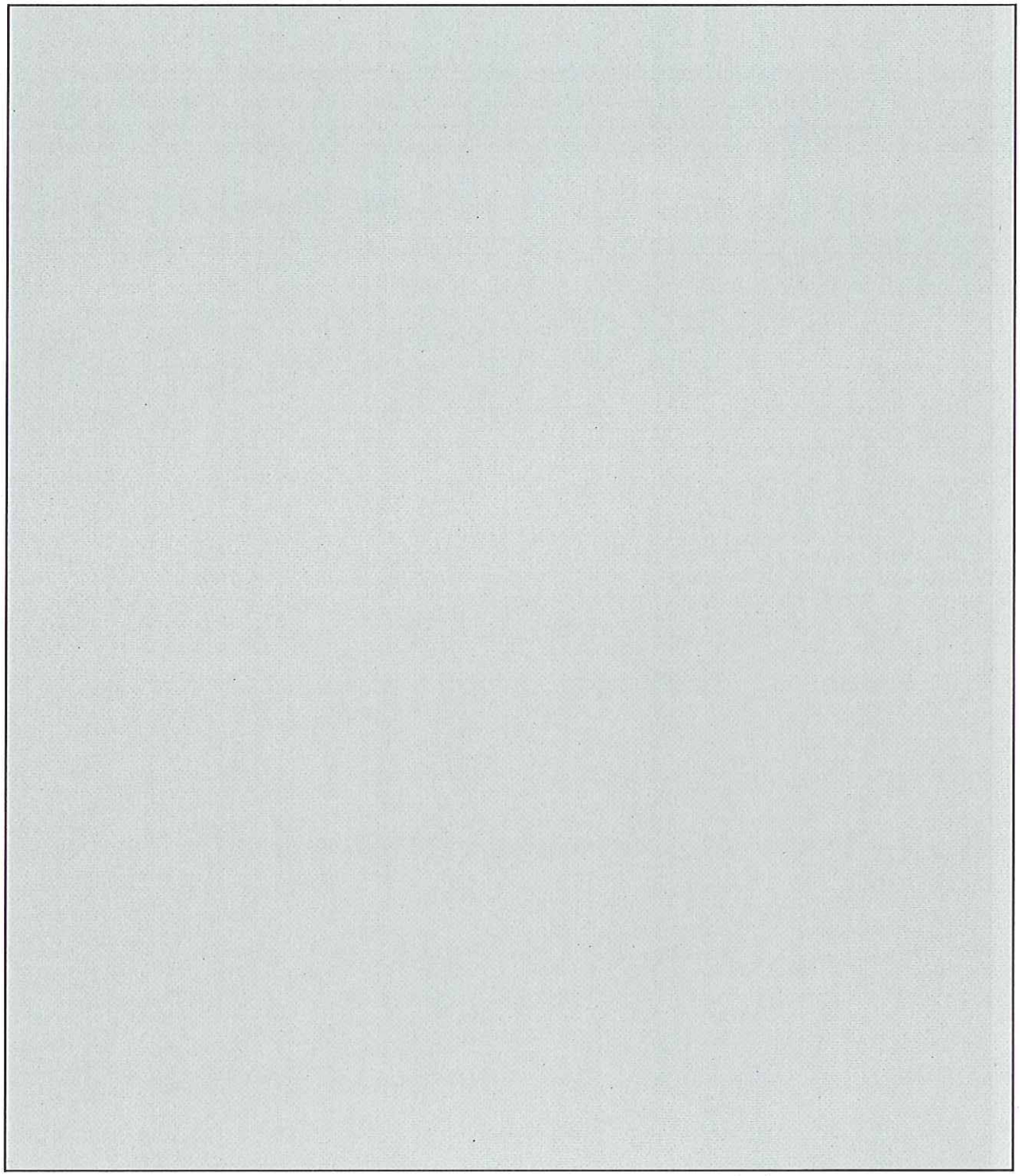
Table 3: Relevant planning criteria

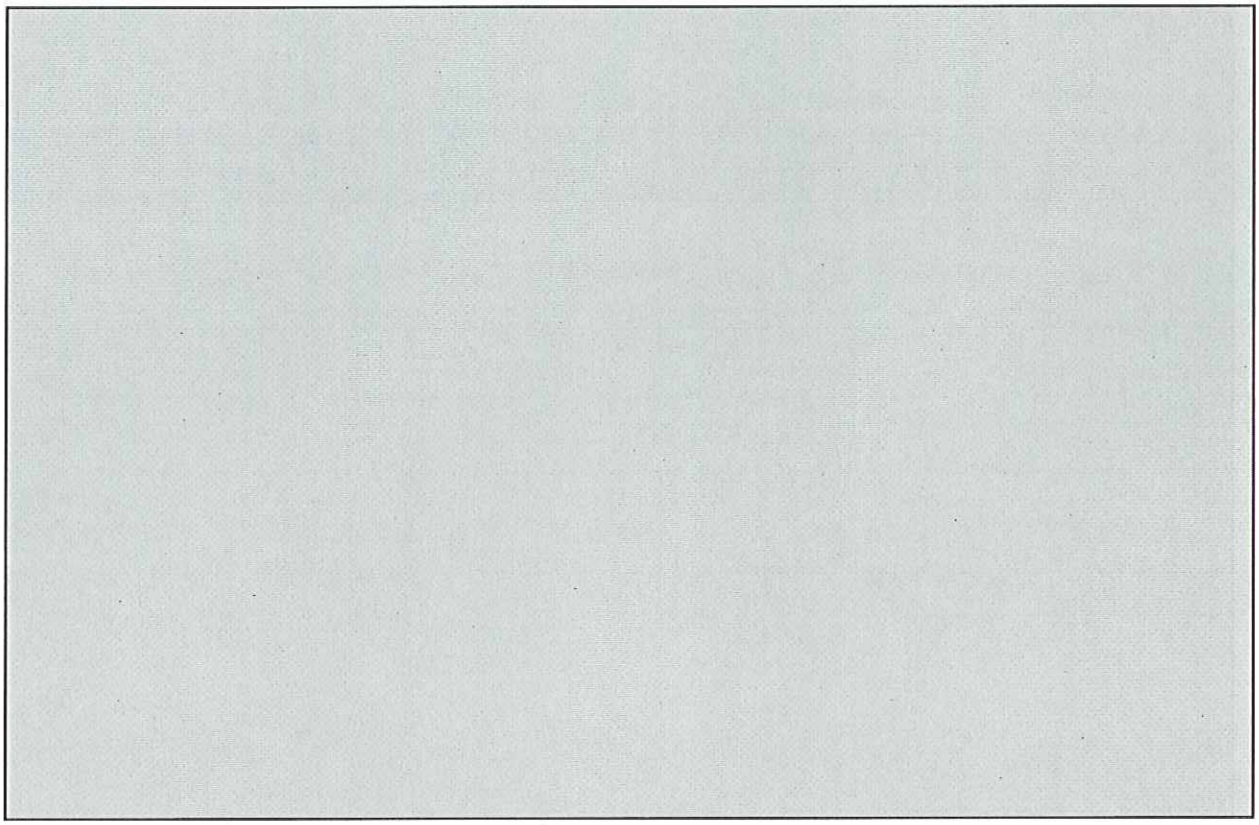
Network Planning	Criteria	Notes
Main Grid including Bulk Supply Transformation	10% PoE "Low", "Medium" and "High" forecasts	Sun Metals at authorised maximum demand
Regional Grid including Zone Supply Transformation	50% PoE "Low", "Medium" and "High" forecasts	
Hydro generation Capacity Factor	Barron Gorge = 15MW Kareeya = 3 x 21MW K5 = 6MW	Barron Gorge is often run 3hrs per day (10am to 1 pm) Not always on-line at peak times Synchronous Condensing Operation at Barron is possible but will require a Network Support Agreement
Wind Generation Capacity Factor	5% of installed capacity coincident with FNQ summer 50% or 10% PoE area peak	
Bagasse Generation Capacity Factor	Network Support Agreements are required to stockpile bagasse for summer generation	Assumed to be 50% of installed capacity at time of peak outside of mill combined operation by entering a network support agreement
N-1	All circuits within normal line ratings prior to contingency All transformers within normal cyclic ratings prior to contingency All circuits within incremental line ratings following N-1 All transformers within emergency cyclic rating following N-1	Network switching (of 275/132/110kV transformers, 132kV and/or 110kV network) allowed to land within the post-contingent ratings Load transfers by the DNSP may be considered but must be pre-contingent Generation can be constrained to meet these objectives (within the limits of installed capacity), but the cumulative market impact needs to be considered

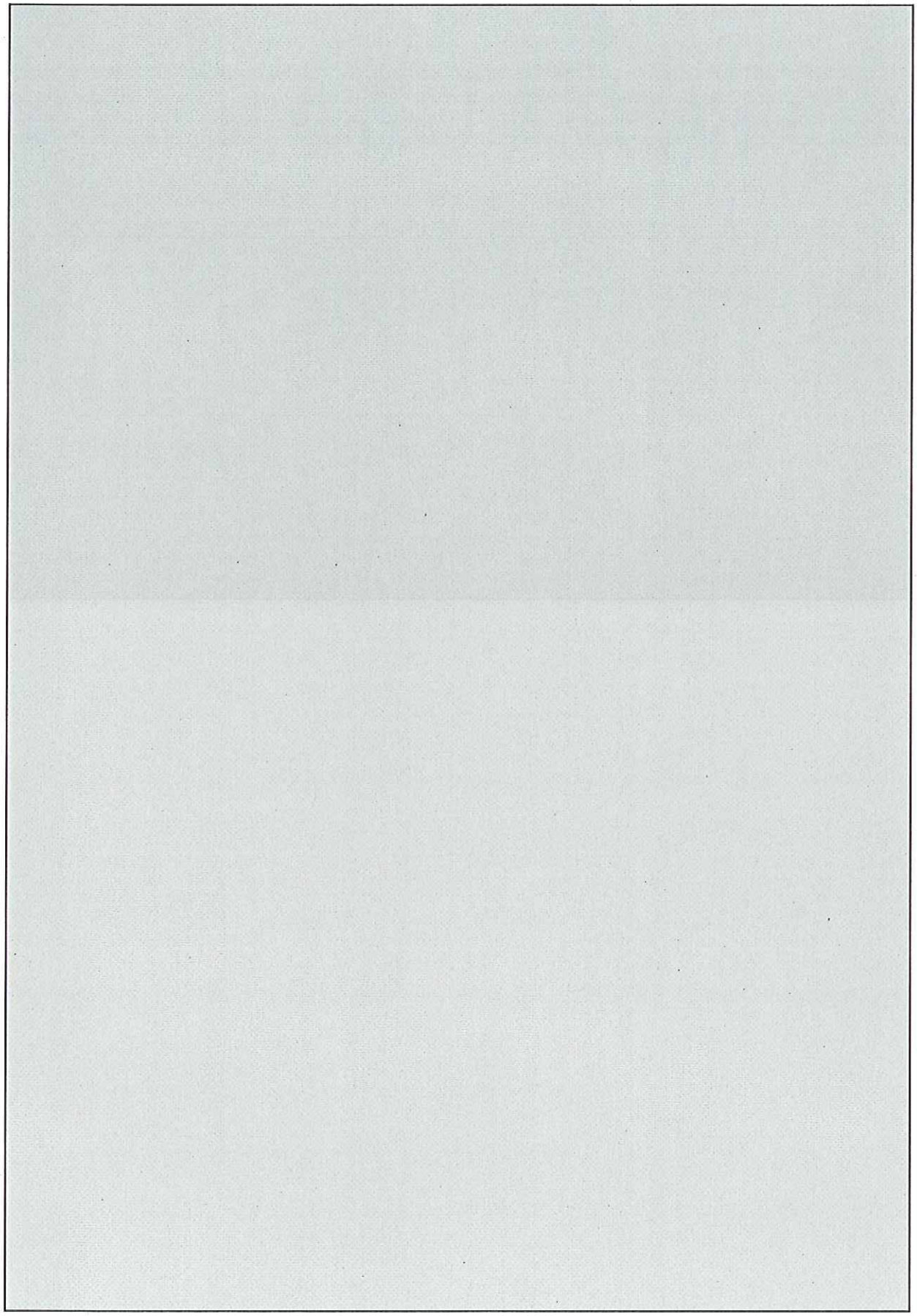


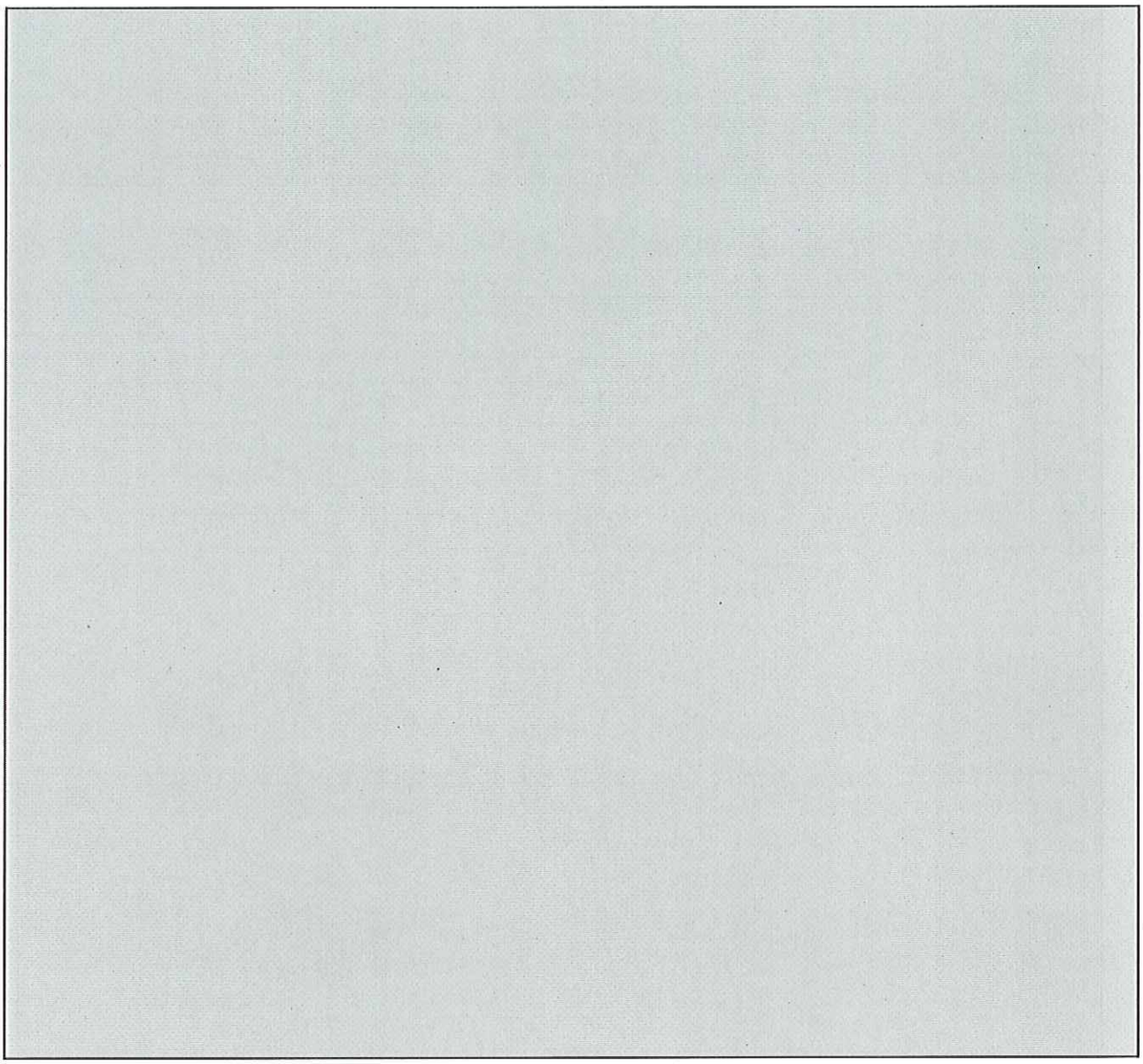


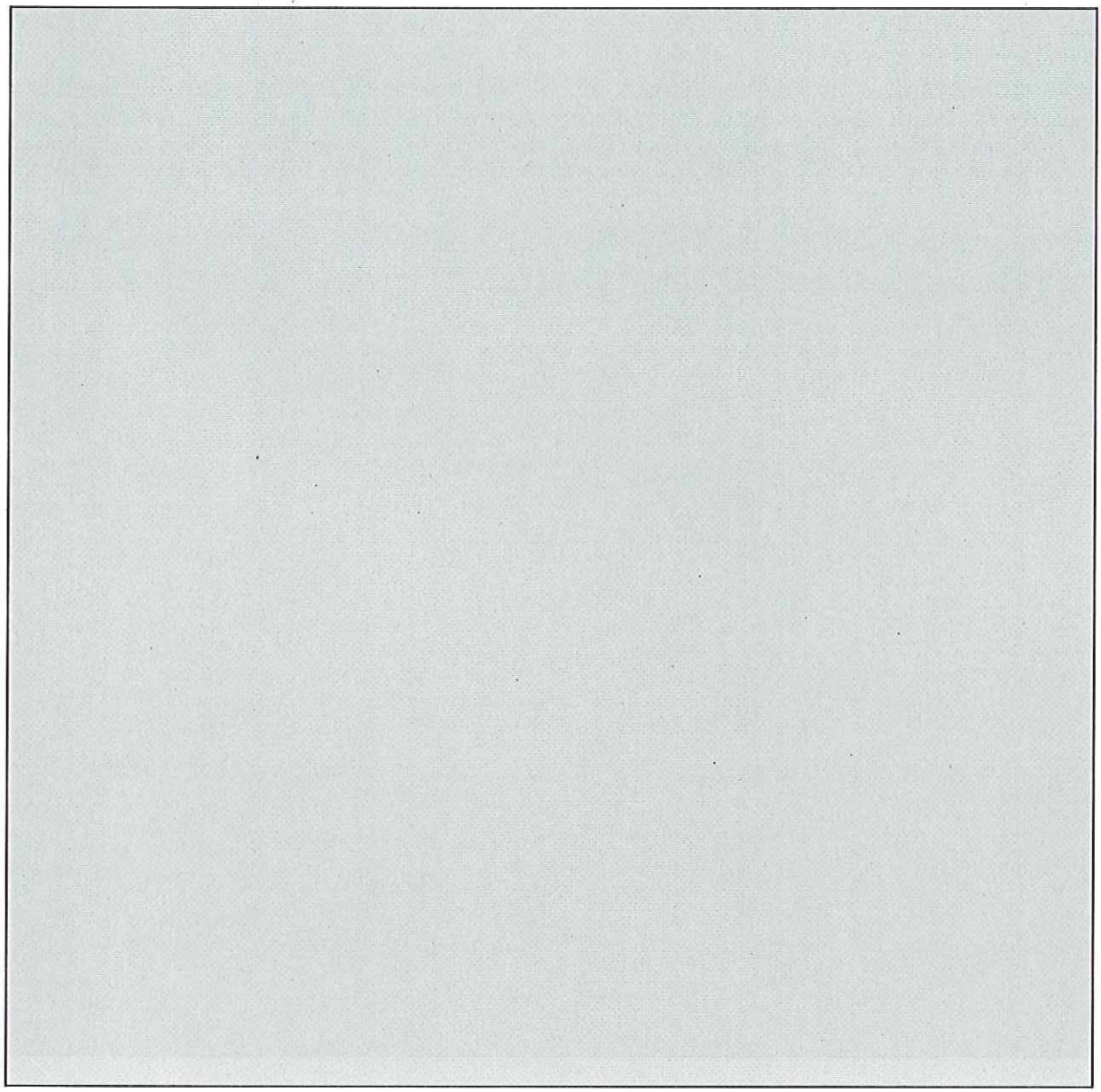


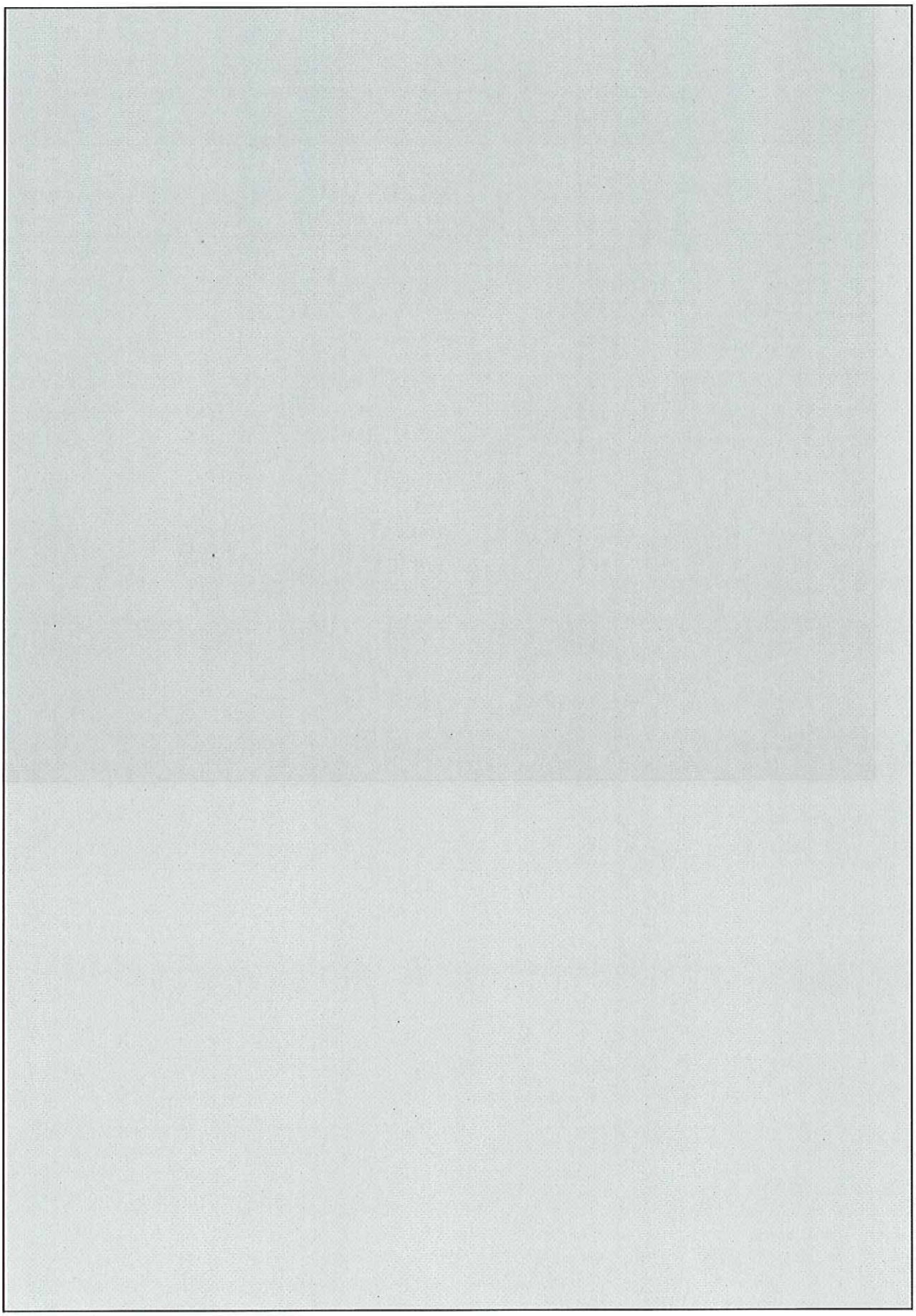


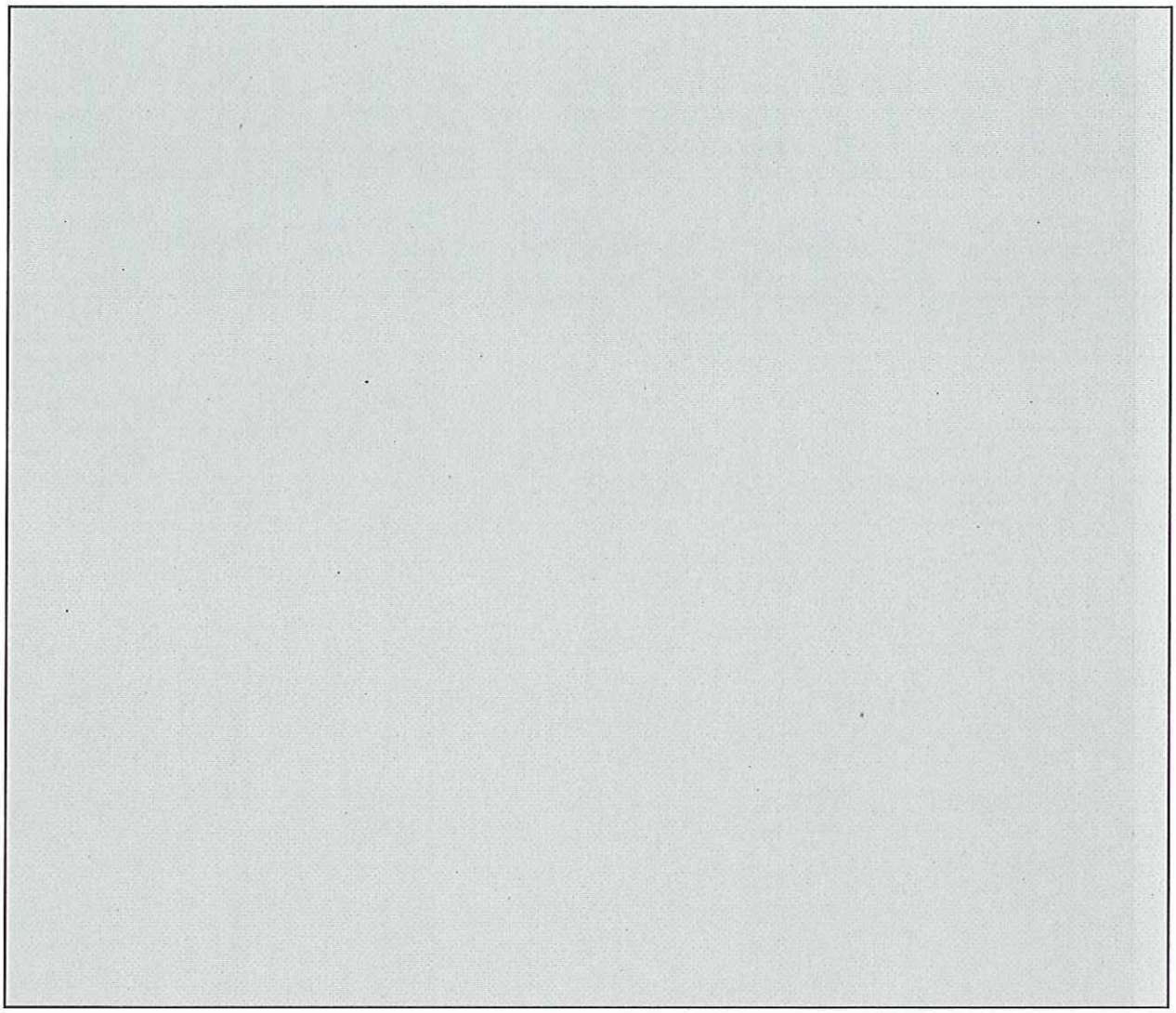


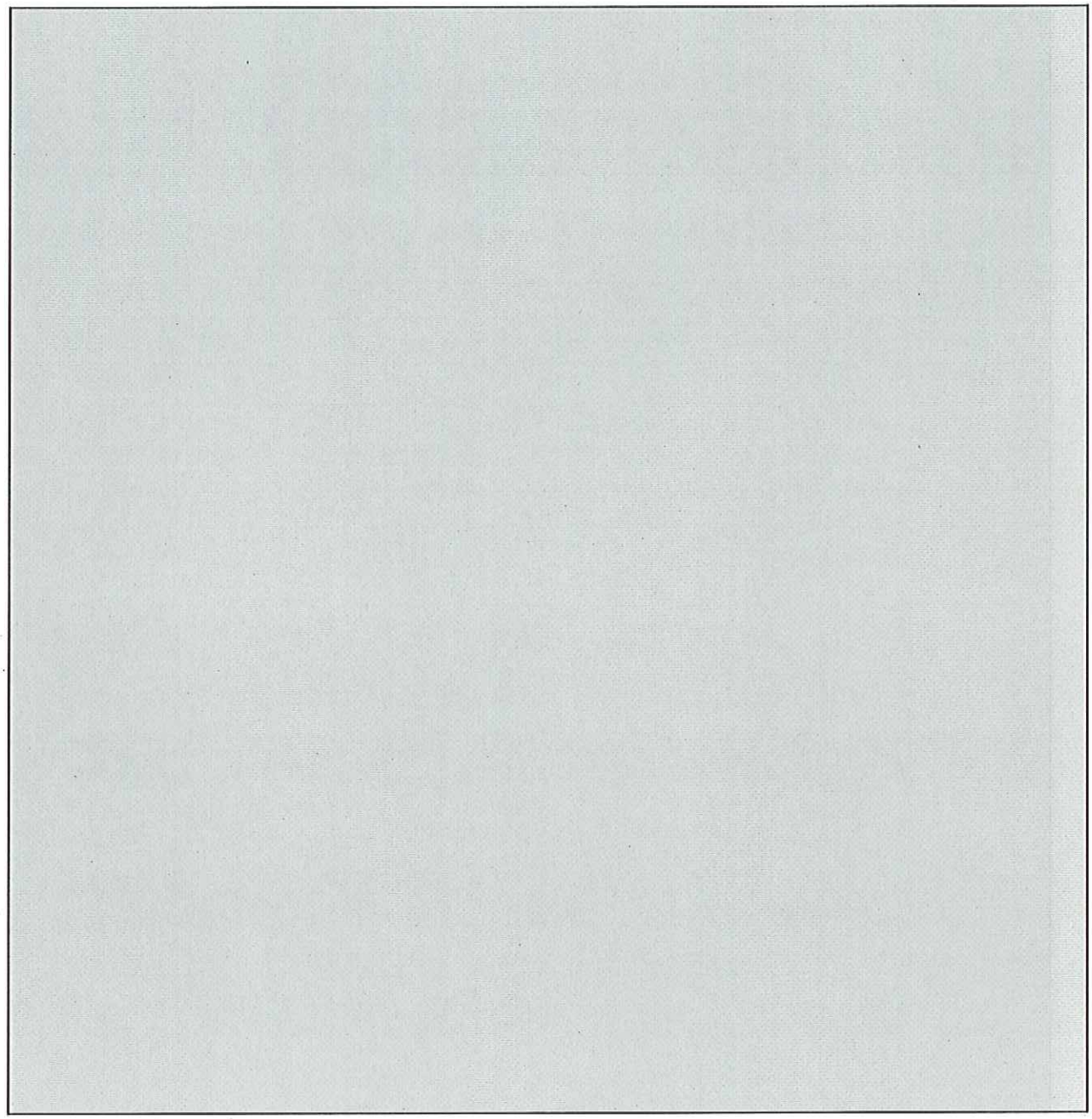


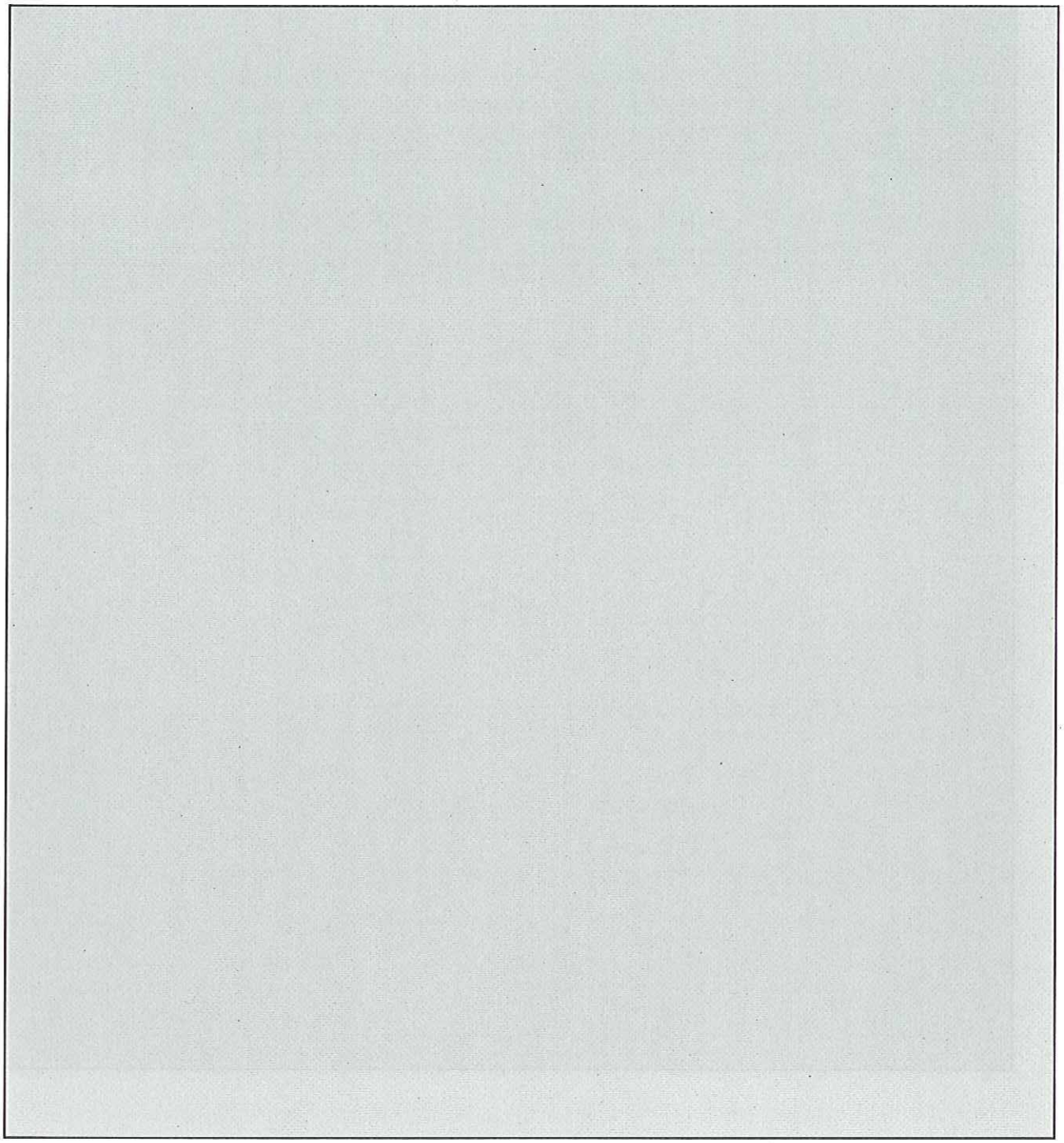


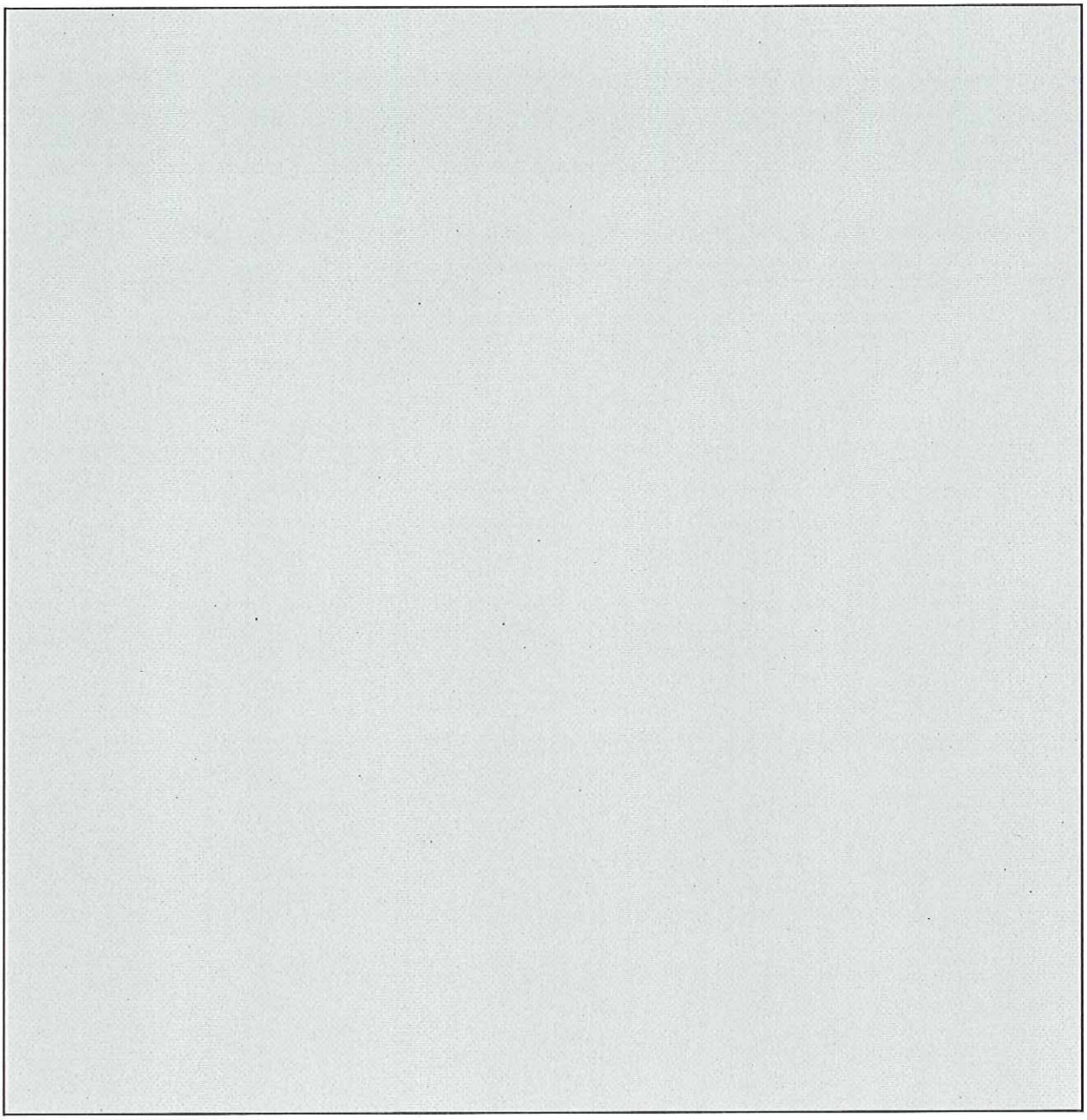










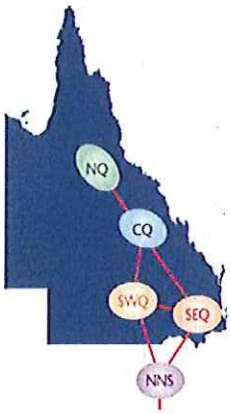


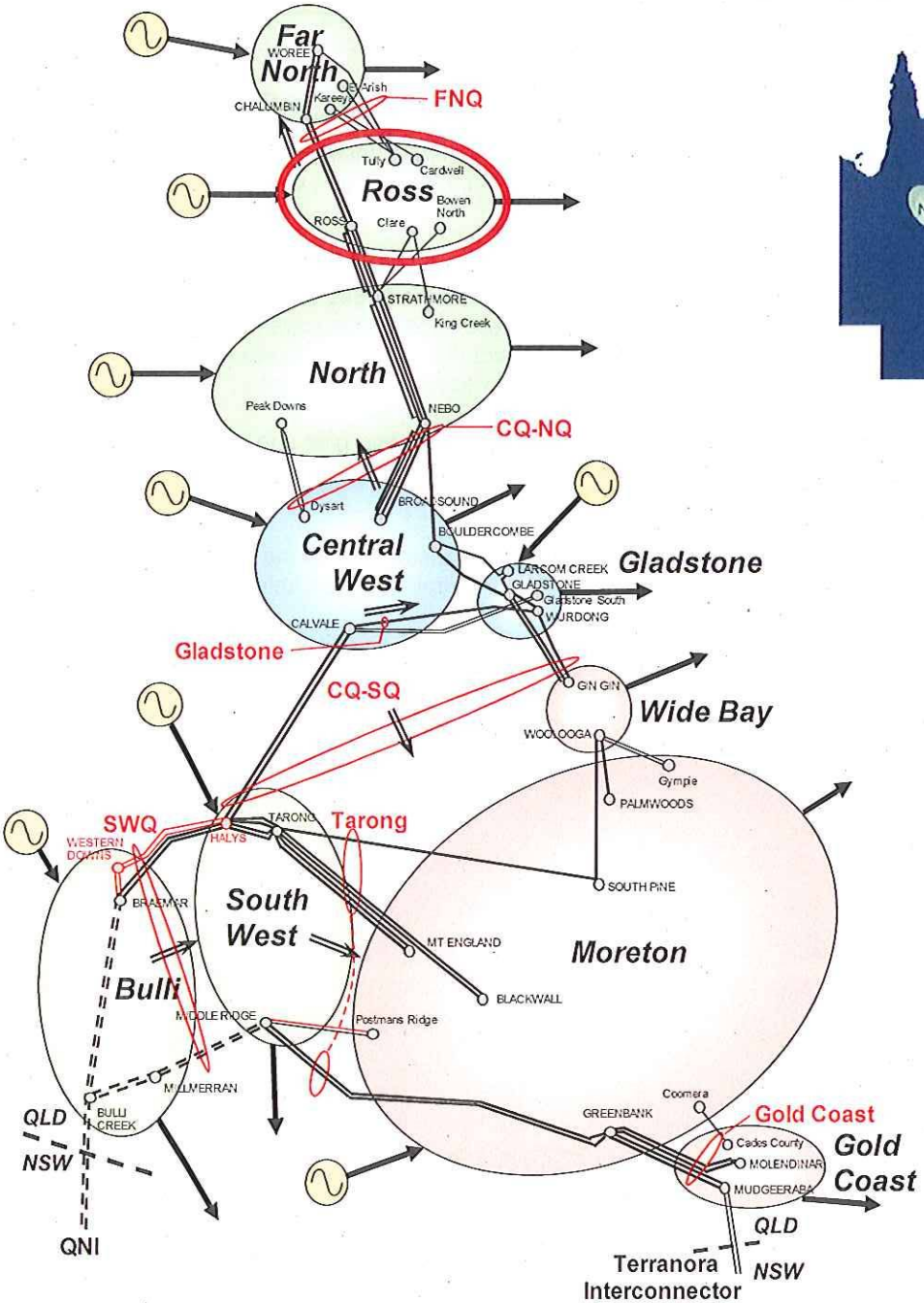
2010 GRID PLAN

VOLUME 2 SECTION 2

Network Development

Ross Area





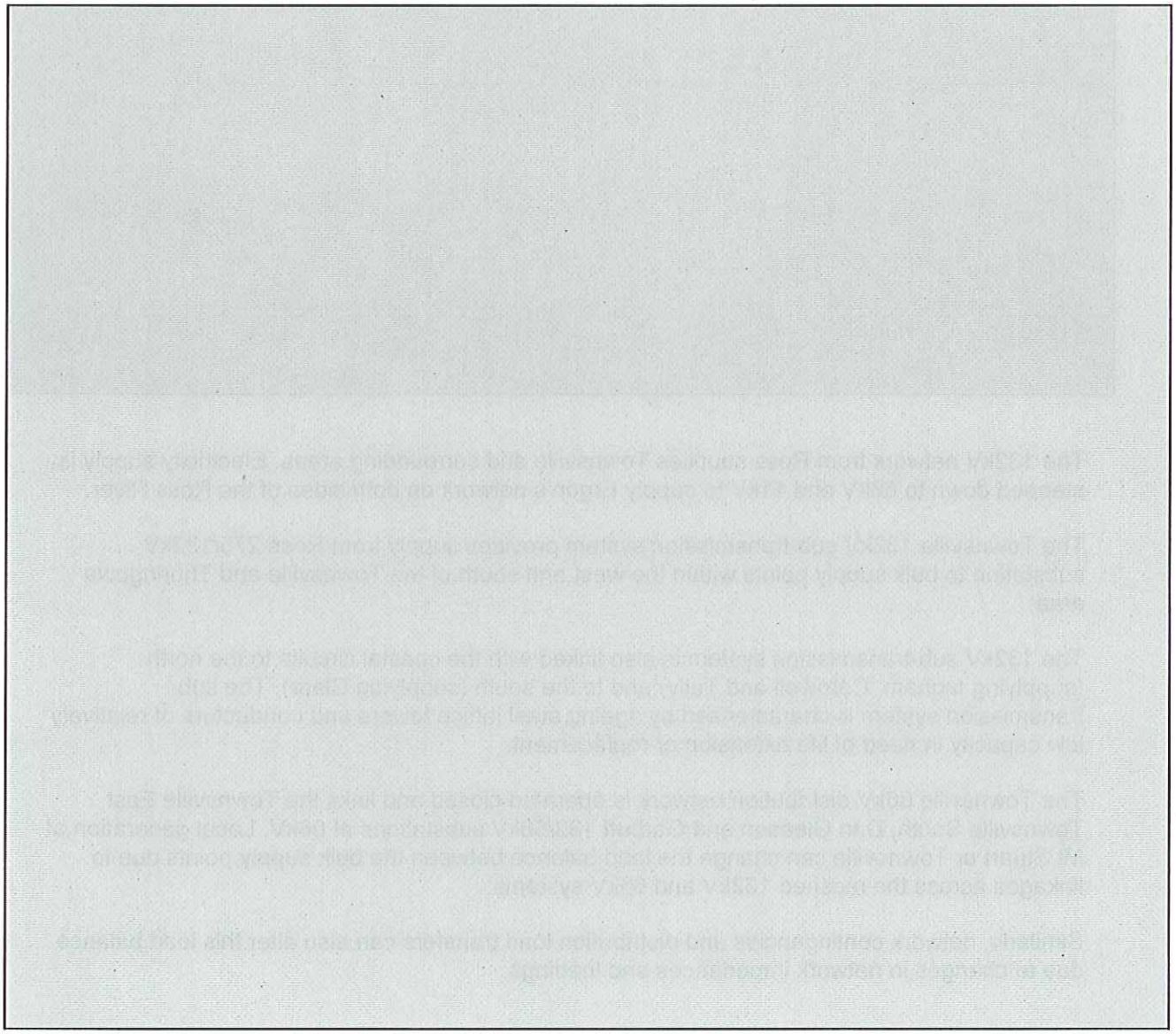
Ross Area

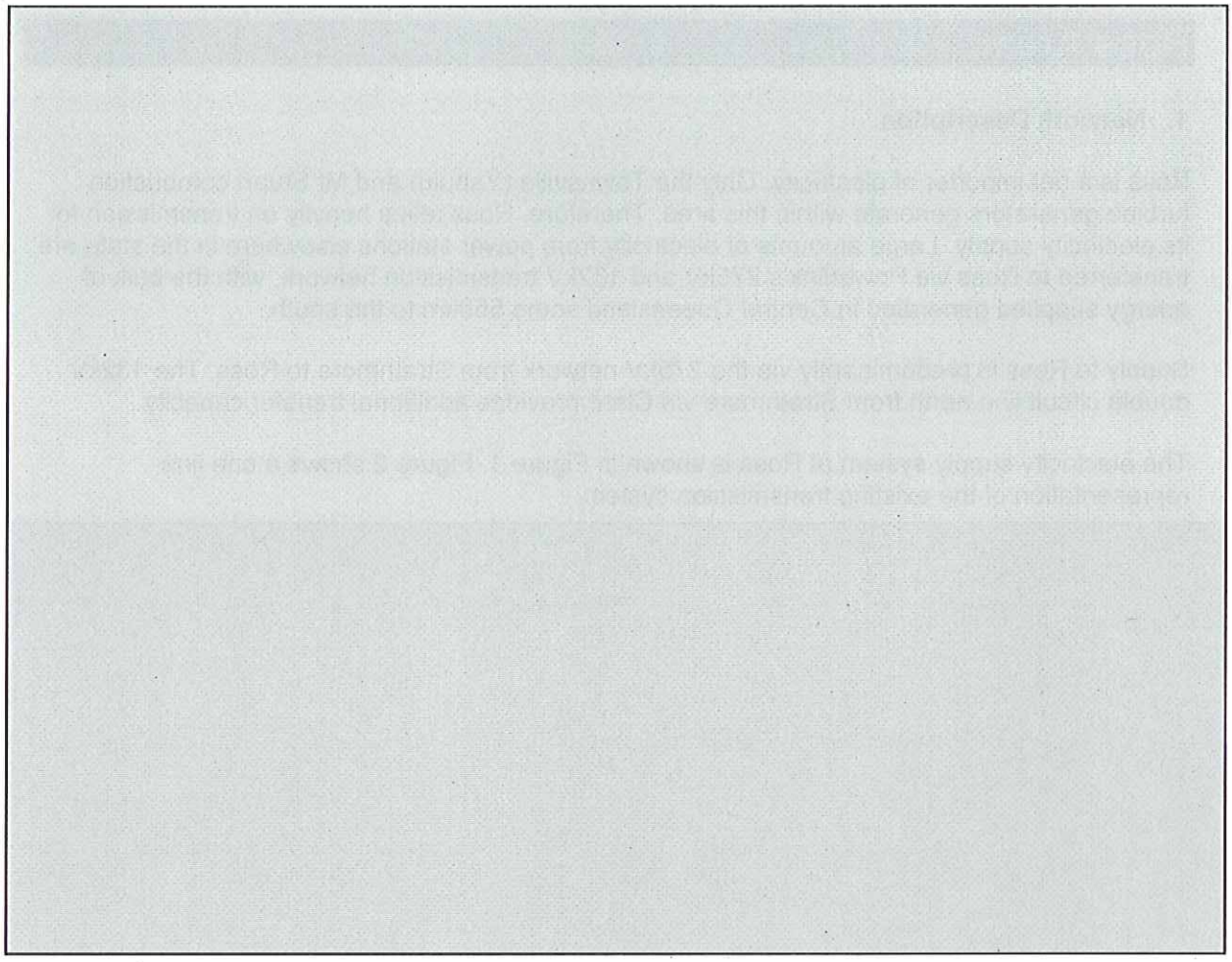
1. Network Description

Ross is a net importer of electricity. Only the Townsville (Yabulu) and Mt Stuart combustion turbine generators generate within this area. Therefore, Ross relies heavily on transmission for its electricity supply. Large amounts of electricity from power stations elsewhere in the state are transferred to Ross via Powerlink's 275kV and 132kV transmission network, with the bulk of energy supplied generated in Central Queensland some 550km to the south.

Supply to Ross is predominantly via the 275kV network from Strathmore to Ross. The 132kV double circuit line north from Strathmore via Clare provides additional transfer capacity.

The electricity supply system at Ross is shown in Figure 1. Figure 2 shows a one line representation of the existing transmission system.





The 132kV network from Ross supplies Townsville and surrounding areas. Electricity supply is stepped down to 66kV and 11kV to supply Ergon's network on both sides of the Ross River.

The Townsville 132kV sub-transmission system provides supply from Ross 275/132kV substation to bulk supply points within the west and south of the Townsville and Thuringowa area.

The 132kV sub-transmission system is also linked with the coastal circuits to the north (supplying Ingham, Cardwell and Tully) and to the south (supplying Clare). The sub-transmission system is characterised by ageing steel lattice towers and conductors of relatively low capacity in need of life extension or replacement.

The Townsville 66kV distribution network is operated closed and links the Townsville East, Townsville South, Dan Gleeson and Garbutt 132/66kV substations at 66kV. Local generation at Mt Stuart or Townsville can change the load balance between the bulk supply points due to linkages across the meshed 132kV and 66kV systems.

Similarly, network contingencies and distribution load transfers can also alter this load balance due to changes in network impedances and loadings.

2. Description of Committed Projects

The coastal 132kV transmission lines from Townsville to Edmonton (via Ingham, Cardwell, Tully, Kareeya and Innisfail) are approaching 55 years old and must be replaced due to deteriorated condition and reliability. The approved replacement strategy constructs a 275/132kV dual voltage transmission line between Townsville and Edmonton via Ingham, Cardwell, Tully and Innisfail. Both circuits are initially operated at 132kV. The Ross to Yabulu South section, and the establishment of Yabulu South 132kV Substation, was completed in 2009. This section has both circuits designed for 275kV, for upgrading from 132kV to supply a new bulk supply point at Yabulu South when 275/132kV transformation limits emerge at Ross.

The condition, age and capacity of the 132kV circuits supplying Garbutt are reaching limits. High growth scenarios will exceed the capacity of the 132/66kV transformers at Garbutt. Projects to addresses these limitations are underway.

Table 1 lists the committed projects assumed in the Grid Plan for this zone.

Table 1: Committed projects assumed in the 2010 Grid Plan in Ross

Project ID	Project Description	Expected Commissioning
CP.00881	Ingham – Yabulu South 132kV Line Replacement	Summer 2011/12
CP.00880	Tully – Cardwell 132kV Line Replacement	Summer 2012/13
CP.01453	Cardwell Transformers Replacement	Winter 2013
CP.00882	Ingham – Cardwell 132kV Line Replacement	Summer 2013/14

3. Existing Generation Capacity

Power generated at Mt Stuart depends on prevailing market conditions. Conversely, Yabulu operation is largely base load on weekdays only. Yabulu is a 235MW combined cycle plant, generating into the Powerlink 132kV and the Ergon 66kV networks. The total capacity of Mt Stuart is 387MW.

The Mt Stuart units are powered by highly priced jet grade aviation fuel. Powerlink has entered into a network support agreement with Origin Energy (owner of Mt Stuart) to manage congestion on the CQNQ intraconnector. Although, highly priced the plant is highly flexible providing 24x7 availability and only requiring payment for their usage (no fixed costs)[1].

Townsville power station is powered by coal seam methane sourced from the Moranbah to Townsville pipeline. The Townsville power station generally runs base load throughout the week and part of the weekend (i.e. Saturday morning). Its historic capacity factor is ~70%.

The CSR Invicta sugar mill is a non-scheduled market generator with net export capacity of around 40MW. The CSR Pioneer Mill is an embedded non-scheduled generating plant with net export capacity of 45MW, and was recently commissioned in 2005.

Both mills traditionally operate during the July to November sugar crushing season. From 2005 to 2010, Powerlink entered into network support arrangements with CSR (and other local generators) to ensure sufficient electricity supplies at times of peak demand. This led to bagasse being transferred from less efficient sugar mills, such as Invicta, and stored at Pioneer Mill extending its operation over the peak summer period. The agreement was discontinued after the commissioning of the Strathmore - Ross 275kV double circuit in late 2010.

[1] Based on the current network support agreement (NSA).

In addition, there are also a number of small generators embedded in the distribution network that effectively reduce the demand on the transmission system when they are generating. These include seasonal output from cogeneration facilities at several sugar mills. This output is already accounted within the demand forecast.

4. Generation Scenarios

Generation scenarios nominated within this area may impact transmission developments in the Ross zone.

ROAM considered that sufficient incentives could exist for sugar mills to invest in upgrading on-site storage facilities for bagasse and generation infrastructure, and this could occur to offset summer peak demand through network support agreements. Nonetheless, the development of these mills would occur over a number of years and be dependent on the strength of the sugar industry across the next decade.

Similarly, the advent of additional wind generation could also occur under a carbon tax future and due to renewable incentive schemes.

Should these developments occur, there may be an impact on the required transmission needs in the area. These impacts have been assessed when developing the transmission plans for each scenario. Table 2 lists potential new entrants (in addition to existing plant) as identified by ROAM.

Table 2: ROAM new entrants in Ross

Generator	Capacity (MW)	Assumed Point of Connection	Cumulative Probability of Proceeding by 2021/22
Victoria Mill	20	Ingham South 132kV	100%
Burdekin Hydro	30	Strathmore 132kV	26%
Tully Mill	70	Tully 132kV	45%
Bowen Wind	100	Bowen North 132kV	77%

5. Dispatchable Loads

The Townsville area incorporates the Sun Metals zinc smelter (~140MW) connected to the Townsville South substation at 132kV. The smelter incorporates a demand side management control system which allows the plant to ramp down to minimum operating levels of around 25MW during times of high pool price. However, recent history suggests that the price of zinc has increased such that electricity demand has been mostly constant and nearing capacity for long periods of time.

6. Description of Transmission Limitations

Main Grid

The Ross area transmission system is characterised by long transmission distances, large electrical angles, voltage sensitivity and significant demand for reactive power for changes in real power transmitted. As a result, maximum power transfer is limited by the occurrence of unstable voltage levels following critical contingencies.

Maximum power transfer across the Central Queensland to North Queensland (CQ-NQ) grid section is set by transient stability, voltage stability or thermal plant rating following a transmission or generation contingency.

Following the commissioning of the 275kV transmission line between Strathmore and Ross substations in late 2010 adequate power transfer capability exists into the Ross area to maintain reliability.

The advent of local generation (connected into the downstream 132kV network) may defer the need for augmentation. However, industrial load developments, such as an expansion of the zinc refinery (e.g. Sun Metals Stage 2) or the Stuart North industrial area, may advance the need for additional 275/132kV transformer capability.

The additional 275/132kV transformer capability may take one of the following forms:

- Installation of an additional Ross 275/132kV transformer;
- Replacement of the existing Ross 200MVA 275/132kV transformers with 375MVA units;
- Establishment of Townsville South 275/132kV substation and Ross to Townsville South 275kV transmission line; or
- Establishment of Yabulu South 275/132kV substation and upgrade of the existing Ross to Yabulu circuit to 275kV operation.

The critical Main Grid contingency is an outage of a 275/132kV transformer at Ross.

Regional Grid

Joint planning studies with Ergon Energy indicate that additional augmentations, mainly in the form of additional 132/66kV transformation capacity to the Townsville area and additional connection bays, will be required over the next five years.

The critical Regional Grid contingencies include:

- 132kV circuits to Alan Sherriff;
- 132kV circuits to Garbutt;
- 132kV circuits to Townsville South;
- 132kV circuits to Bowen North; and
- 132/66kV transformer at Garbutt.

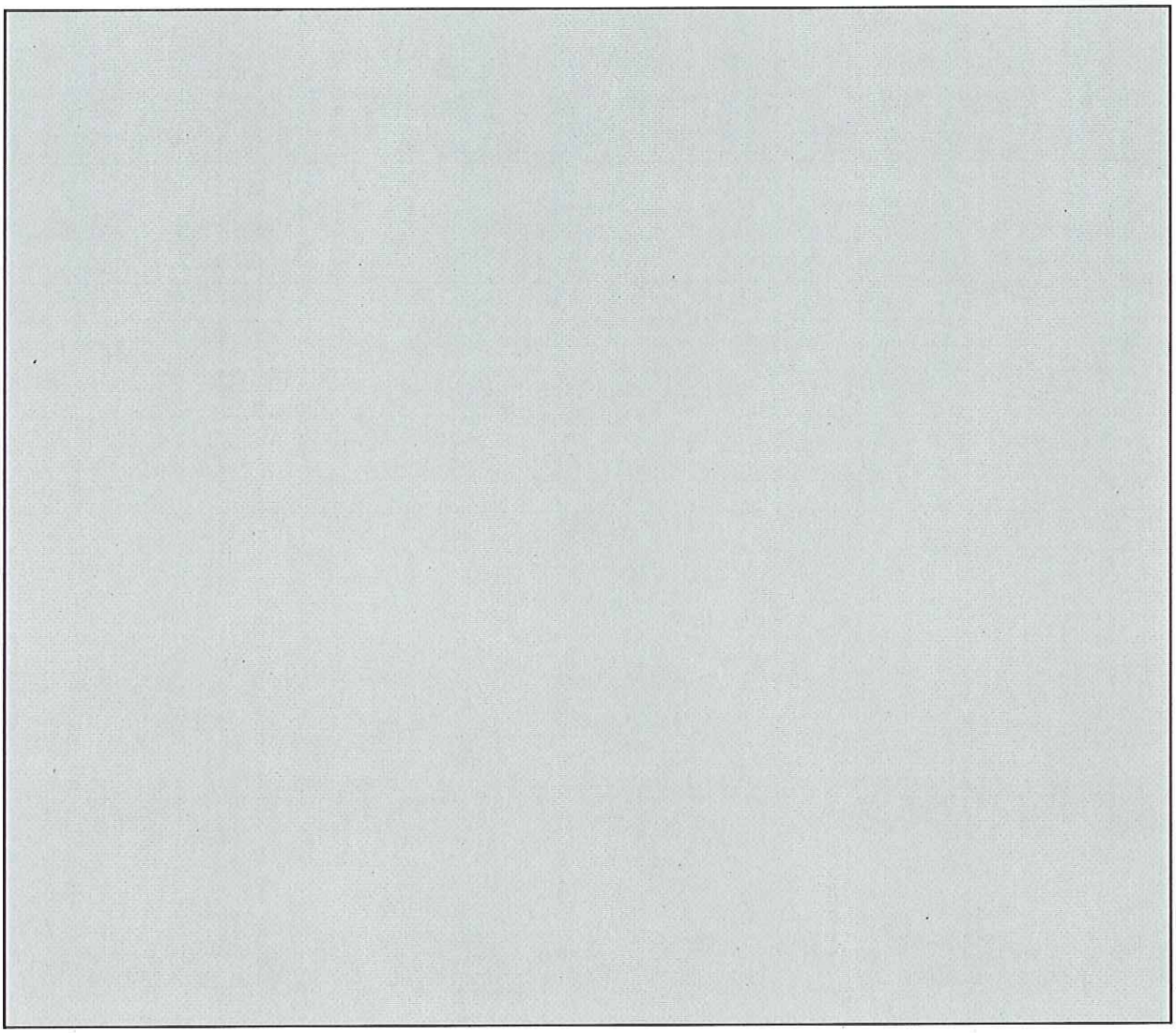
Powerlink is also aware of additional load associated with the Abbot Point State Development Area, however due to a lack of certainty around these developments this load has not been included in Powerlink's demand forecast. Additional load from this development would cause limitations on the 132kV network to Bowen North, and Powerlink has included a contingent project to address these limitations in accordance with the requirements of the Rules.

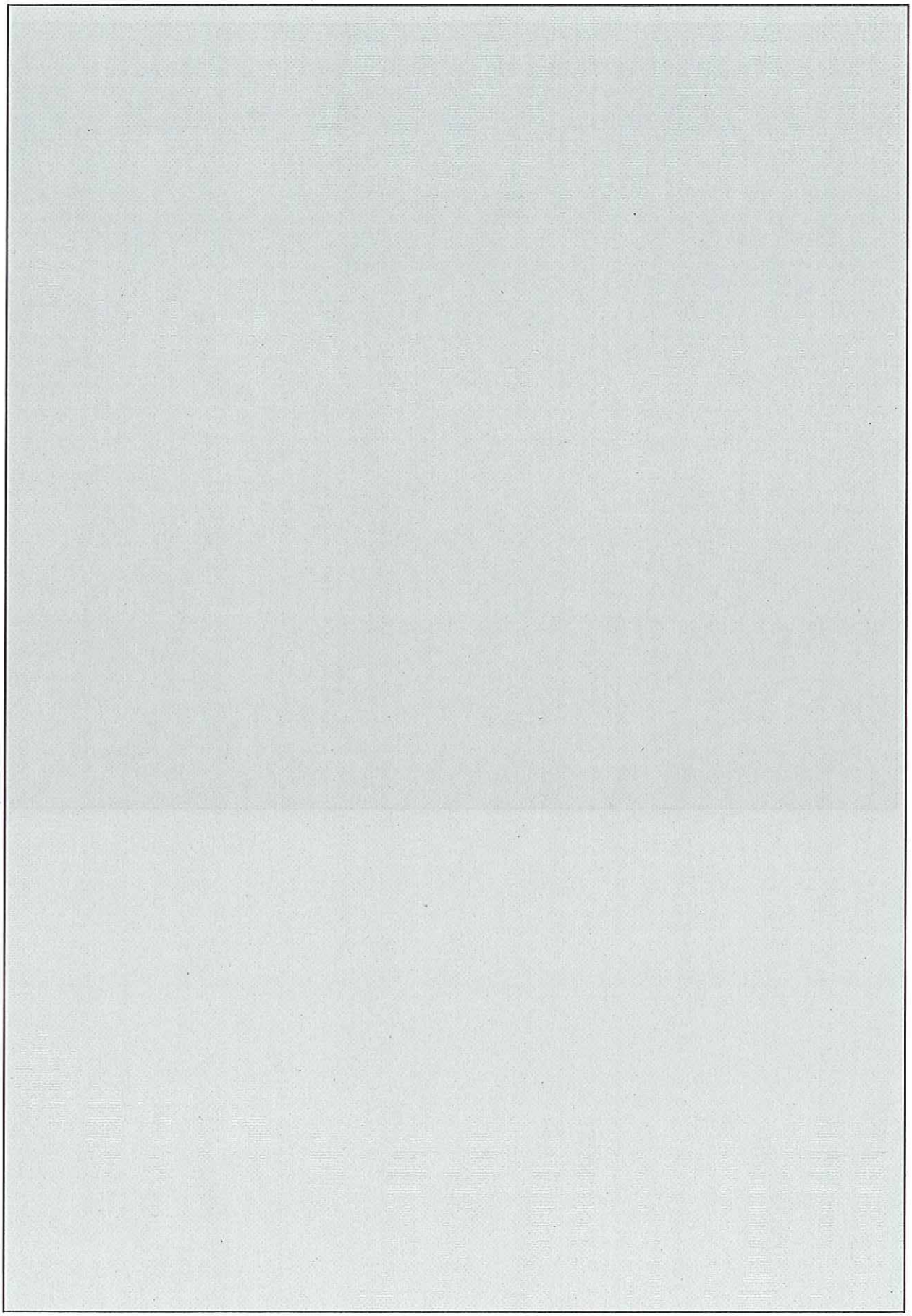
7. Relevant Planning Criteria

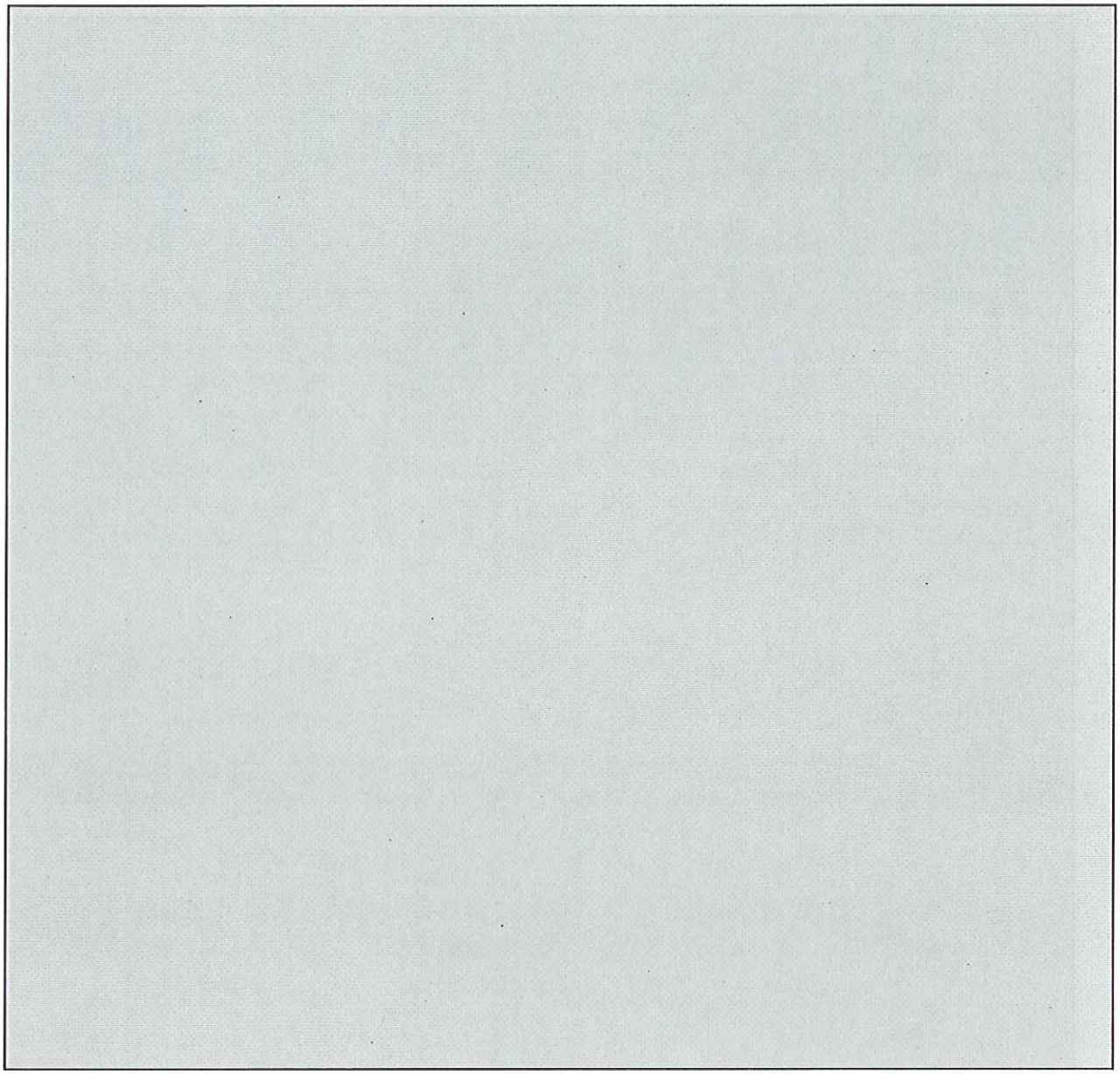
Powerlink's planning criteria, as it applies to this section, is summarised in.Table 3.

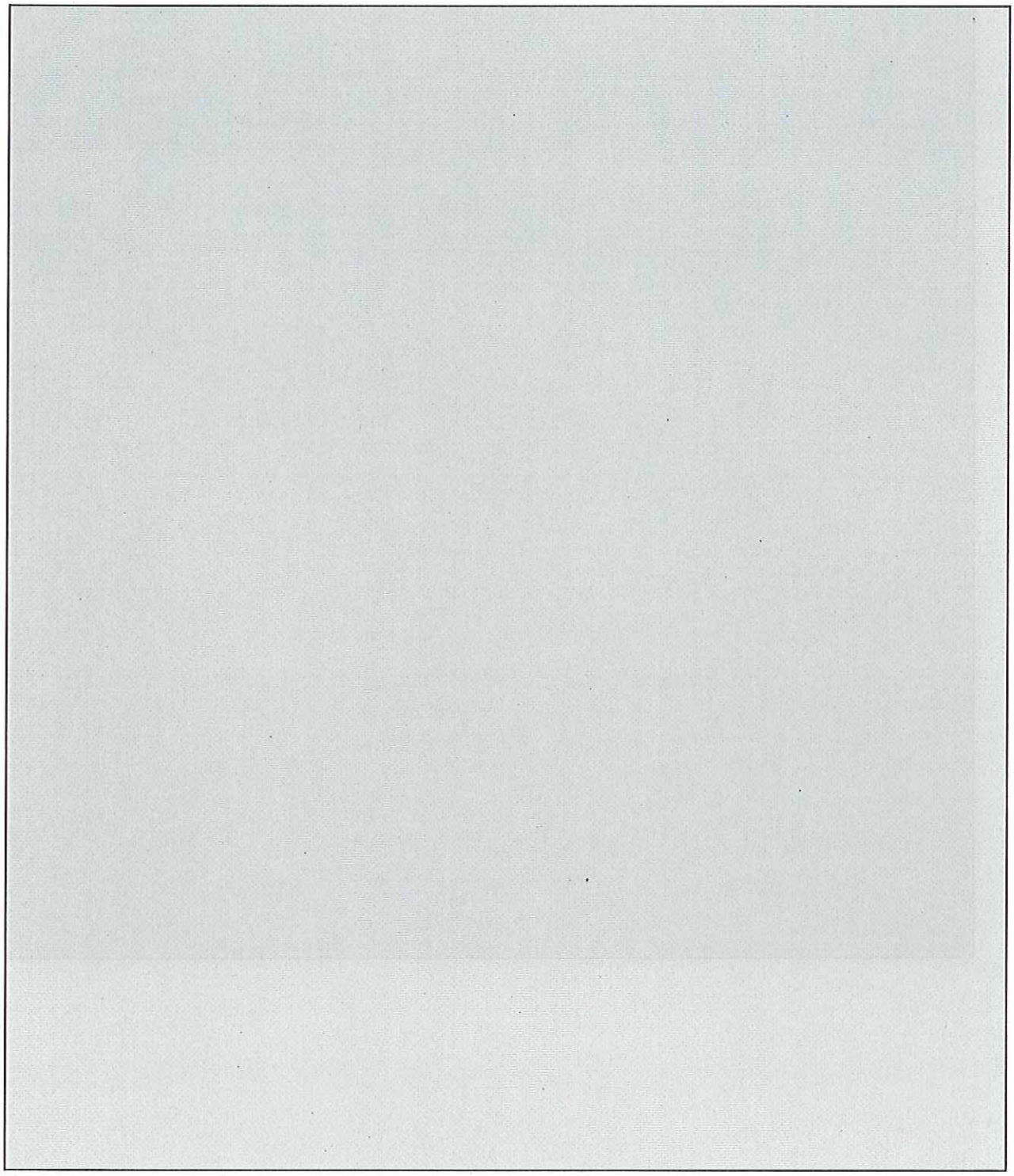
Table 3: Relevant planning criteria

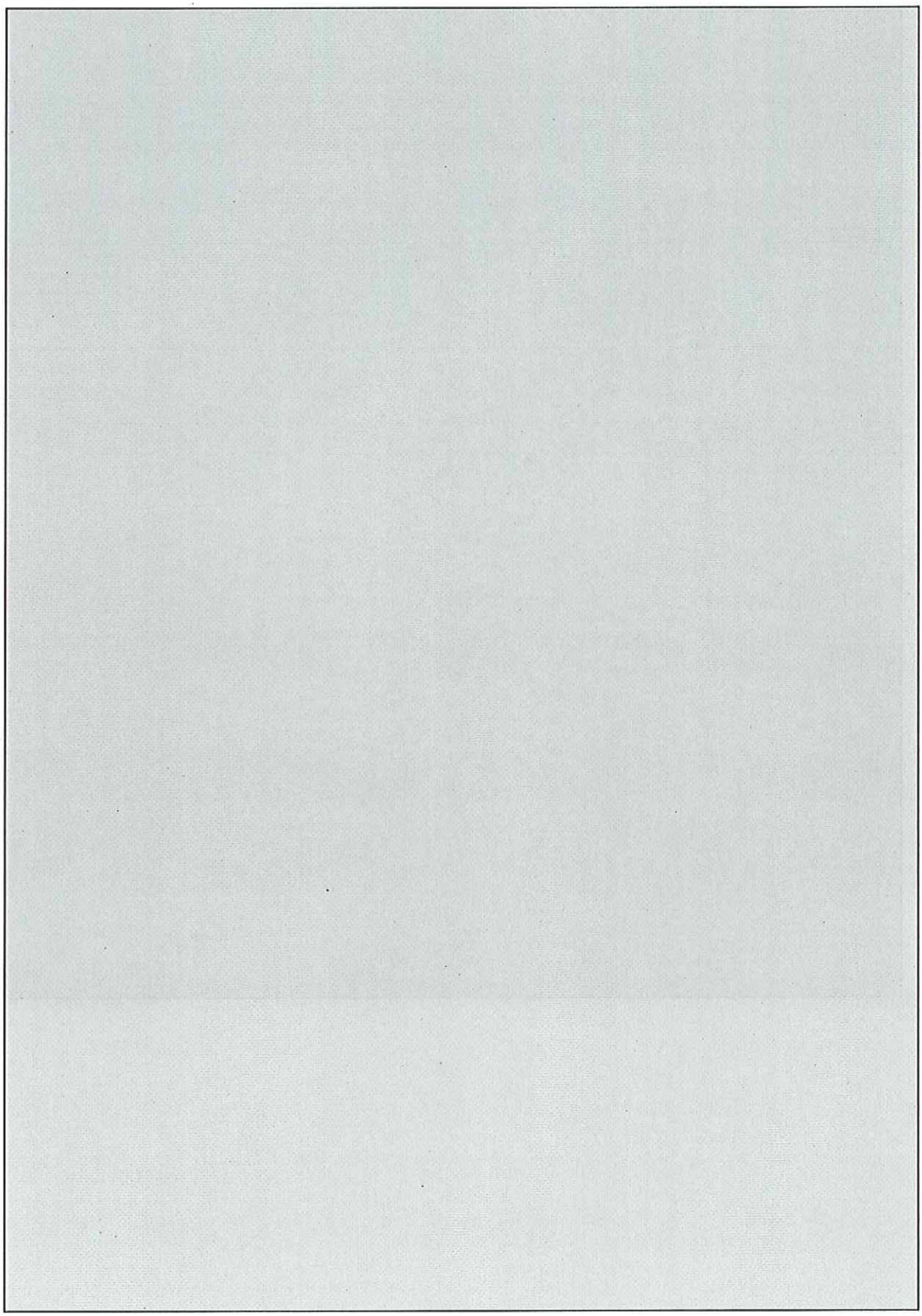
Network Planning	Criteria	Notes
Main Grid including Bulk Supply Transformation	10% PoE "Low", "Medium" and "High" forecasts	Sun Metals at authorised maximum demand
Regional Grid including Zone Supply Transformation	50% PoE "Low", "Medium" and "High" forecasts	
Hydro generation Capacity Factor	Barron Gorge = 15MW Kareeya = 3x21MW K5 = 6MW	Barron Gorge is often run 3hrs per day (10am to 1 pm) Not always on-line at peak times
Wind Generation Capacity Factor	5% of installed capacity coincident with NQ summer 50% or 10% PoE area peak	
Bagasse Generation Capacity Factor	Network Support Agreements are required to stockpile bagasse for summer generation	Assumed to be 50% of installed capacity at time of peak outside of mill combined operation by entering a network support agreement
N-1	All circuits within normal line ratings prior to contingency All transformers within normal cyclic ratings prior to contingency All circuits within incremental line ratings following N-1 All transformers within emergency cyclic rating following N-1	Network switching (of 275/132/110kV transformers, 132kV and/or 110kV network) allowed to land within the post-contingent ratings Load transfers by the DNSP may be considered but must be pre-contingent Generation can be constrained to meet these objectives (within the limits of installed capacity), but the cumulative market impact needs to be considered

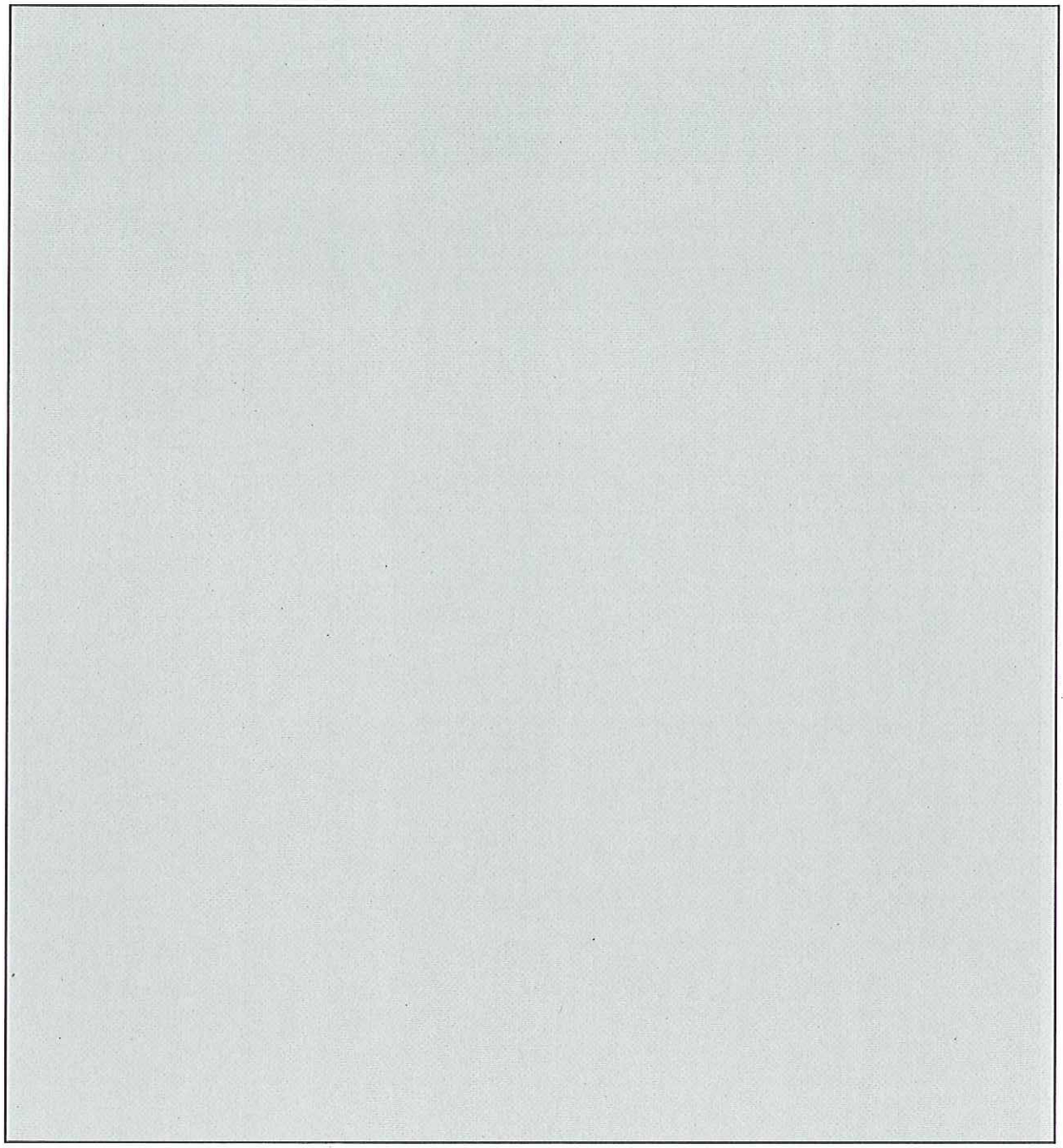


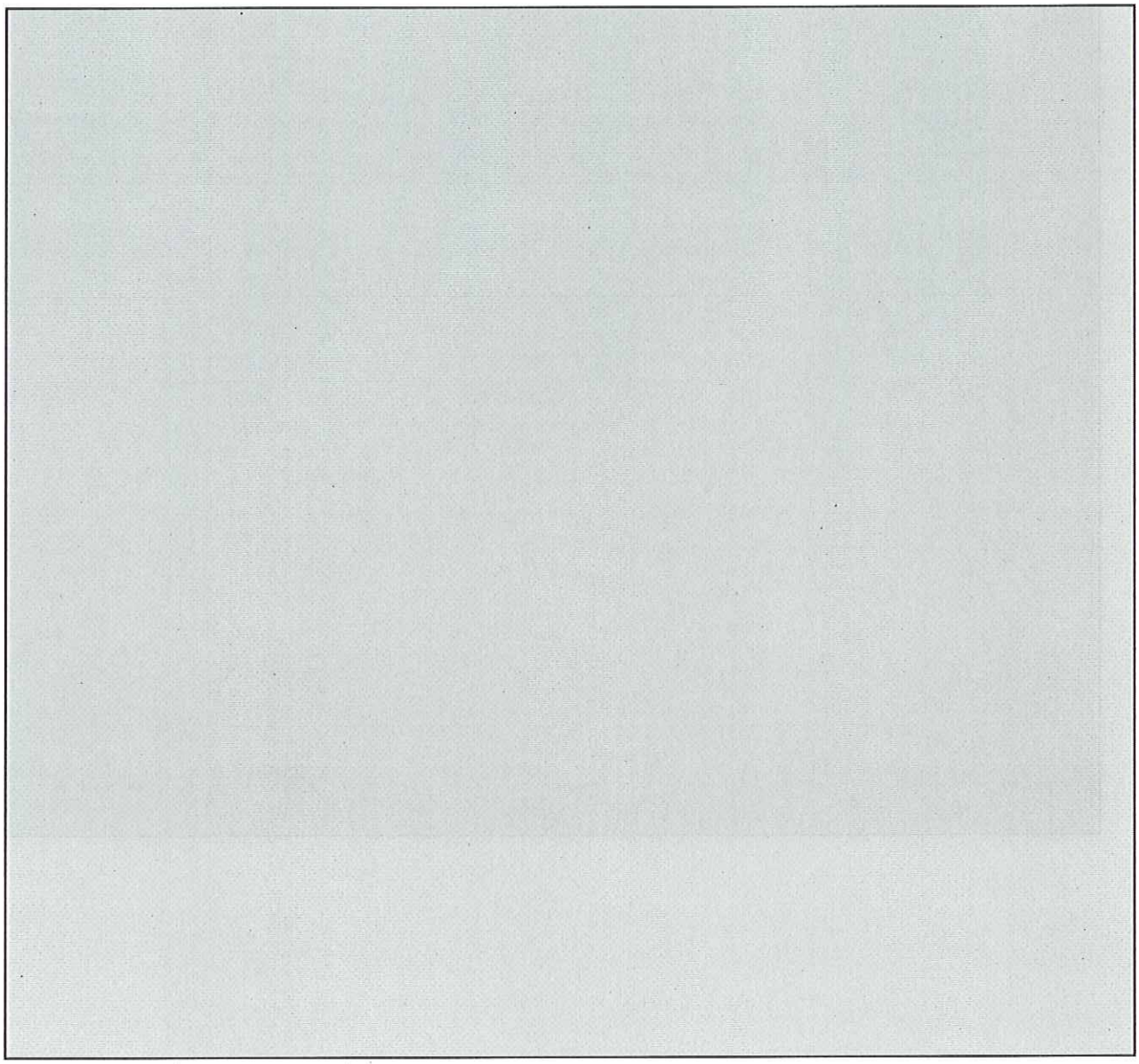


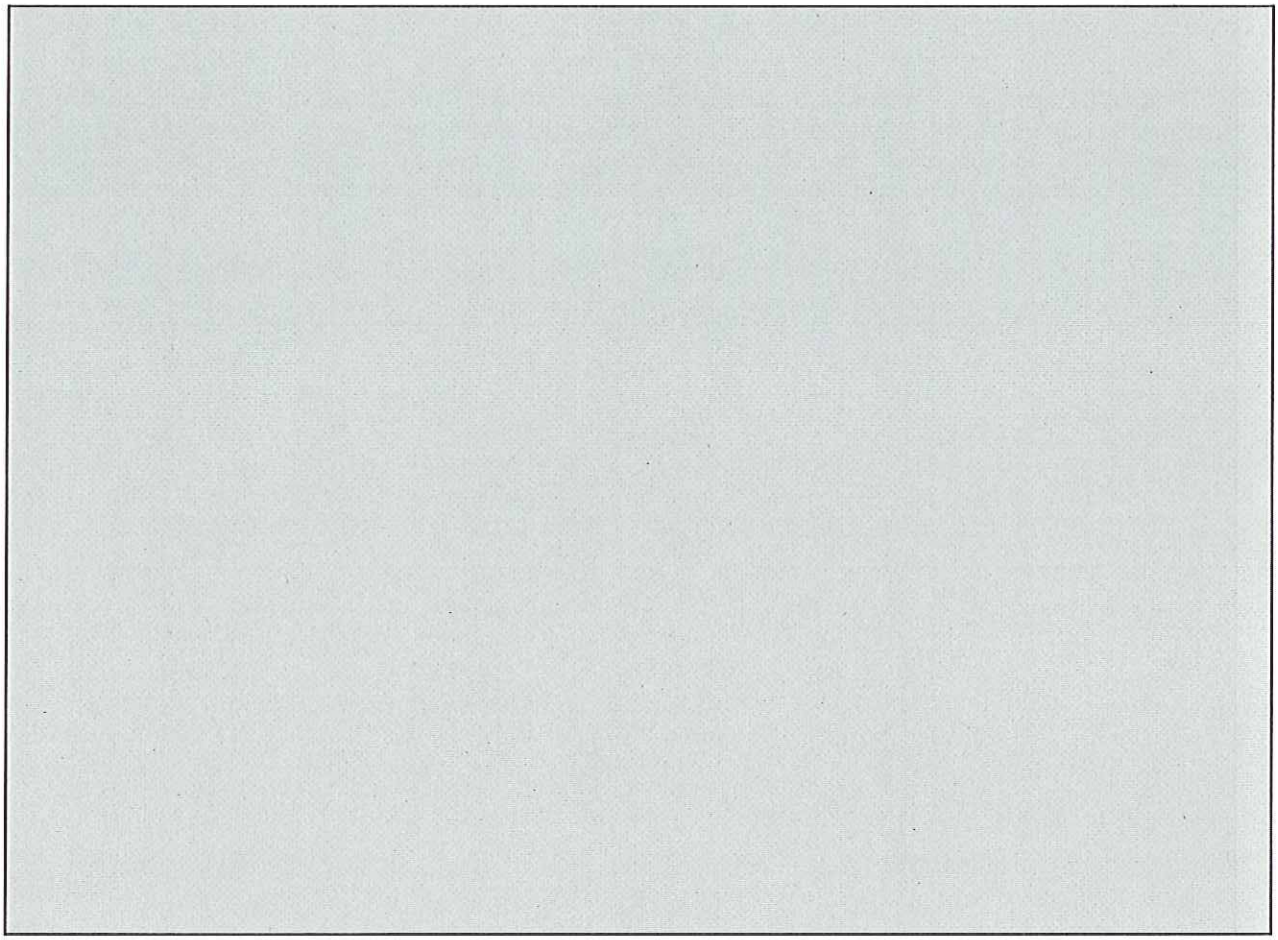


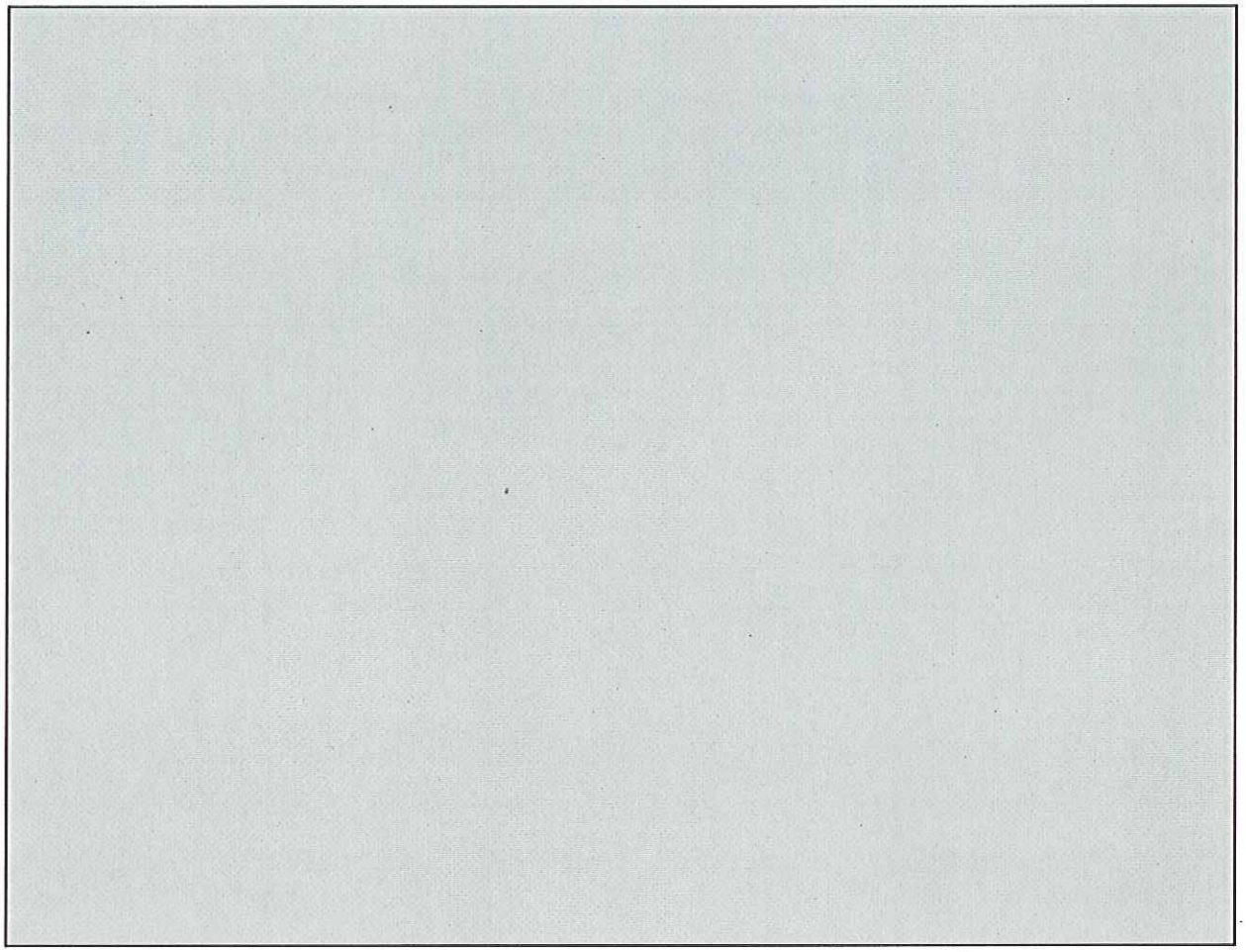


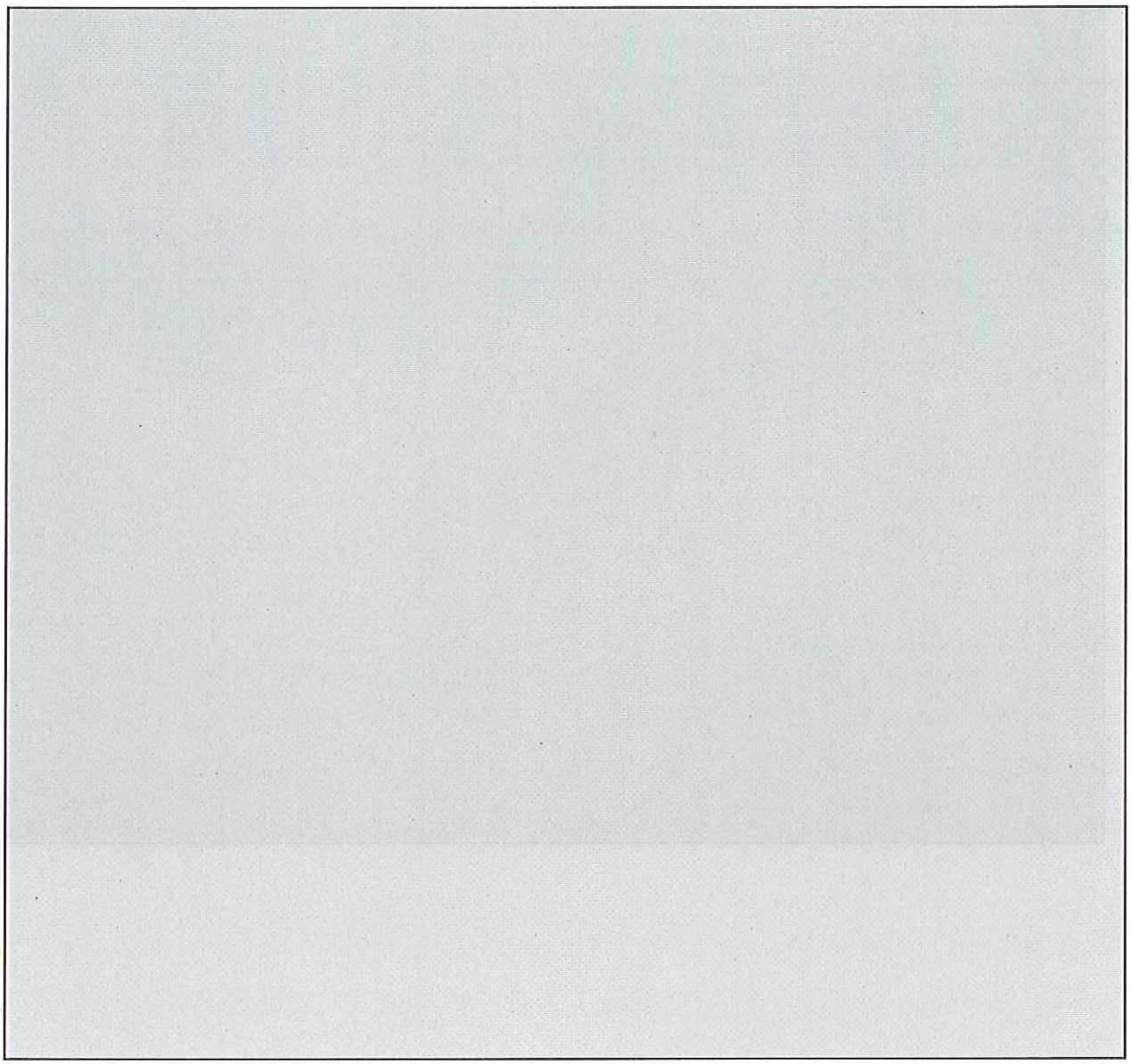










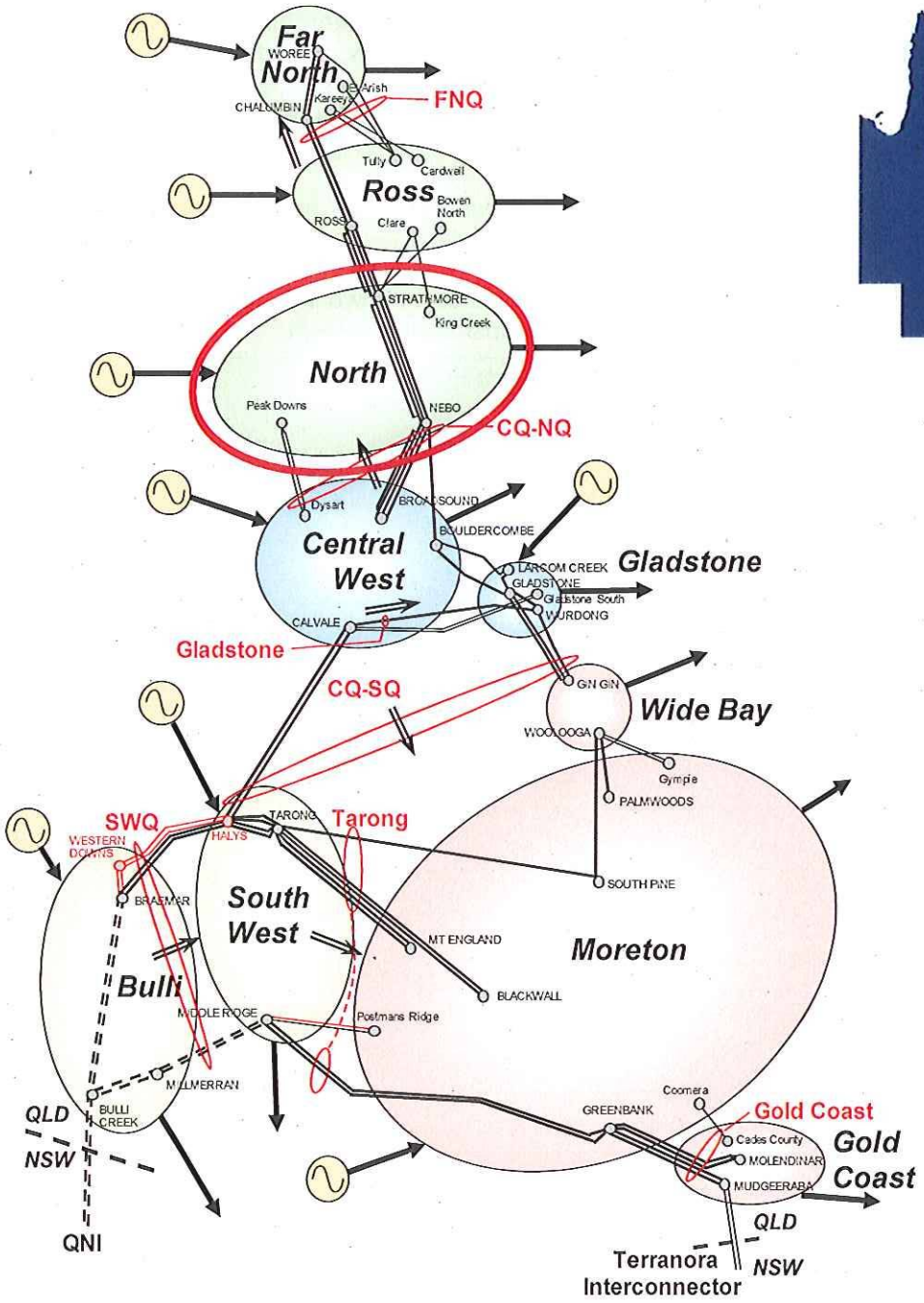


2010 GRID PLAN

VOLUME 2 SECTION 3

Network Development

North Area



North Area

1. Network Description

The North Queensland area is defined as south of Clare and north of Rockhampton and Dysart. The zone comprises sugar cane farming areas, the Whitsundays and Airlie Beach tourist region, Mackay residential and commercial centre, and the inland Bowen Basin coal mining areas.

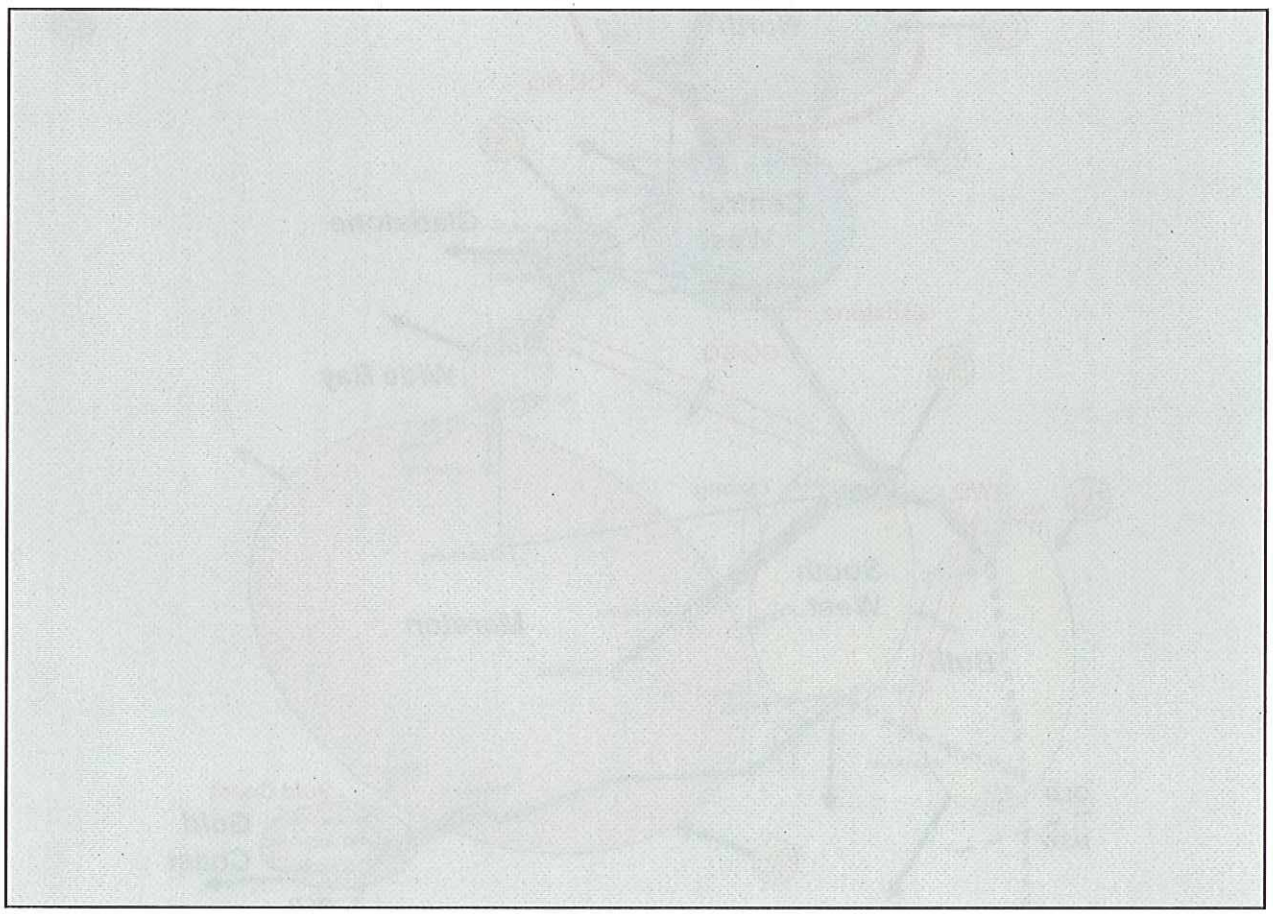
The major injection points into the area are Nebo and Strathmore 275/132kV substations. The North Queensland 132kV sub-transmission network provides supply from Strathmore and Nebo 275/132kV substations to coastal bulk supply points at Proserpine, Mackay and Pioneer Valley.

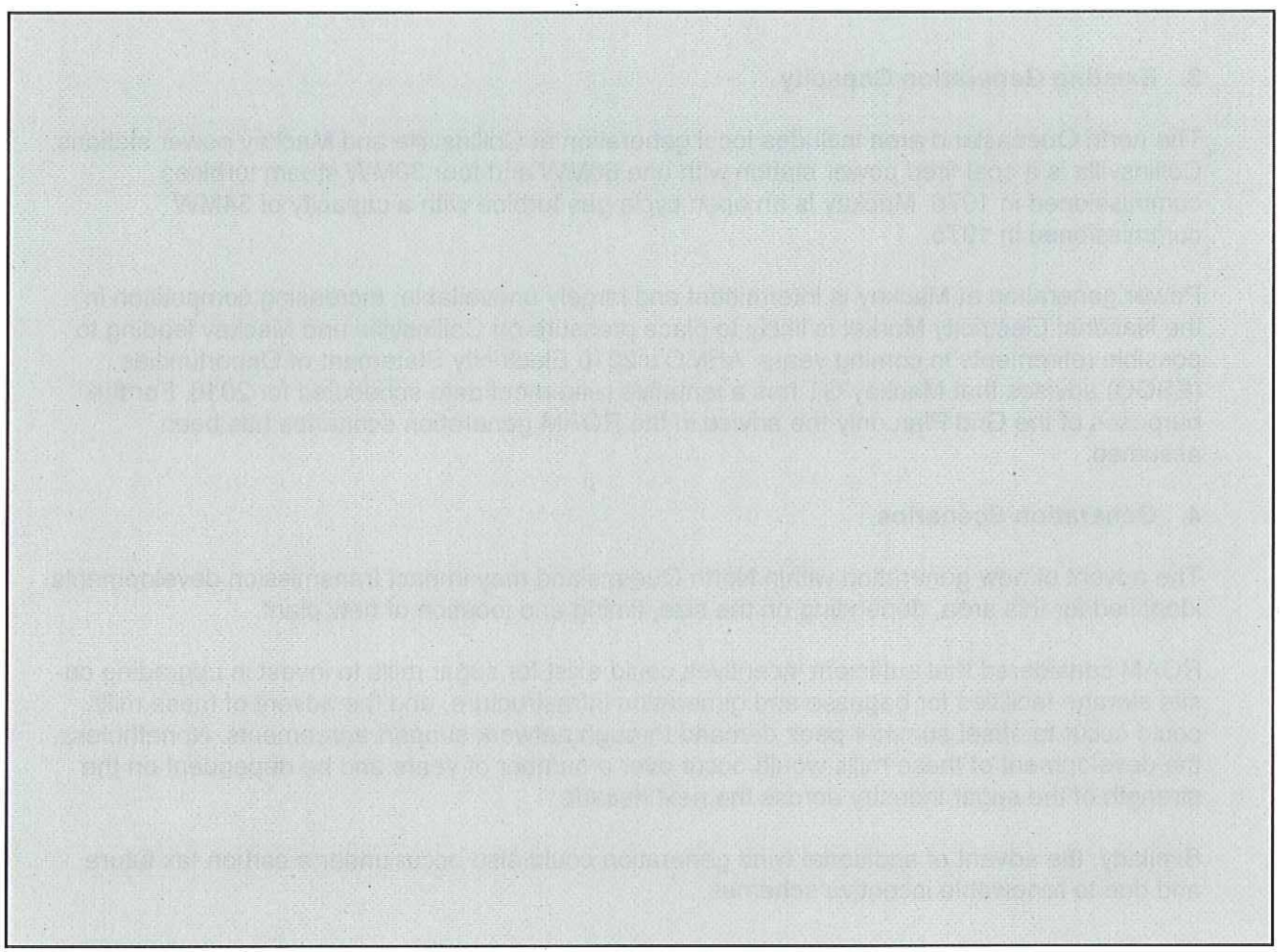
Another 132kV system supplies the inland Bowen Basin coal mines at Kemmis, Burton Downs, North Goonyella and Moranbah. This network continues south linking the southern Bowen Basin coal mining centres at Dysart, Blackwater and Moura.

North Queensland is a net importer of electricity. Only Collinsville coal-fired generators and the Mackay combustion turbine are located within this zone. Therefore, North Queensland relies heavily on transmission for its electricity supply. Large amounts of electricity from power stations elsewhere in the state are transferred to the north via Powerlink's 275kV and 132kV transmission network. By far the bulk of energy supplied is generated in Central Queensland some 350km to the south.

Supply to North Queensland is predominantly via the 275kV network from Broadsound and Bouldercombe to Nebo.

The electricity supply system in North Queensland is shown in Figure 1. Figure 2 shows a one line diagram representation of the existing transmission system.





2. Description of Committed Projects

The 132kV transmission lines from Strathmore and Nebo supply cities and towns along the coastline and across to the west, including significant mining developments. A committed load development has resulted in additional 132kV transmission and 132/66kV transformation occurring at Bowen North. Similarly, the commitment of additional mining loads in the Moranbah area is being addressed by augmentation at a new site called Broadlea.

A 132/66kV transformer augmentation at Pioneer Valley is committed for late 2012, to increase transformation capacity to growing loads on the Ergon network.

In addition to committed augmentations in the area, a project to replace the aging transformers at Nebo and decommissioning of Mackay to Proserpine are likely by late 2014.

Table 1 lists the committed projects assumed in the Grid Plan for this zone.

Table 1: Committed projects assumed in the 2010 Grid Plan in the North zone

Project ID	Project Description	Expected Commissioning
CP.01758	Pioneer Valley 132/66kV Transformer Replacement	Summer 2012/13

3. Existing Generation Capacity

The north Queensland area includes local generation at Collinsville and Mackay power stations. Collinsville is a coal fired power station with one 60MW and four 30MW steam turbines commissioned in 1976. Mackay is an open cycle gas turbine with a capacity of 34MW commissioned in 1975.

Power generation at Mackay is intermittent and largely unavailable. Increasing competition in the National Electricity Market is likely to place pressure on Collinsville and Mackay leading to possible retirements in coming years. AEMO's 2010 Electricity Statement of Opportunities (ESOO) advises that Mackay GT has a tentative retirement date scheduled for 2016. For the purposes of the Grid Plan only the advice in the ROAM generation scenarios has been assumed.

4. Generation Scenarios

The advent of new generation within North Queensland may impact transmission developments identified for this area, depending on the size, timing and location of new plant.

ROAM considered that sufficient incentives could exist for sugar mills to invest in upgrading on-site storage facilities for bagasse and generation infrastructure, and the advent of these mills could occur to offset summer peak demand through network support agreements. Nonetheless, the development of these mills would occur over a number of years and be dependent on the strength of the sugar industry across the next decade.

Similarly, the advent of additional wind generation could also occur under a carbon tax future and due to renewable incentive schemes.

Should these developments occur, there may be an impact on the required transmission needs in the area. These impacts have been assessed when developing the transmission plans for each scenario. Table 2 lists potential new entrants (in addition to existing plant) as identified by ROAM.

Table 2: ROAM new entrants in the North zone

Generator	Capacity (MW)	Assumed Point of Connection	Cumulative Probability of Proceeding by 2021/22
Racecourse Mill	27	Mackay 132kV	100%
Crediton Wind	40	Mackay 132kV	52%
Proserpine Mill	70	Proserpine 66kV	94%

ROAM has assigned a probability of 41% to the decommissioning of Collinsville by 2021/22.

5. Description of Transmission Limitations

Main Grid

The North Queensland transmission system is characterised by long transmission distances, large electrical angles, voltage sensitivity and significant demand for reactive power for changes in real power transmitted. As a result, maximum power transfer into North Queensland is mostly limited by the occurrence of voltage instability following critical contingencies.

The North Queensland area is heavily reliant on the 275kV transmission system for the supply of low cost base load generation within Central Queensland to the northern part of the State. However, under high load summer conditions, power flows across this transmission corridor can reach the transfer capability resulting in the need for dispatch of higher cost local generation.

Analysis has demonstrated optimum economic outcomes occur by entering into a number of network support arrangements with North Queensland power stations and incrementally augment as required due to reliability triggers between and within CQ and NQ. However, the construction of Strathmore – Ross was fully justified based on market benefits. This last stage of the long term CQNQ augmentation strategy released significant capacity resulting in large savings in variable costs of NQ plant. Future expansion plans for CQNQ are also expected to be triggered by benefits to the market in avoiding the dispatch of the high variable cost NQ generation.

Currently, maximum transfer may be set by thermal ratings associated with an outage of a 275kV transmission circuit between Stanwell and Broadsound under certain prevailing ambient conditions.

Power transfers may also be constrained by voltage stability limitations associated with the trip of one of the larger North Queensland gas turbines (such as Townsville power station) operating at high generation levels. Under conditions where the gas turbines are not operating (or running at low levels), voltage stability limitations occur as a result of a 275kV transmission circuit contingency.

The critical Main Grid contingencies include:

- 275kV circuits between CQ and NQ; and
- 275/132kV transformers at Strathmore and Nebo.

The CopperString project is a proposal by development company CuString Pty Ltd and construction company Leighton Contractors Pty Ltd. It seeks construction of an electricity transmission line to connect the Mt. Isa region and the northwest Queensland electricity supply network to the national transmission network. This is a private sector initiative with substantial Queensland Government support. Support for the proposal has also been received by local economic development bodies, the regional councils in the area and the Queensland Resources Council.

Powerlink is not discounting the prospect of other significant development projects, or expansion by existing industrial users, occurring in the Mt. Isa area in the relatively near future. As such a contingent project is proposed for potential connection of significant loads to be connected to a new Woodstock Substation.

Regional Grid

Strong load growth in the North Queensland zone is largely driven by the development and expansion of coal mining in the Northern Bowen Basin. Strong load growth is continuing in the Proserpine area, leading to the Ergon Energy 66kV distribution system supplying Bowen from Proserpine and Townsville South approaching thermal ratings.

The critical Regional Grid contingencies include:

- 132kV circuits to Proserpine, Mackay and Collinsville;
- 132kV circuits to Moranbah; and
- 132kV circuits between Moranbah and Lilyvale via Dysart.

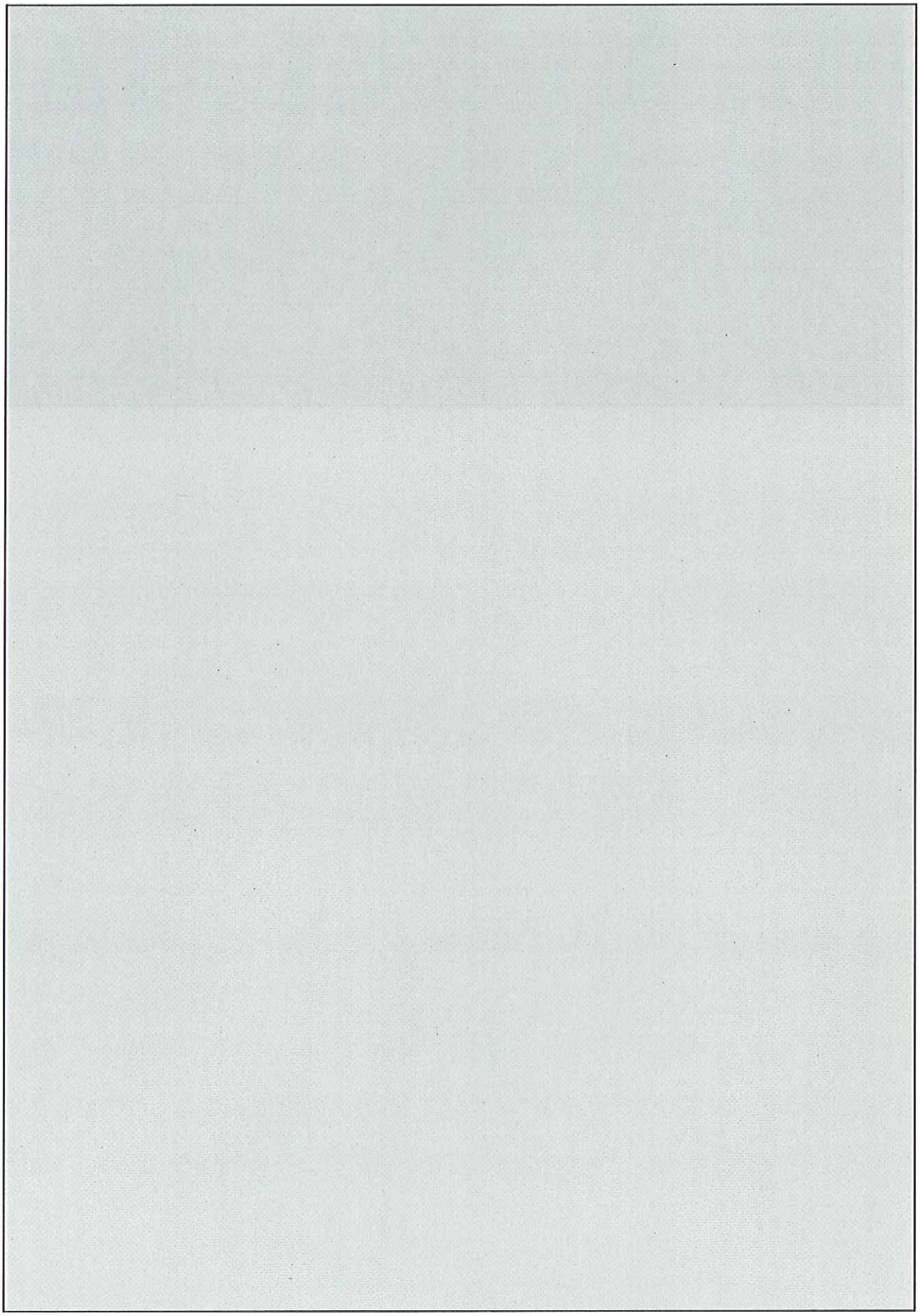
Powerlink has received a number of enquiries from proponents in the Northern Bowen Basin for additional load, and whilst Powerlink has allowed for load growth associated with a portion of these developments, the augmentations proposed will not be able to supply the full scale of the load enquiries should they eventuate. To address this, Powerlink has included a contingent project should the scale of the developments exceed the capacity of the network.

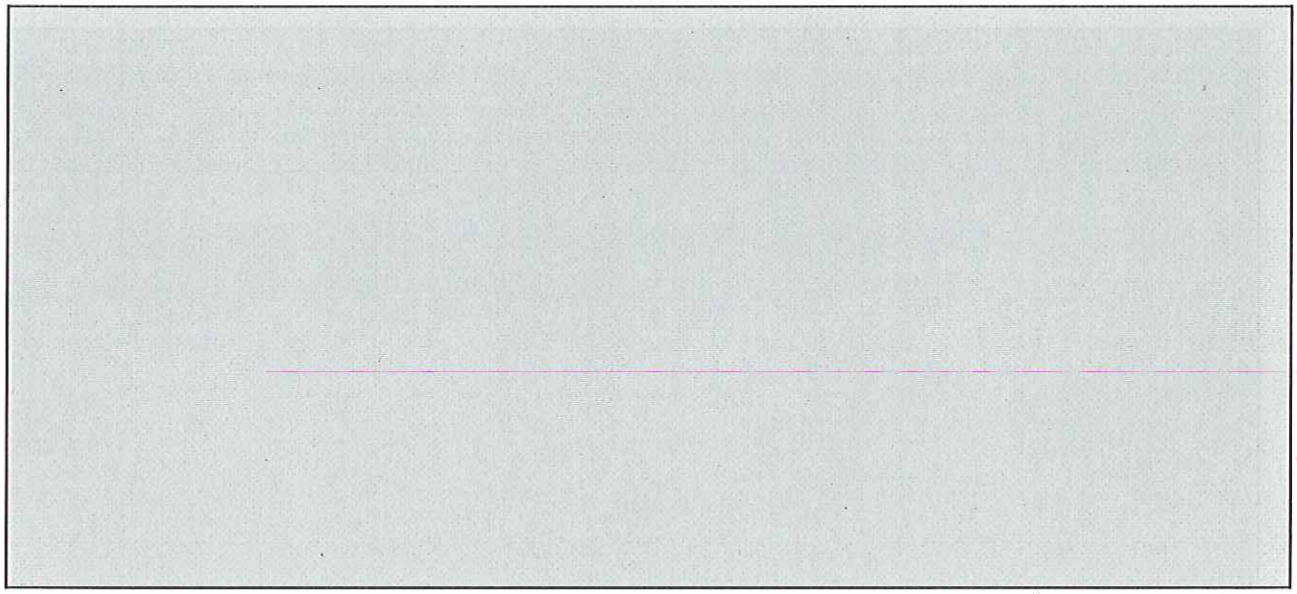
6. Relevant Planning Criteria

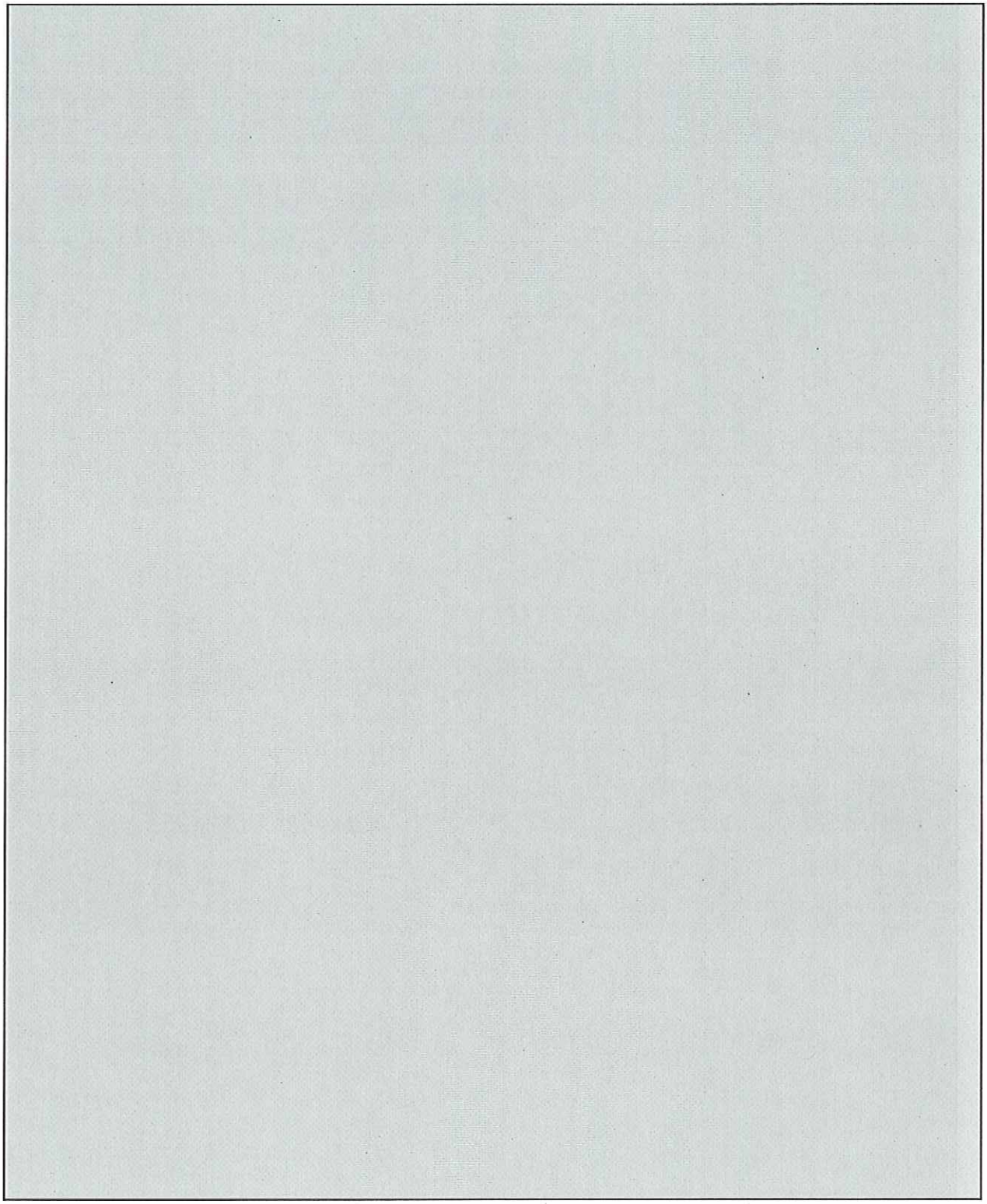
Powerlink's planning criteria, as it applies to this section, is summarised in Table 3.

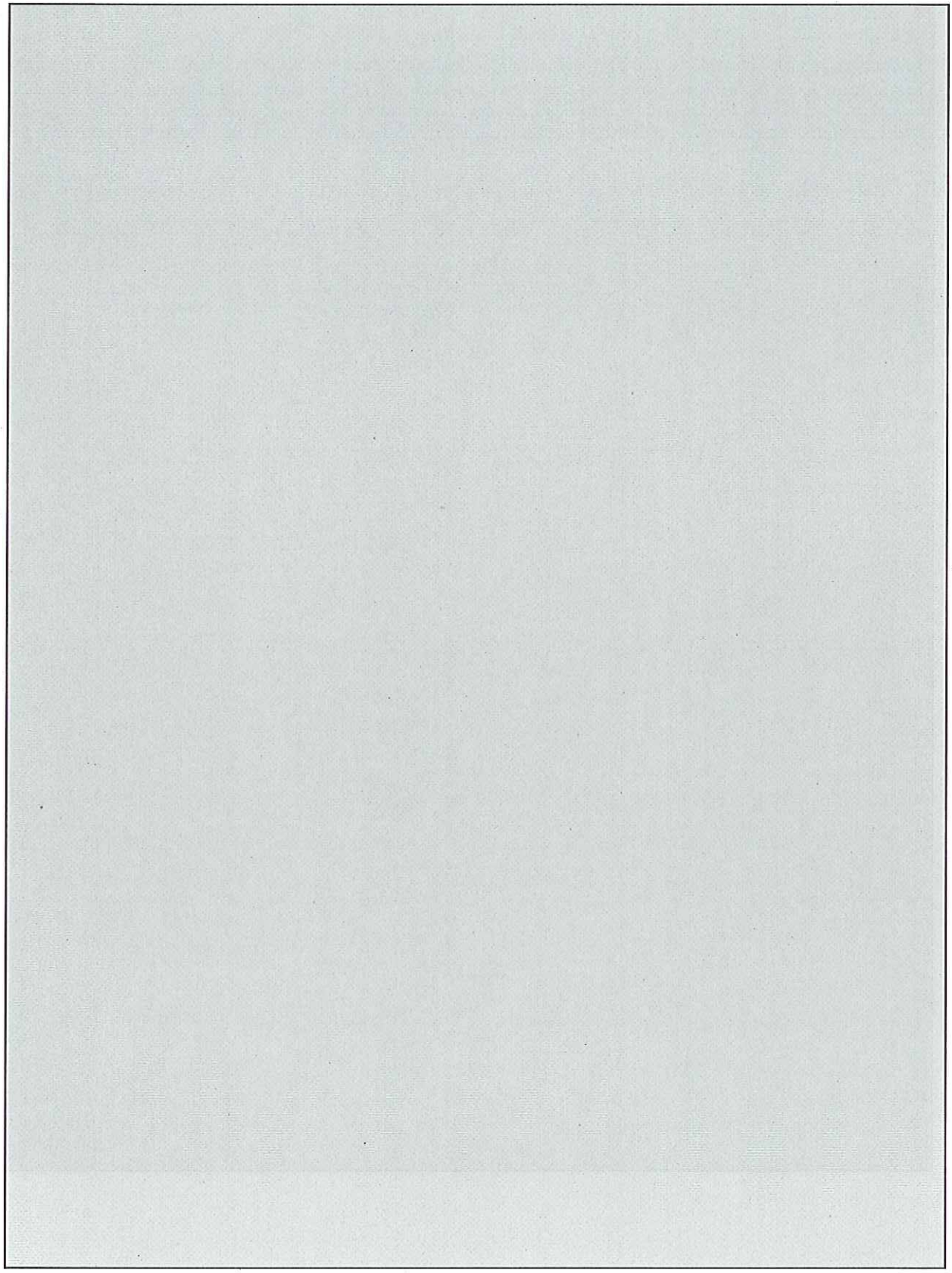
Table 3: Relevant planning criteria

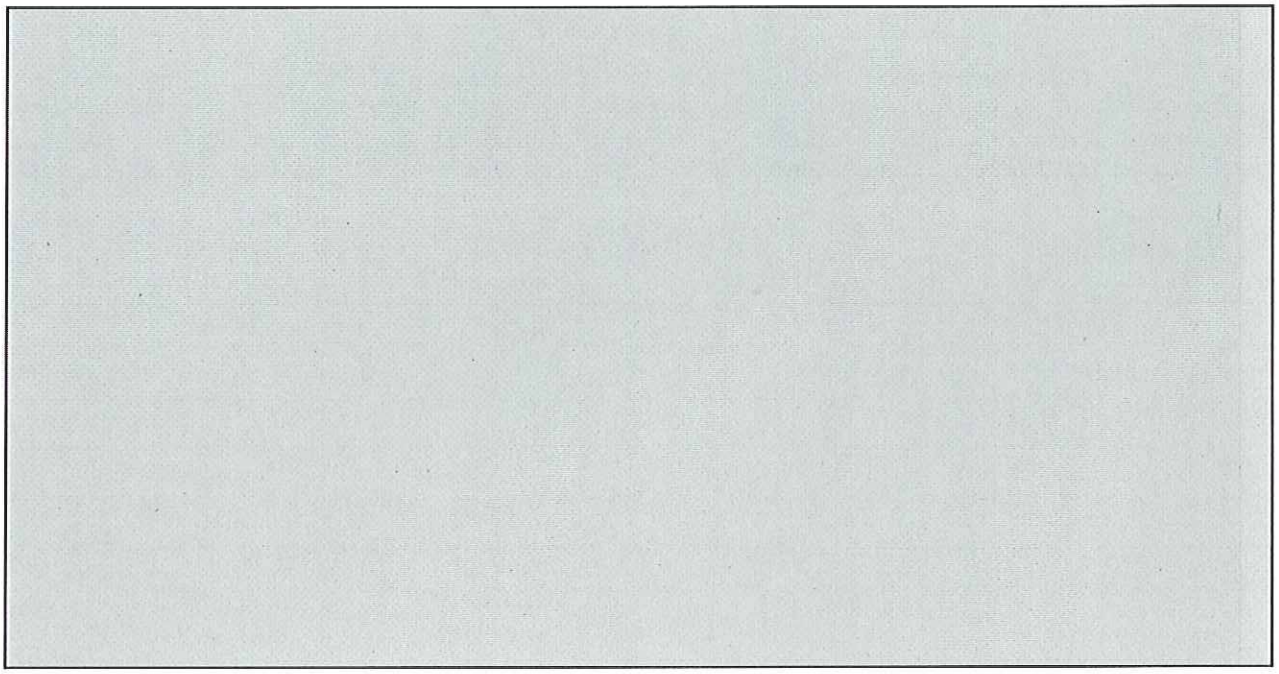
Network Planning	Criteria	Notes
Main Grid including Bulk Supply Transformation	10% PoE "Low", "Medium" and "High" forecasts	Sun Metals at authorised maximum demand
Regional Grid including Zone Supply Transformation	50% PoE "Low", "Medium" and "High" forecasts	
Hydro generation Capacity Factor	Barron Gorge = 15MW Kareeya = 3x21MW K5 = 6MW	Barron Gorge is often run 3hrs per day (10am to 1 pm) Not always on-line at peak times Synchronous Condensing Operation at Barron is possible but will require a Network Support Agreement
Wind Generation Capacity Factor	5% of installed capacity coincident with NQ summer 50% or 10% PoE area peak	
Bagasse Generation Capacity Factor	Network Support Agreements are required to stockpile bagasse for summer generation	Assumed to be 50% of installed capacity at time of peak outside of mill combined operation by entering a network support agreement
N-1	All circuits within normal line ratings prior to contingency All transformers within normal cyclic ratings prior to contingency All circuits within incremental line ratings following N-1 All transformers within emergency cyclic rating following N-1	Network switching (of 275/132/110kV transformers, 132kV and/or 110kV network) allowed to land within the post-contingent ratings Load transfers by the DNSP may be considered but must be pre-contingent Generation can be constrained to meet these objectives (within the limits of installed capacity), but the cumulative market impact needs to be considered

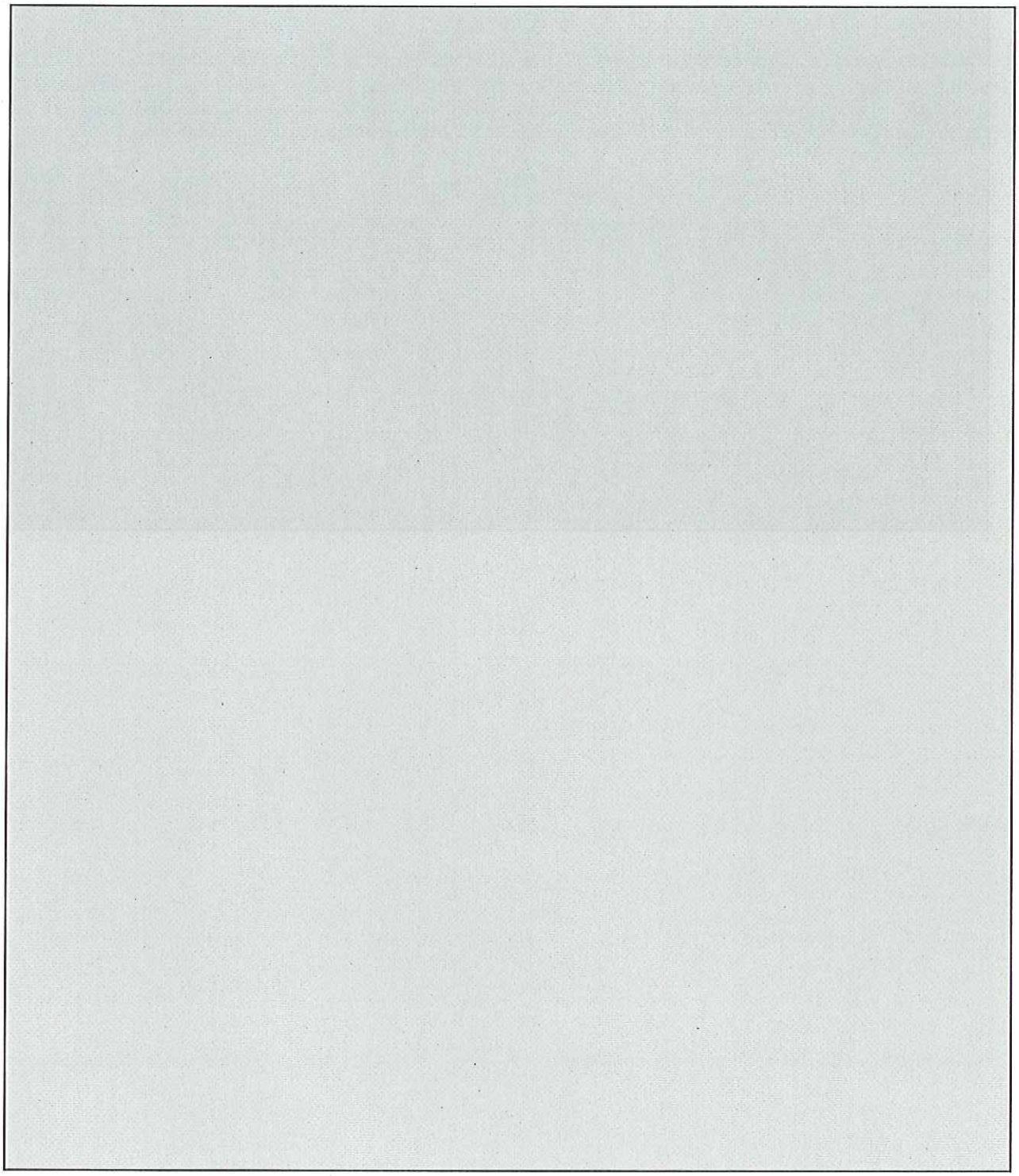


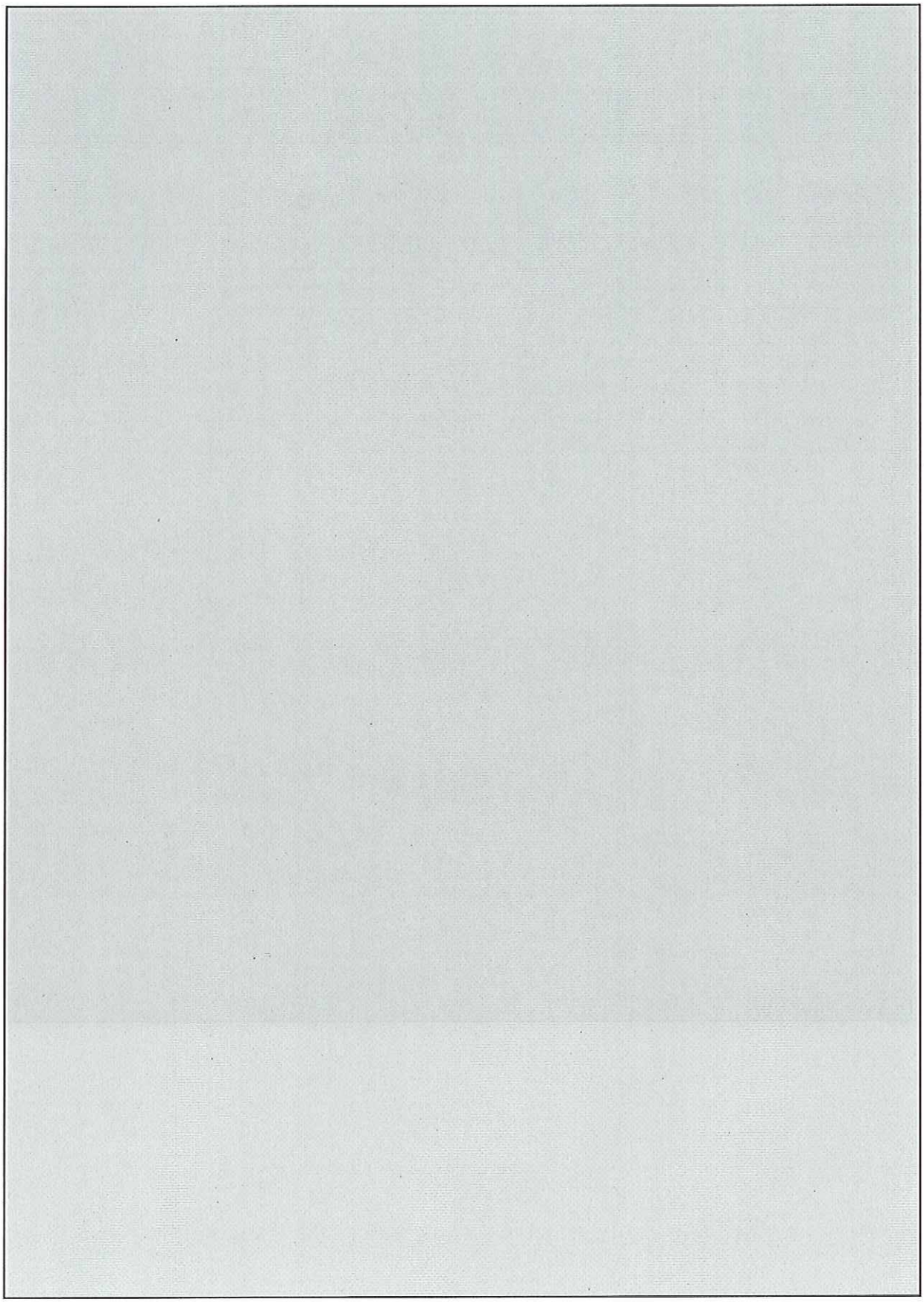


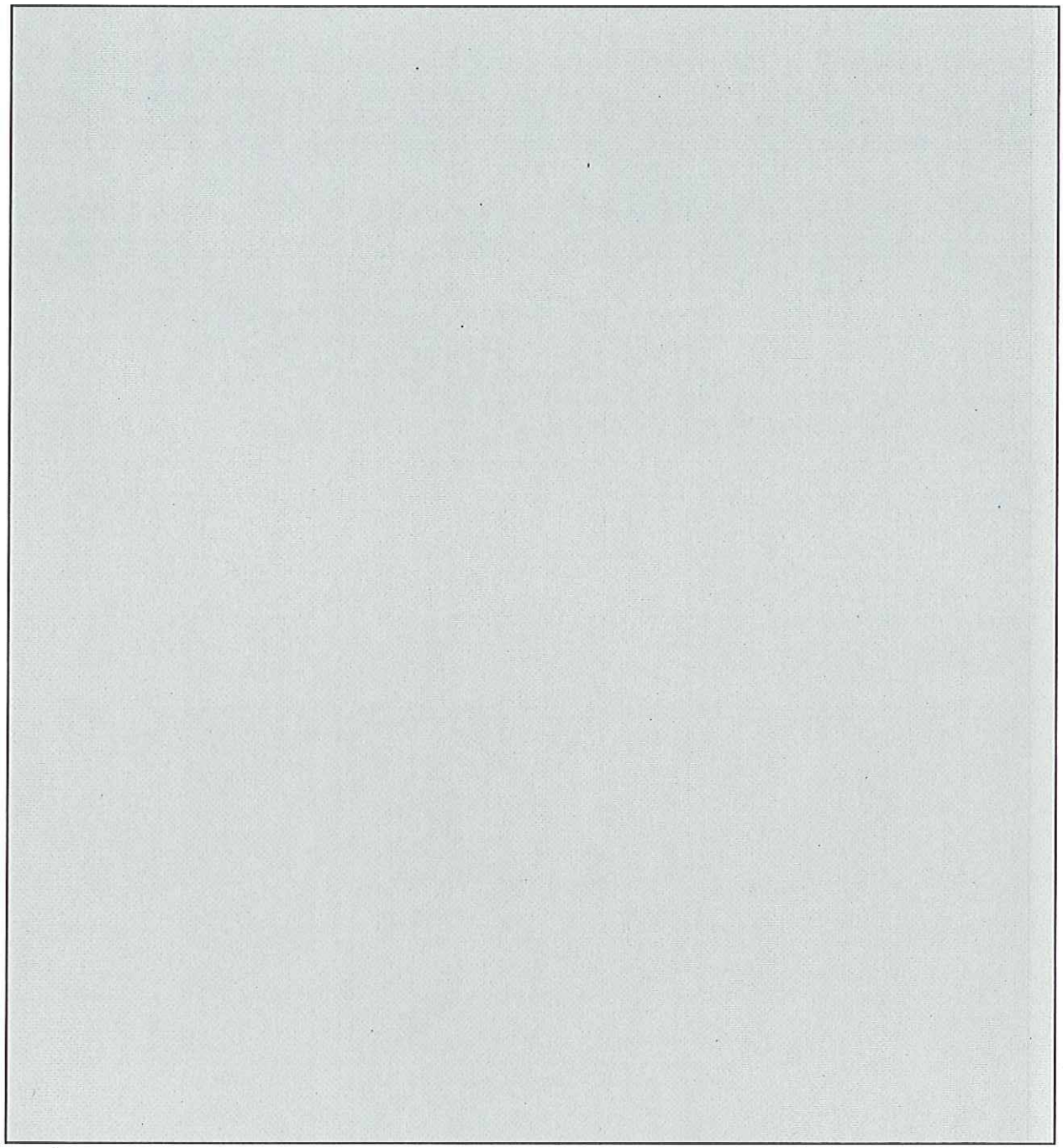


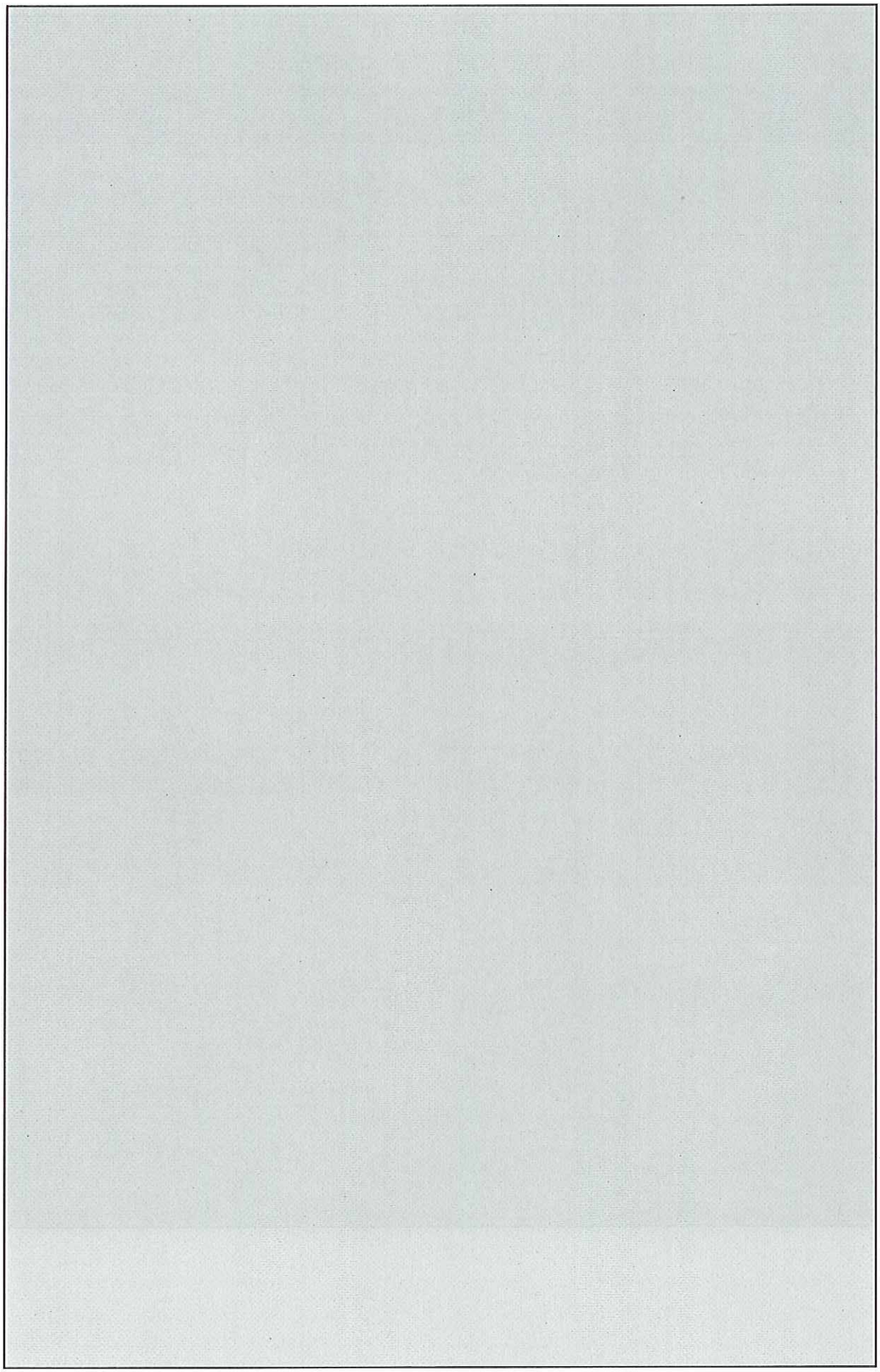


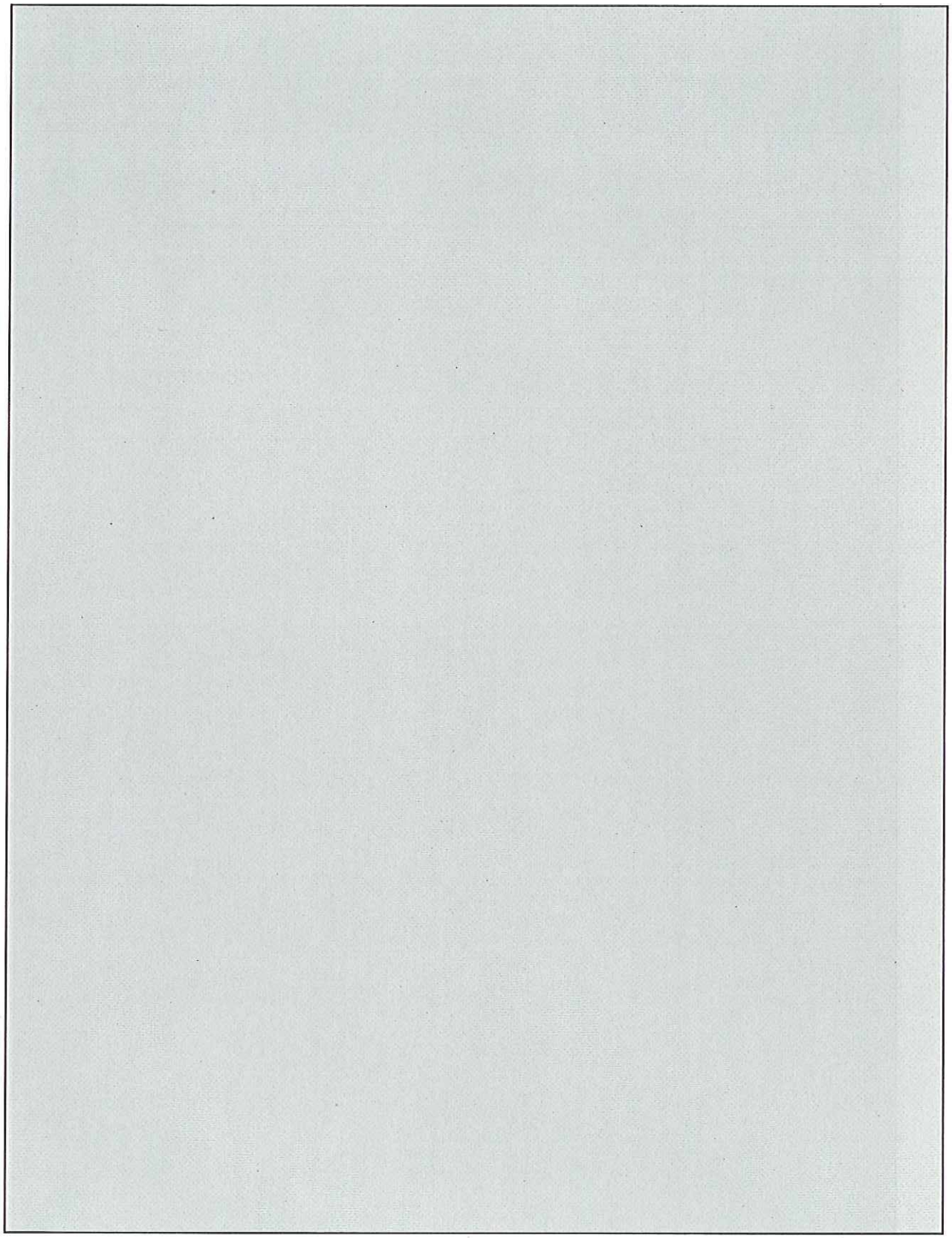


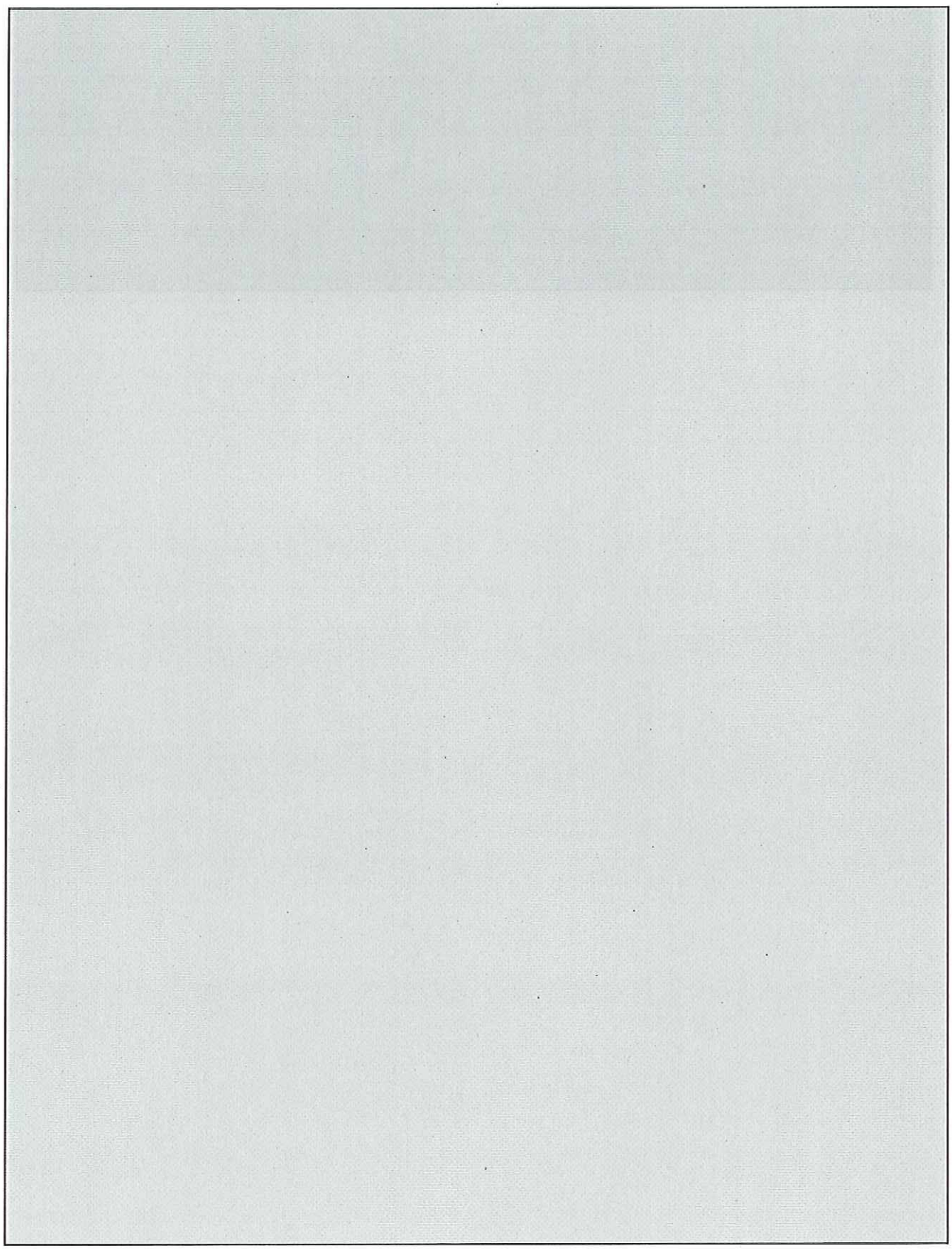


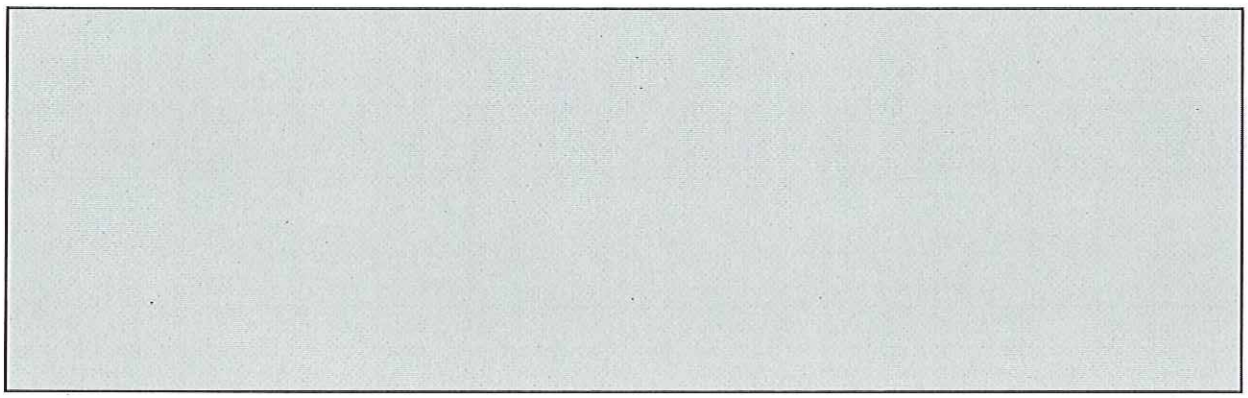


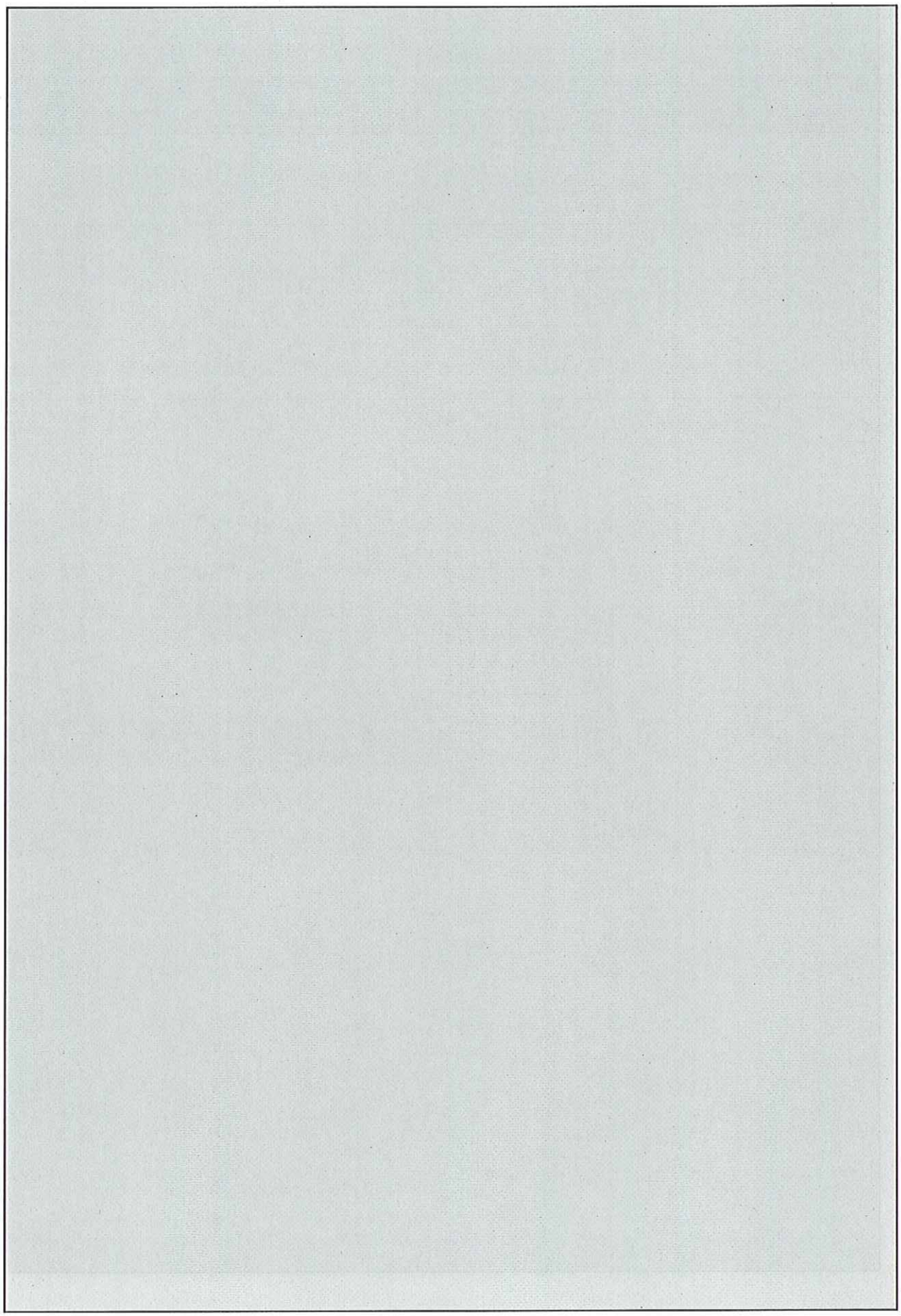


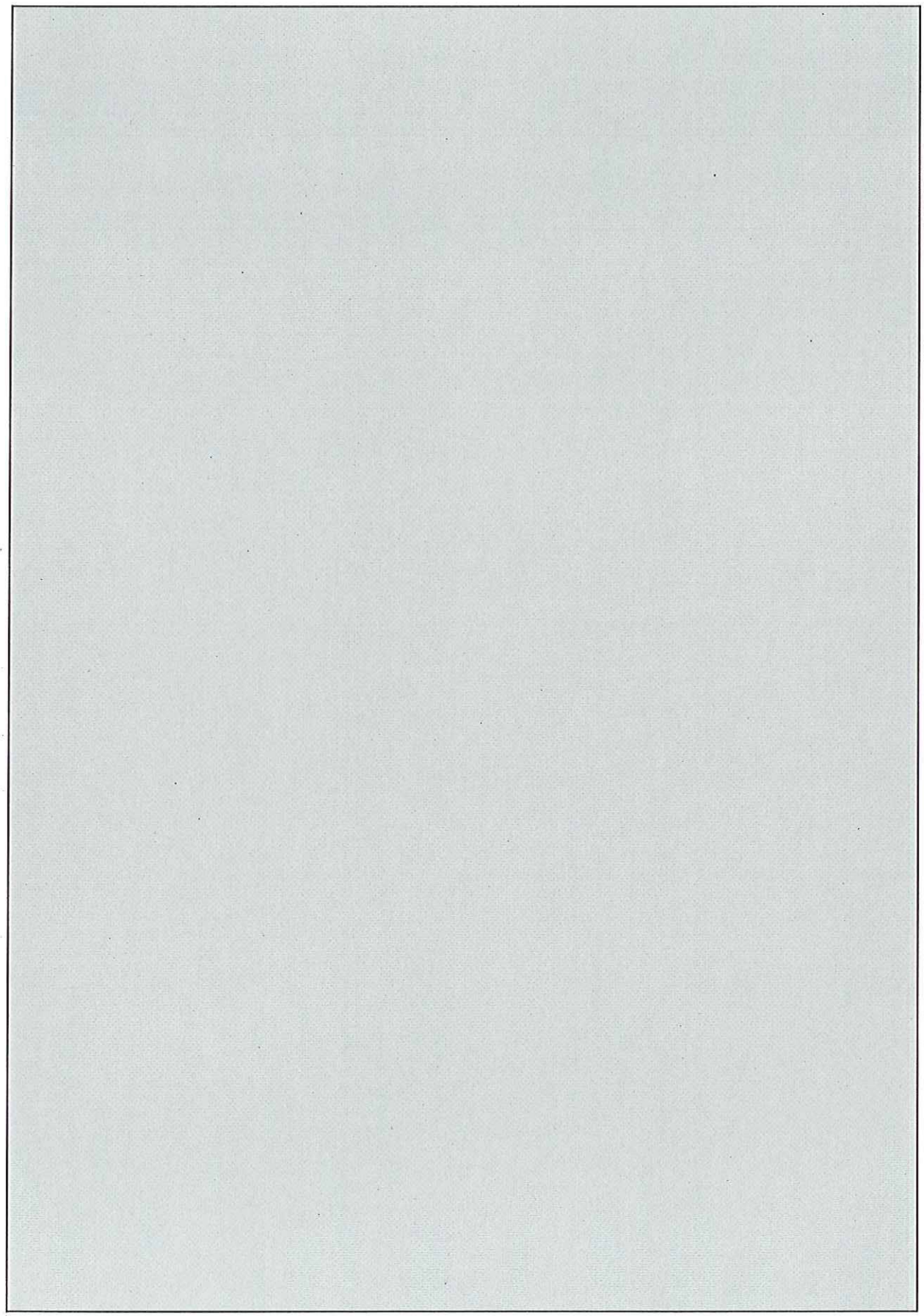


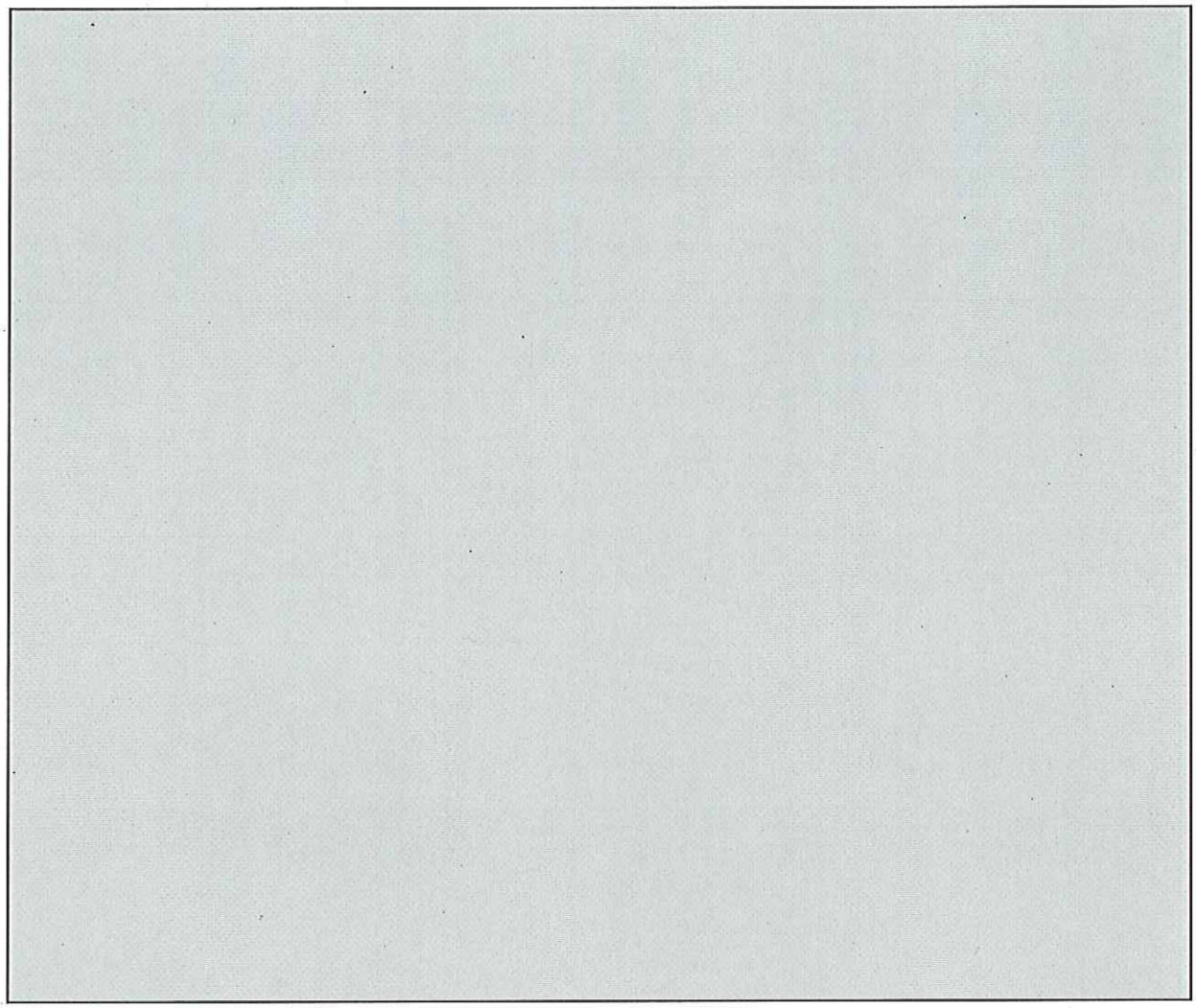


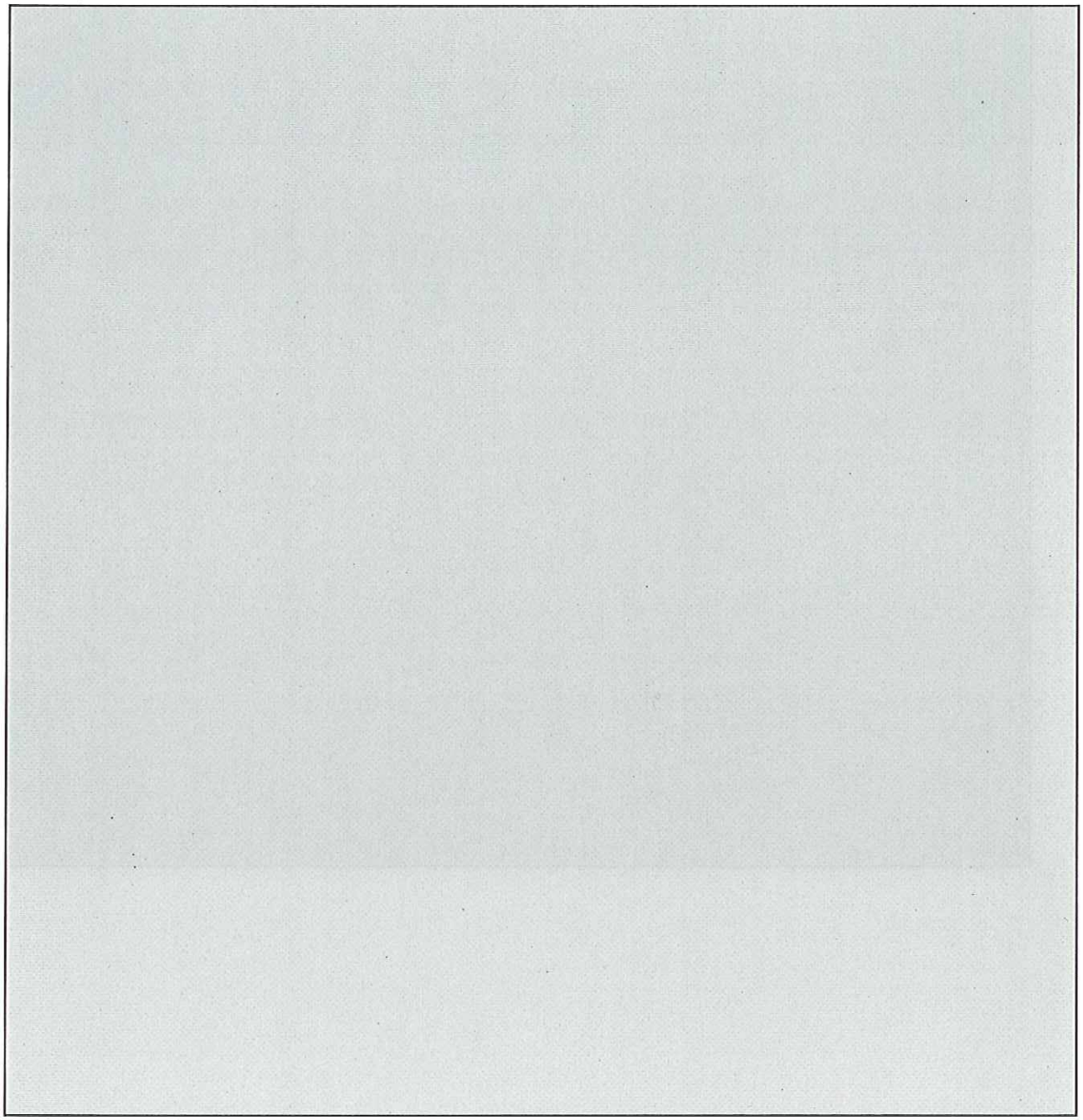


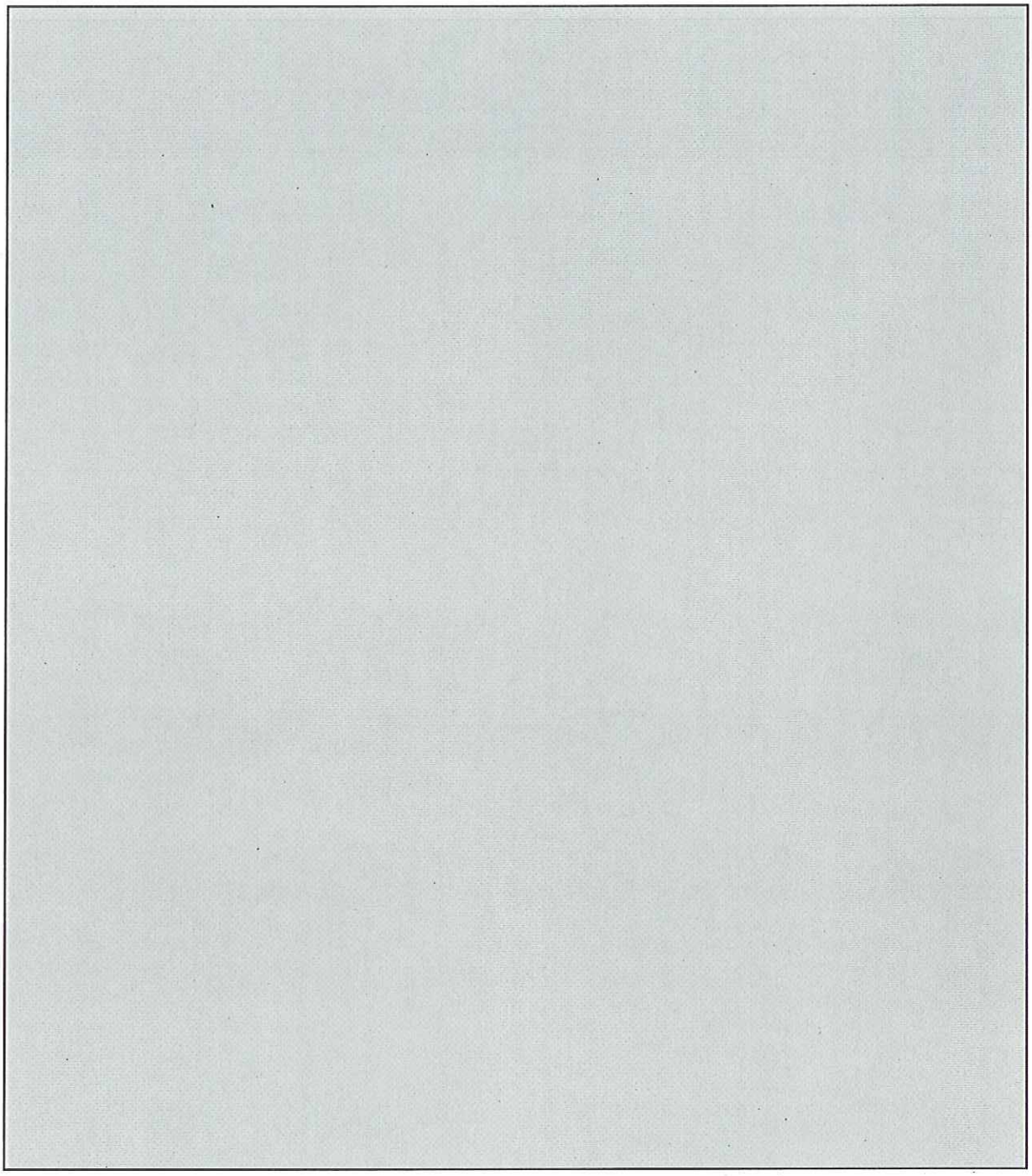


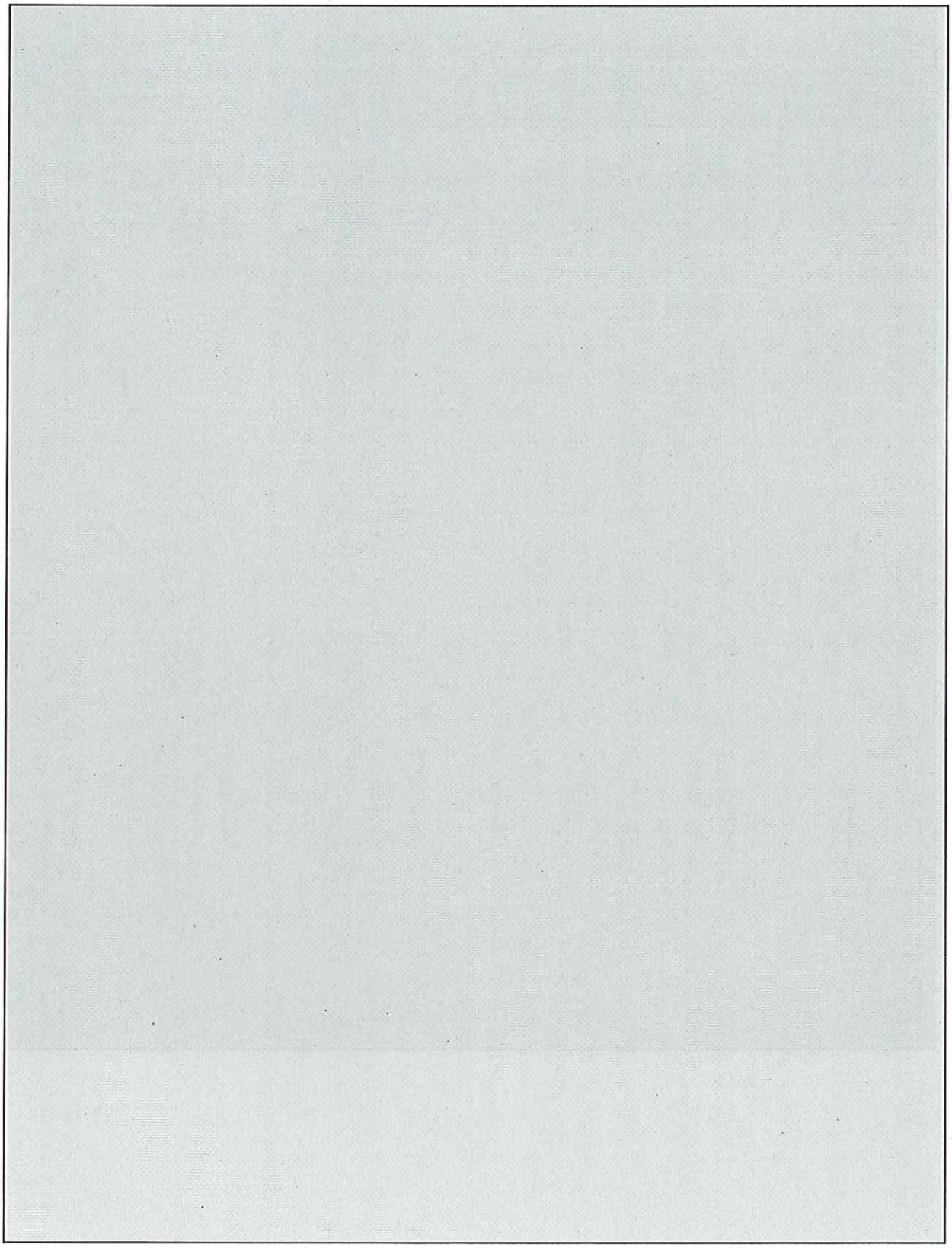


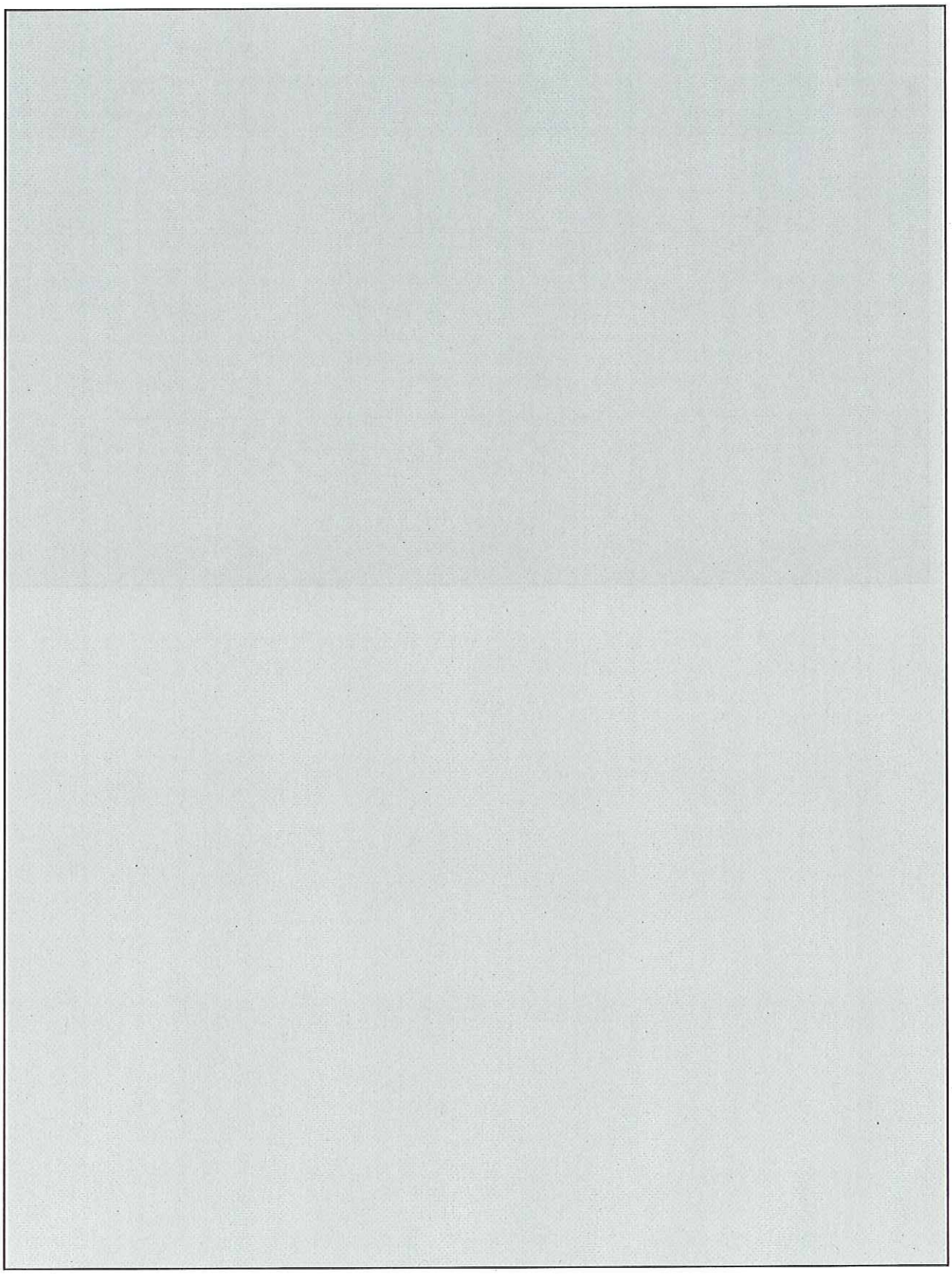


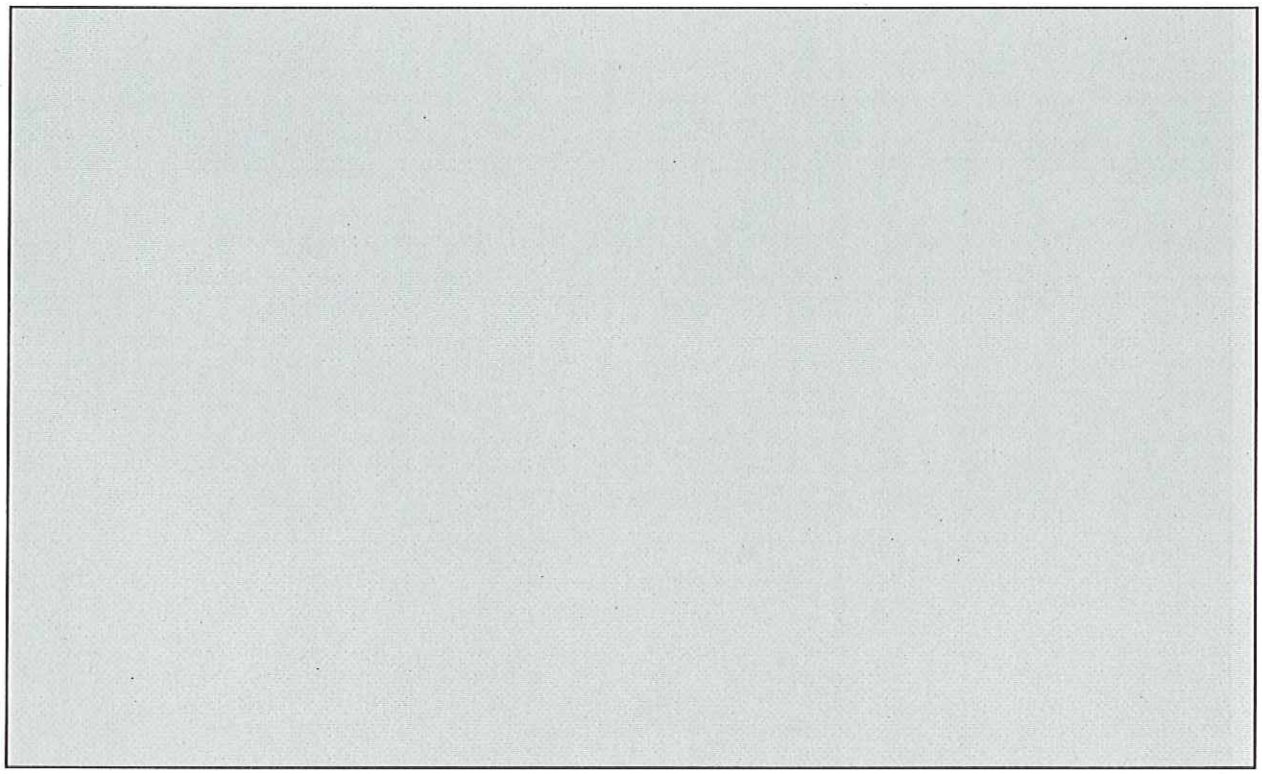


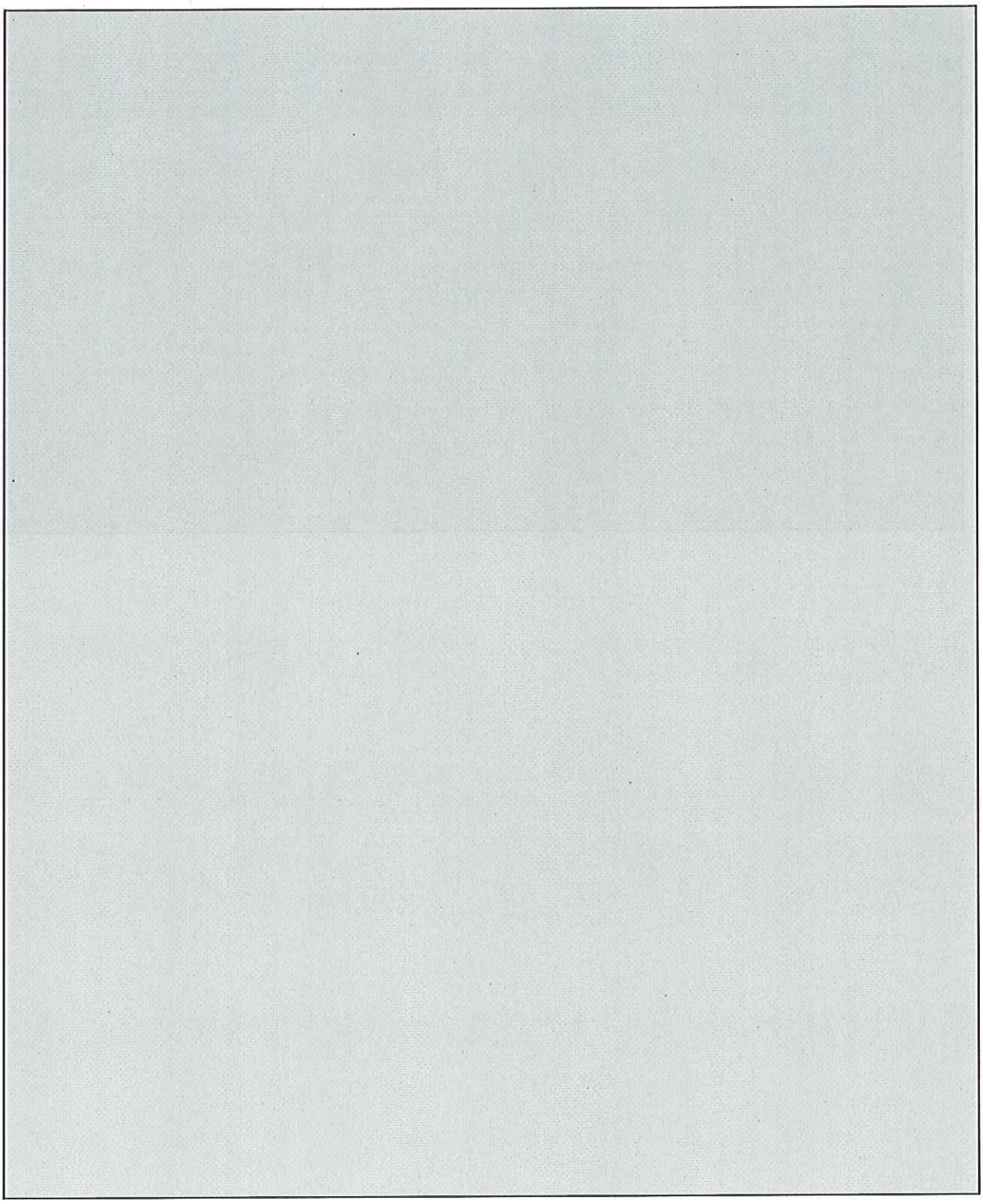


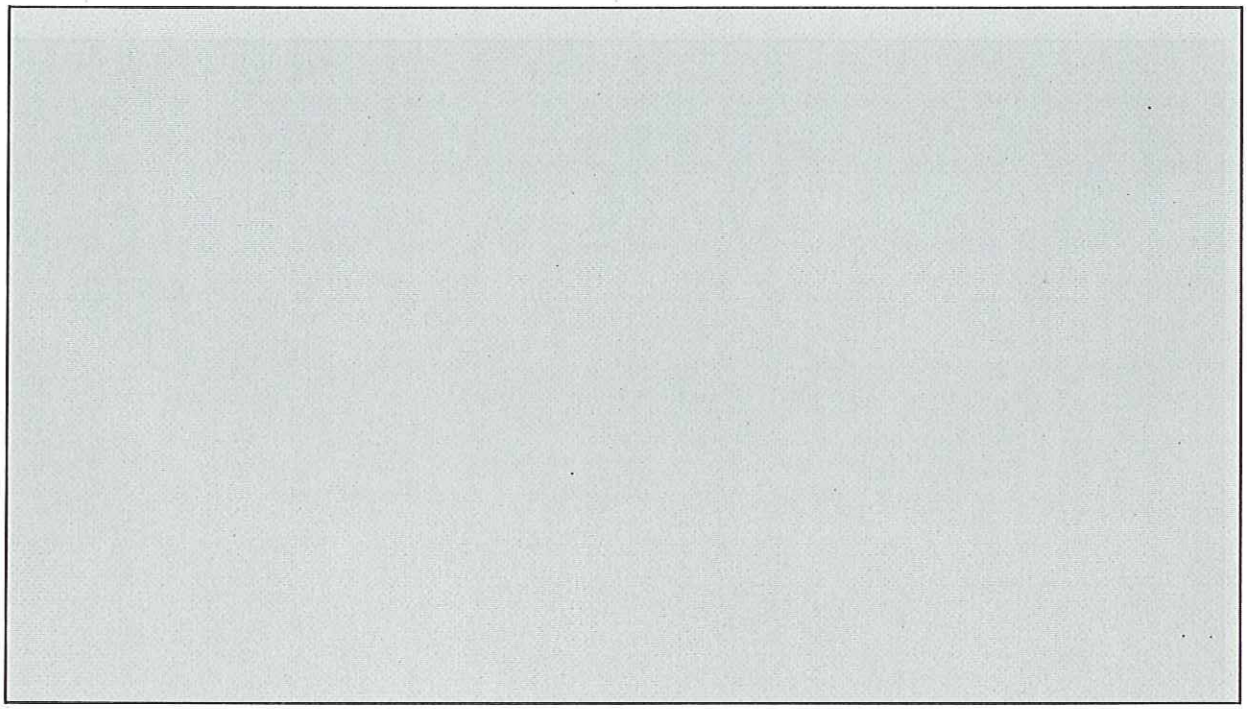


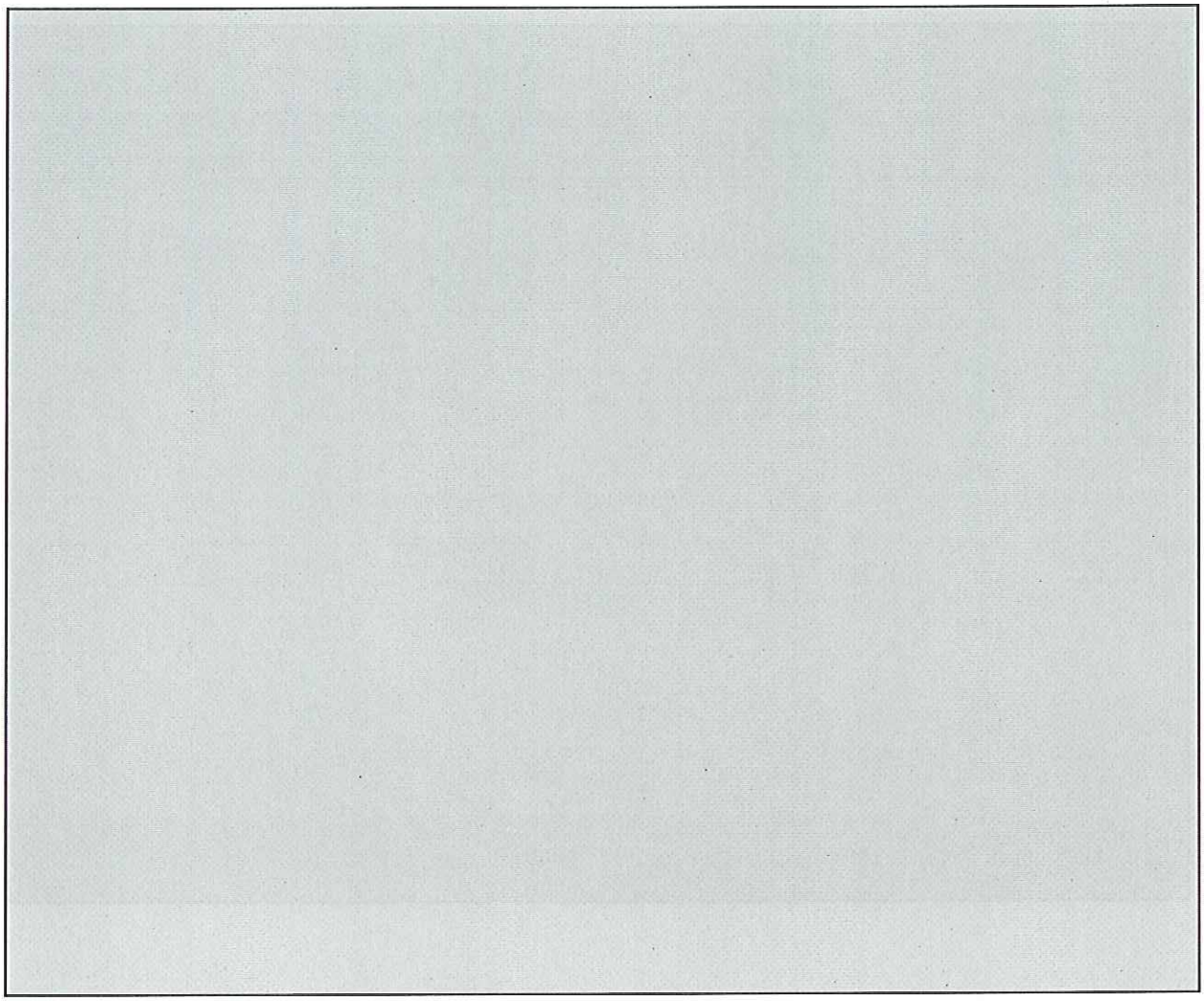


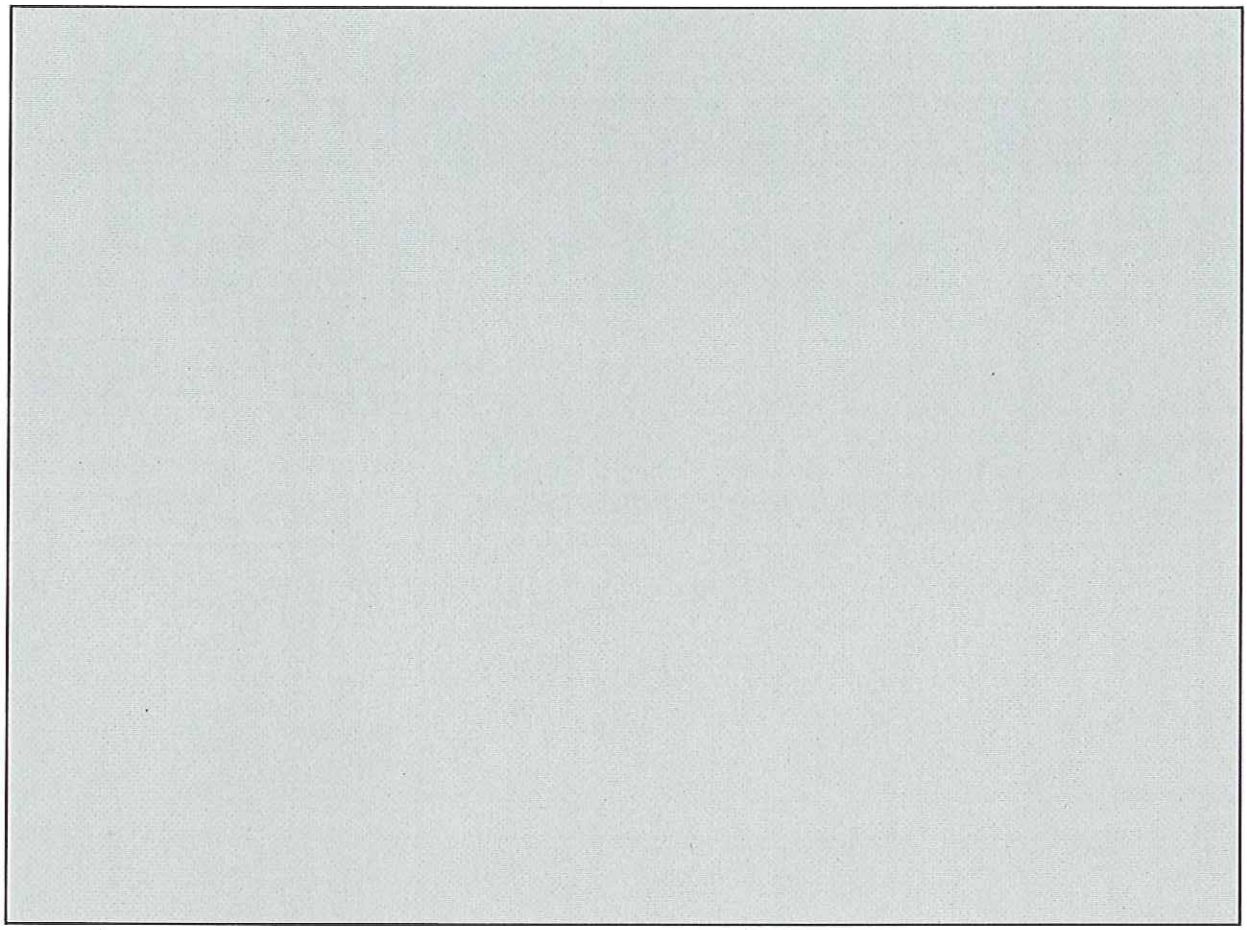


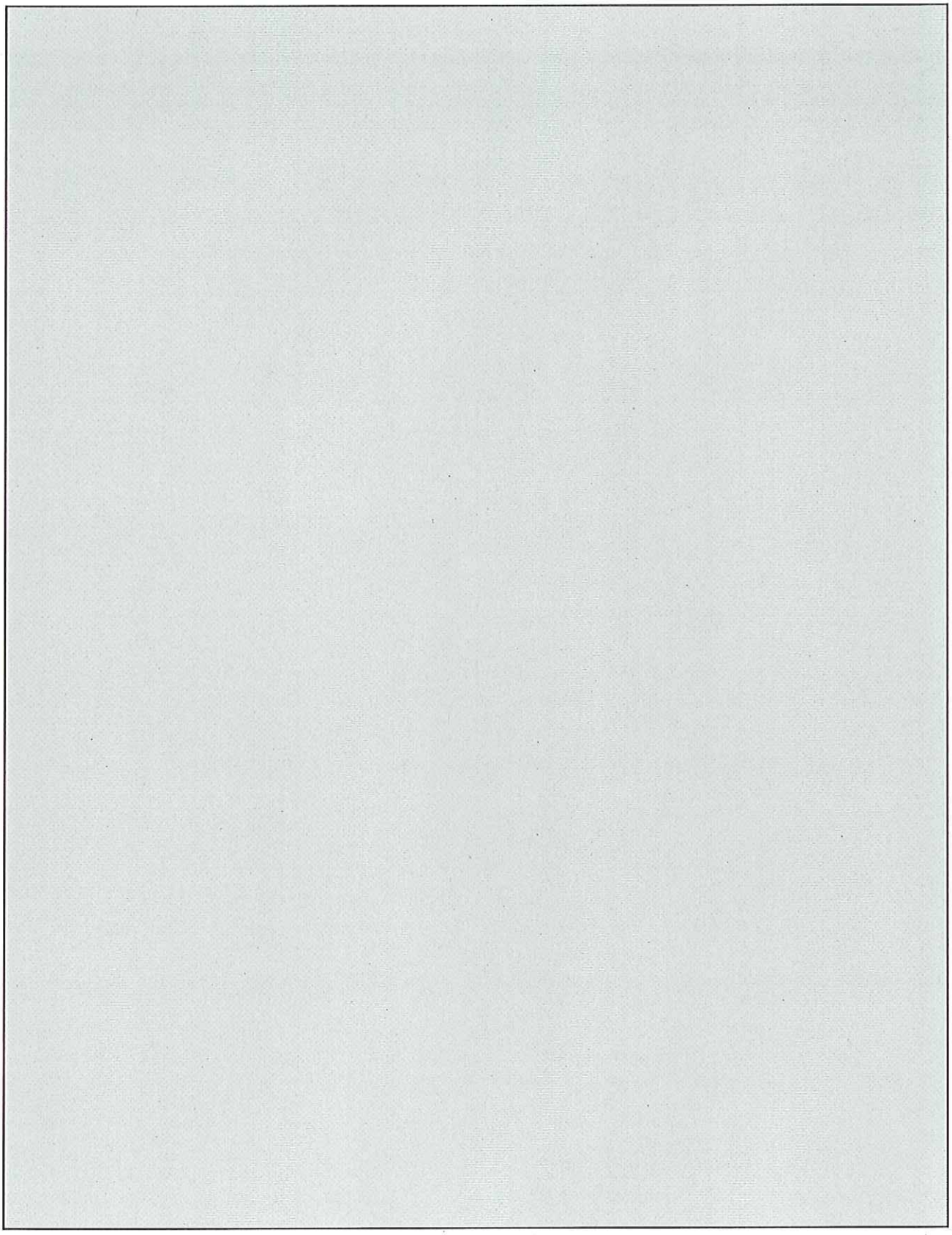










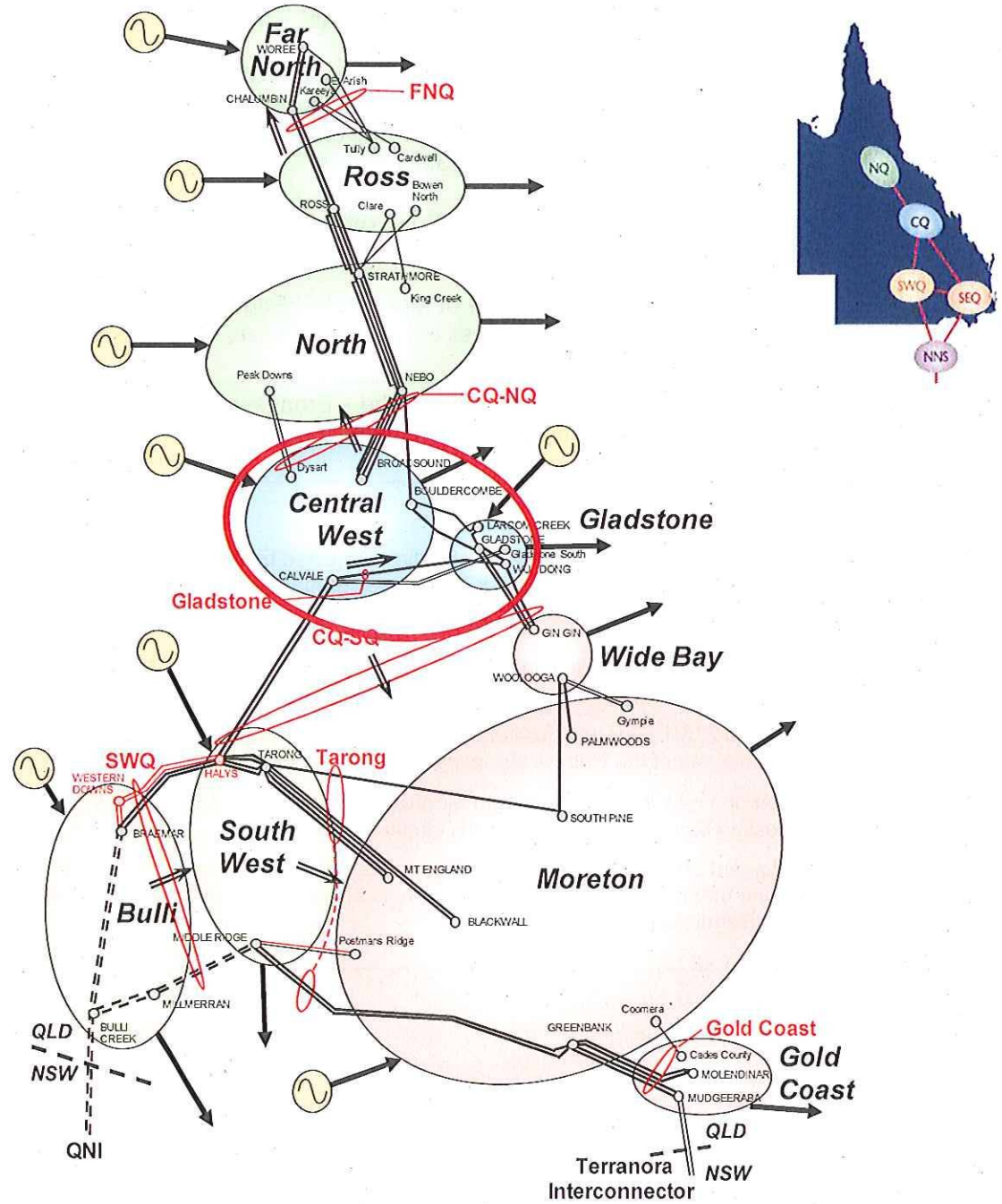


2010 GRID PLAN

VOLUME 2 SECTION 4

Network Development

Central West and Gladstone Area



Central West and Gladstone Area

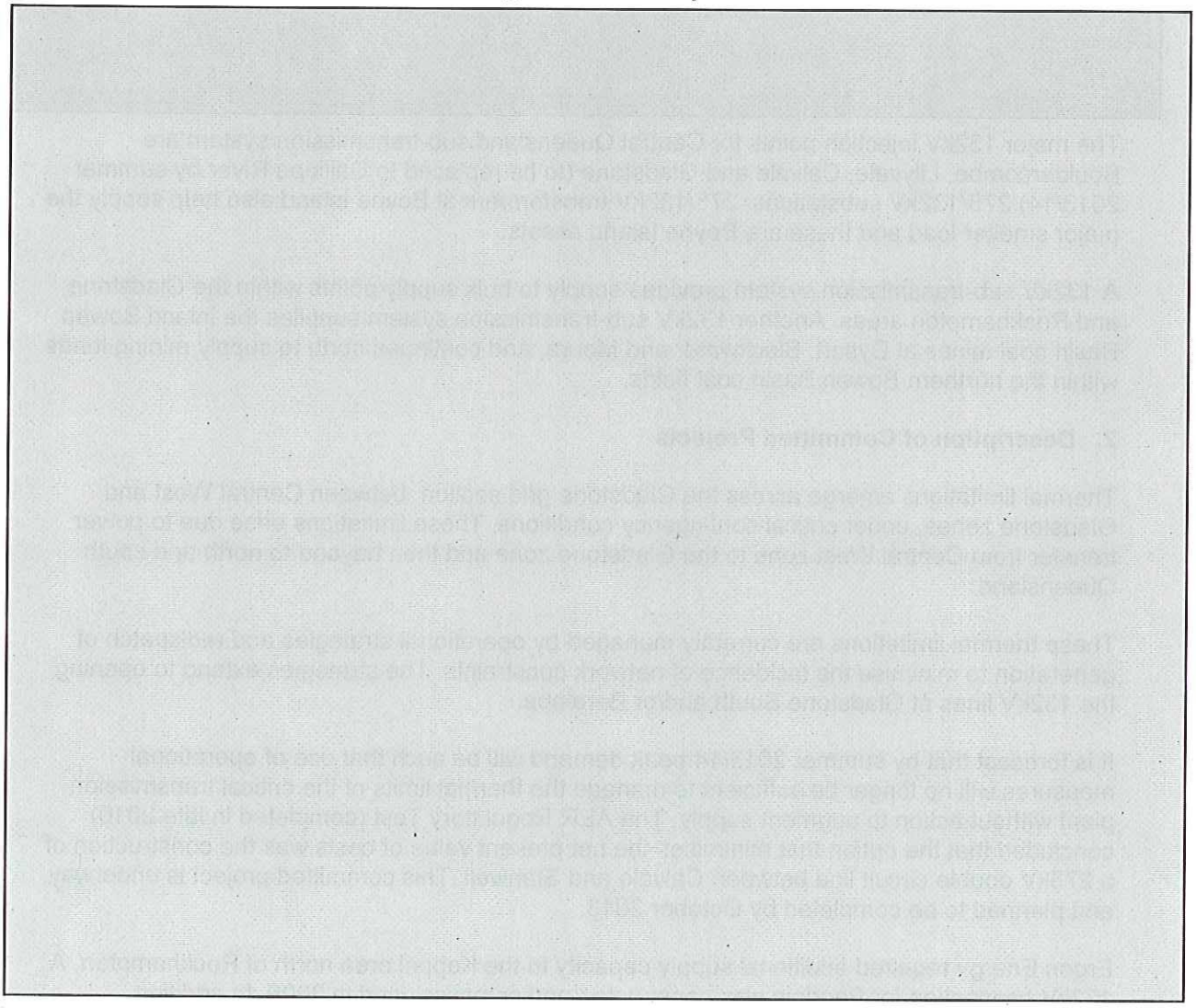
1. Network Description

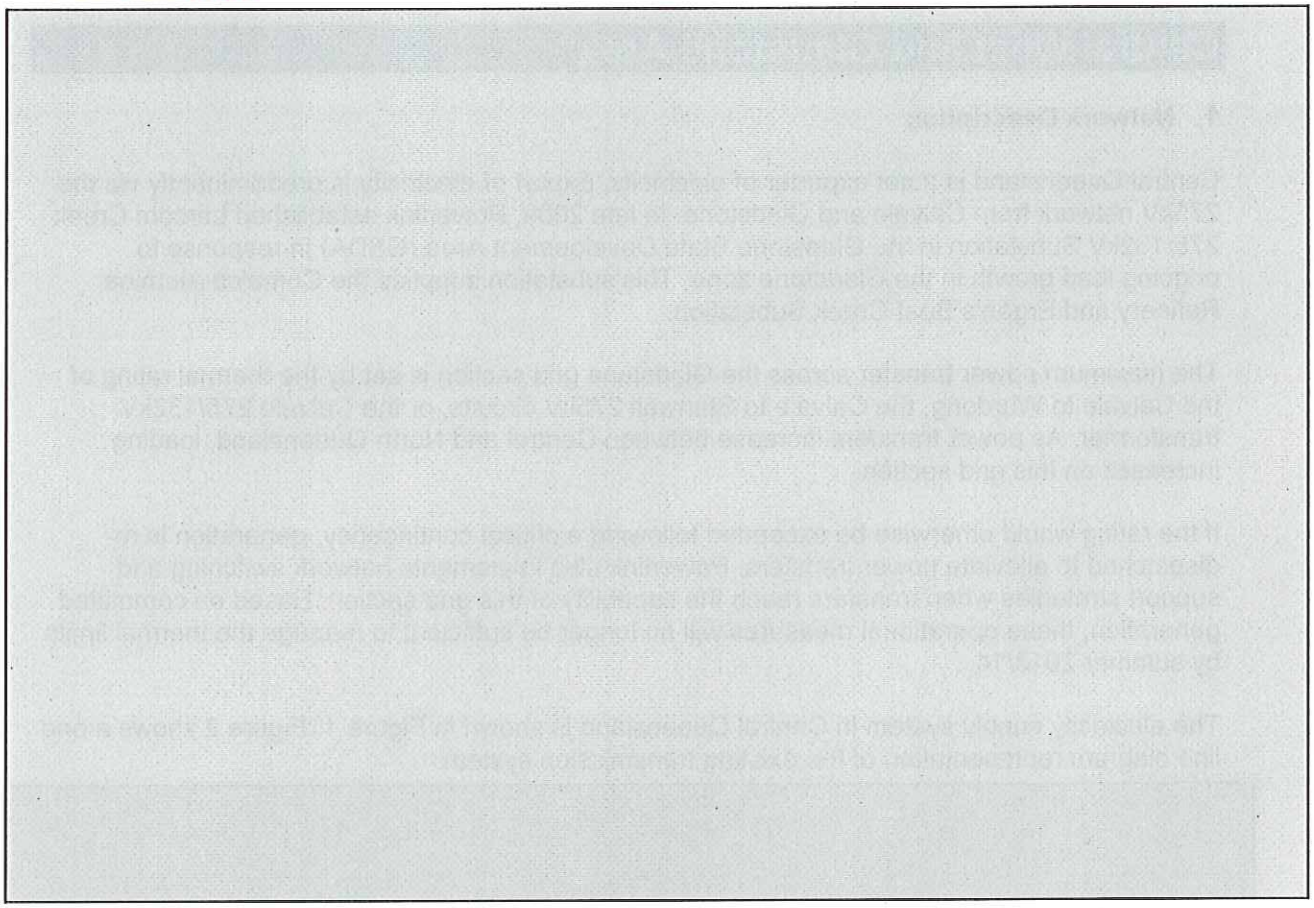
Central Queensland is a net exporter of electricity. Export of electricity is predominantly via the 275kV network from Calvale and Gladstone. In late 2009, Powerlink established Larcom Creek 275/132kV Substation in the Gladstone State Development Area (GSDA) in response to ongoing load growth in the Gladstone zone. This substation supplies the Comalco Alumina Refinery and Ergon's Boat Creek Substation.

The maximum power transfer across the Gladstone grid section is set by the thermal rating of the Calvale to Wurdong, the Calvale to Stanwell 275kV circuits, or the Calvale 275/132kV transformer. As power transfers increase between Central and North Queensland, loading increases on this grid section.

If the rating would otherwise be exceeded following a critical contingency, generation is re-dispatched to alleviate power transfers. Powerlink also implements network switching and support strategies when transfers reach the capability of this grid section. Based on committed generation, these operational measures will no longer be sufficient to manage the thermal limits by summer 2013/14.

The electricity supply system in Central Queensland is shown in Figure 1. Figure 2 shows a one line diagram representation of the existing transmission system.





The major 132kV injection points for Central Queensland sub-transmission system are Bouldercombe, Lilyvale, Calvale and Gladstone (to be replaced to Calliope River by summer 2013/14) 275/132kV substations. 275/132kV transformers at Boyne Island also help supply the major smelter load and these are Boyne Island assets.

A 132kV sub-transmission system provides supply to bulk supply points within the Gladstone and Rockhampton areas. Another 132kV sub-transmission system supplies the inland Bowen Basin coal mines at Dysart, Blackwater and Moura, and continues north to supply mining loads within the northern Bowen Basin coal fields.

2. Description of Committed Projects

Thermal limitations emerge across the Gladstone grid section, between Central West and Gladstone zones, under critical contingency conditions. These limitations arise due to power transfer from Central West zone to the Gladstone zone and then beyond to north and south Queensland.

These thermal limitations are currently managed by operational strategies and redispatch of generation to minimise the incidence of network constraints. The strategies extend to opening the 132kV lines at Gladstone South and/or Baralaba.

It is forecast that by summer 2013/14 peak demand will be such that use of operational measures will no longer be sufficient to manage the thermal limits of the critical transmission plant without action to augment supply. The AER Regulatory Test (completed in late 2010) concluded that the option that minimises the net present value of costs was the construction of a 275kV double circuit line between Calvale and Stanwell. This committed project is underway and planned to be completed by October 2013.

Ergon Energy required additional supply capacity to the Keppel area north of Rockhampton. A 132kV connection for Pandoin was constructed and commissioned in 2009. In addition,

Queensland Rail required additional supply for haulage electrification. Three projects are committed for Wycarbah, Bluff and Duaringa rail sites by late 2012.

Due to ongoing demand growth, from late 2010 a 132kV circuit outage results in unacceptably low voltage conditions in the Moura area during summer peak demand periods. This limitation has recently been addressed by installation of a 132kV capacitor bank at Moura Substation.

Table 1 lists the committed projects assumed in the Grid Plan for this area.

Table 1: Committed projects assumed in the 2010 Grid Plan in Central Queensland

Project ID	Project Description	Expected Commissioning
CP.01620	Bouldercombe 275/132kV Transformer Reinforcement	Summer 2012/13
CP.02412	Lilyvale – Blackwater 3rd Circuit Connection	Summer 2012/13
CP.01705	Calvale – Stanwell 275kV DCST Line	Summer 2013/14
CP.01780	Gladstone PS Switchyard Full Rebuild	Summer 2013/14

3. Existing Generation Capacity

Gladstone Power Station comprises of six coal fired steam turbines with a combined generating capacity of 1680MW. It is one of the older stations commissioned in 1976. Four of the Gladstone generators (units 1, 2, 5 and 6) are connected to the 275kV system and two (units 3 and 4) are connected to the 132kV system. The systems are connected by two 275/132kV bus-tie transformers located within the site.

Stanwell Power Station is powered by four steam turbines with a combined generating capacity of 1400MW. It was commissioned in 1996.The Callide "B" Power Station consists of two coal fired steam turbines with combined capacity of 700MW, and was commissioned in 1988. The Callide Power Plant (or Callide "C") is the newest of the coal fired generation stations, consisting of two advanced cycle 450MW steam turbines, and was commissioned in 2001.

The CAR Stage 2 project, connected to the 132kV network at Yarwun Substation, incorporates a 160MW combined cycle gas fired cogeneration plant as the refinery's primary fuel source. Origin Energy and Rio Tinto have entered into a Gas Supply Agreement which has resulted in coal seam methane supplied from the Walloon coal seam gas fields within the central Queensland Surat Basin. The Larcom Creek to Yarwun double circuit line has been constructed partly within an existing easement earmarked for future 275kV circuits. Hence, this part of the line was built for 275kV operation, with a new 132kV supply to Yarwun to be constructed when 275kV is required between Larcom Creek and Calliope River substations.

4. Generation Scenarios

Generation scenarios nominated within this area may impact transmission developments in the Central Queensland area.

Should these developments occur, there may be an impact on the required transmission needs in the area. These impacts have been taken into account in developing the transmission plans for each scenario. Table 2 lists potential new entrants (in addition to existing plant) as identified by ROAM.

Table 2: ROAM new entrants in Central Queensland

Generator	Capacity (MW)	Assumed Point of Connection	Cumulative Probability of Proceeding by 2021/22
ZeroGen 1	120	Lilyvale 275kV	35%
ZeroGen 2	400	Lilyvale 275kV	35%
Mini 3 Solar Thermal	20	Lilyvale 132kV	17%

ROAM has assigned a probability of 100% to the decommissioning of Callide A by 2014/15, 65% to the decommissioning of Gladstone units 1 and 2 and 20% to the decommissioning of Gladstone units 3 and 4 by 2017/18.

5. Description of Transmission Limitations

Main Grid

Central Queensland is a net exporter of electricity. Power is exported to north and south Queensland to meet reliability of supply obligations. Within Central Queensland there is also a requirement to export power east from Calvale to the Gladstone zone. As power transfers increase from central to north and/or south Queensland, loading increases on this grid section.

The maximum power transfer within the Gladstone zone and between the Central West and Gladstone zones is set by the thermal rating of the transmission and sub-transmission plant. The critical Main Grid contingencies include:

- 275kV circuits between Calvale and Stanwell substations;
- 275kV circuit between Calvale and Wurdong substations (871);
- 275kV circuit between Calliope River and Wurdong substations (818); and
- 275/132kV transformer at Calvale Substation.

Limitations are forecast to re-emerge within and between the Central West and Gladstone zones for one or more of the above critical contingencies. Thermal overloads may occur across the Calvale 275/132kV transformer, Calvale to Wurdong 275kV circuit (871) or Calliope River to Wurdong 275kV circuit (818). The timing and extent of the limitations are dependent on the economic growth outlook and the generation scenario.

In December 1993, the Queensland Government established the Gladstone State Development Area (GSDA) under the State Development and Public Works Organisation Act 1971 as an industrial park to attract energy intensive industries, given its proximity to globally competitive electric power. Since then an area on Curtis Island has been set aside and designated for the production and export of LNG. As a result, in the medium to long-term, there is huge potential for large scale electricity supply requirements in the Gladstone area. Given the size of the GSDA and Curtis Island LNG industrial precincts the potential exists for load in the Gladstone area to increase by as much as 2,500 MW over the next 15 to 20 years. Powerlink has proposed a contingent project address these limitations.

The Galilee Basin, 450km west of Rockhampton, is the last remaining major coal province yet to be developed in Queensland. It is an emerging asset with many significant energy related proposals including multiple coal mines, underground coal gasification and oil and gas exploration. In April 2010, the State Government was joining forces with local authorities to fund a Galilee Economic and Social Impact Study, which is aimed at managing regional growth for the economic and social benefit of the area.

Powerlink is not discounting the prospect of other significant development projects, or expansion by existing industrial users, occurring in the Galilee Basin in the relatively near future. Powerlink has proposed a contingent project address these limitations.

Regional Grid

Demand in the Blackwater area is expected to grow strongly due to new large industrial loads comprising additional committed coal haulage rail traffic projects. As a result, thermal limitations are expected to occur under critical contingency conditions in the 132kV network supplying the area by summer 2012/13, without action to augment supply.

The critical Regional Grid contingencies include:

- 132kV circuits between Callide 'A' and Gladstone South substations (7104, 7105);
- 132kV circuits between Calliope River and Boyne Island substations (7145, 7146); and
- 132kV circuits between Calliope River and Gladstone South.

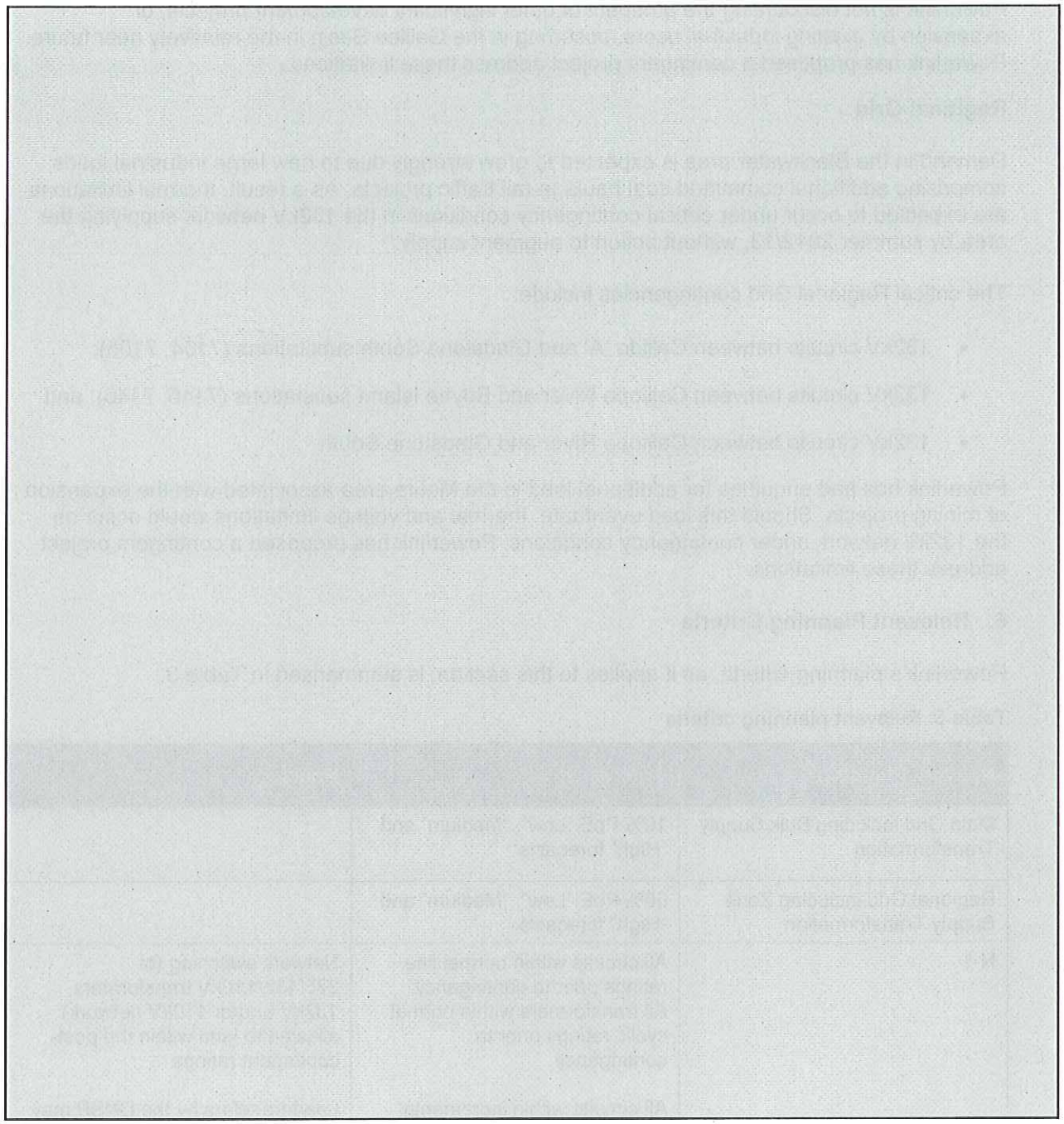
Powerlink has had enquiries for additional load in the Moura area associated with the expansion of mining projects. Should this load eventuate, thermal and voltage limitations would occur on the 132kV network under contingency conditions. Powerlink has proposed a contingent project address these limitations.

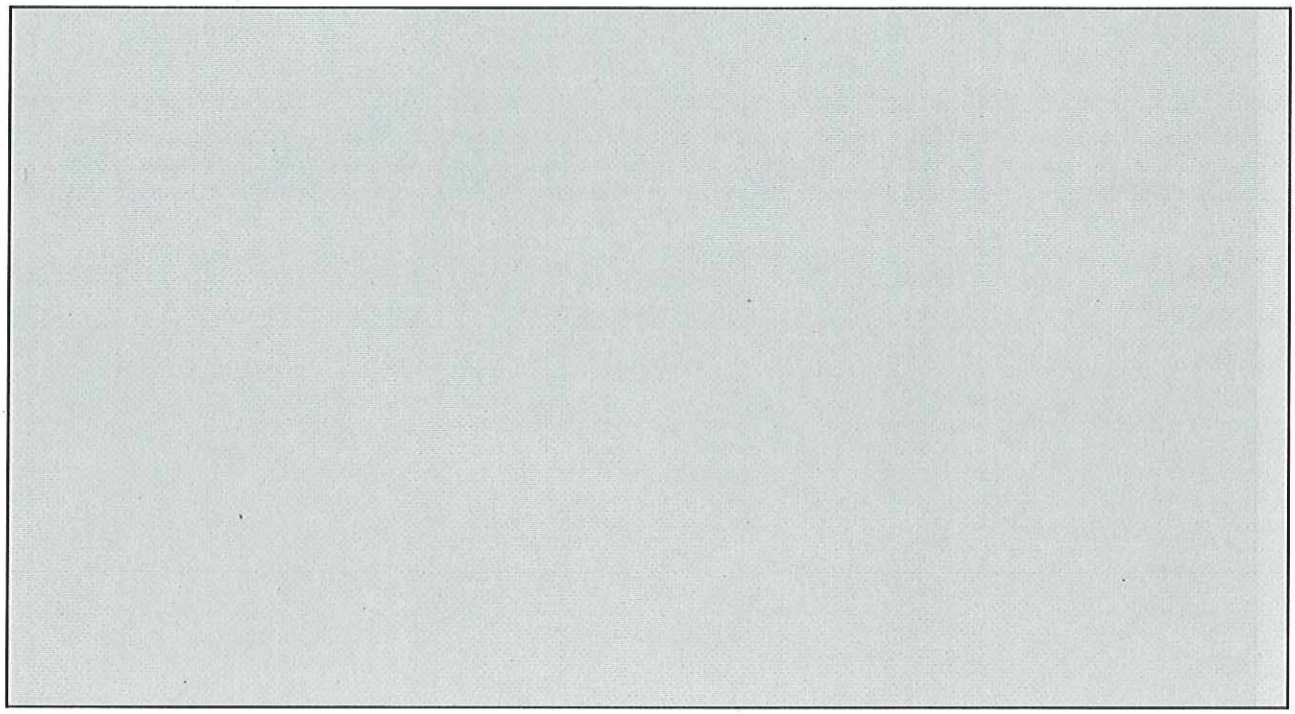
6. Relevant Planning Criteria

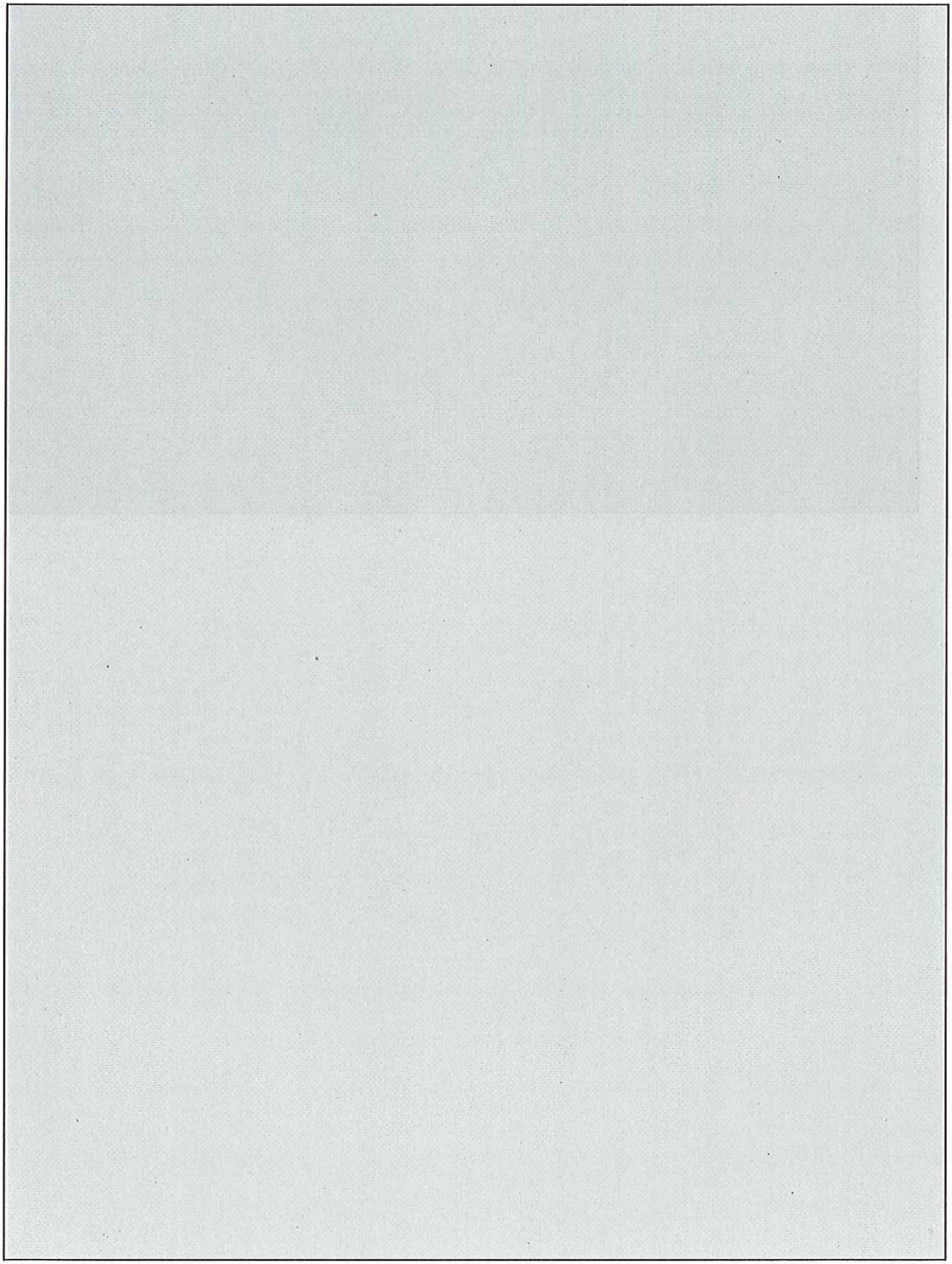
Powerlink's planning criteria, as it applies to this section, is summarised in Table 3.

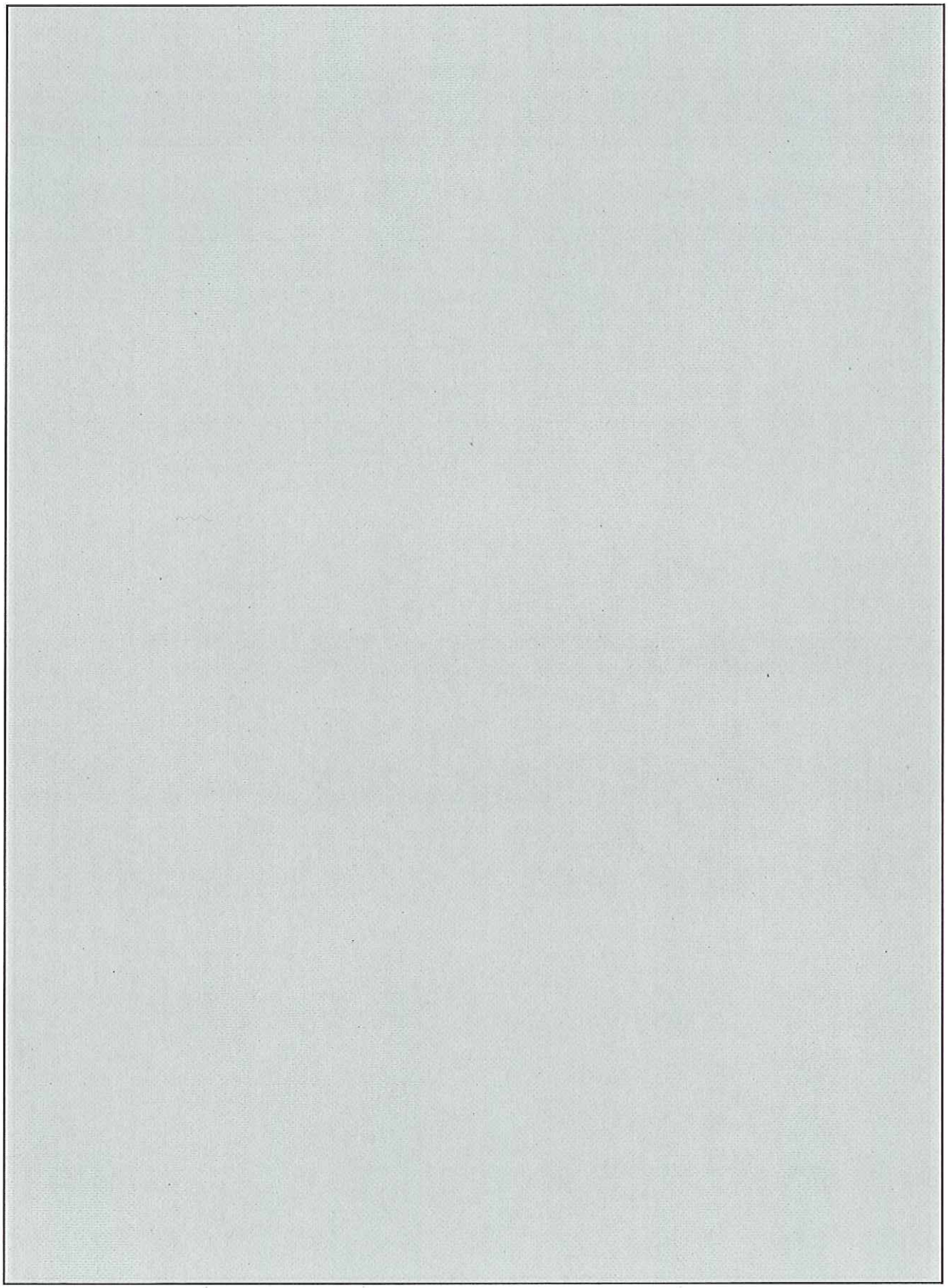
Table 3: Relevant planning criteria

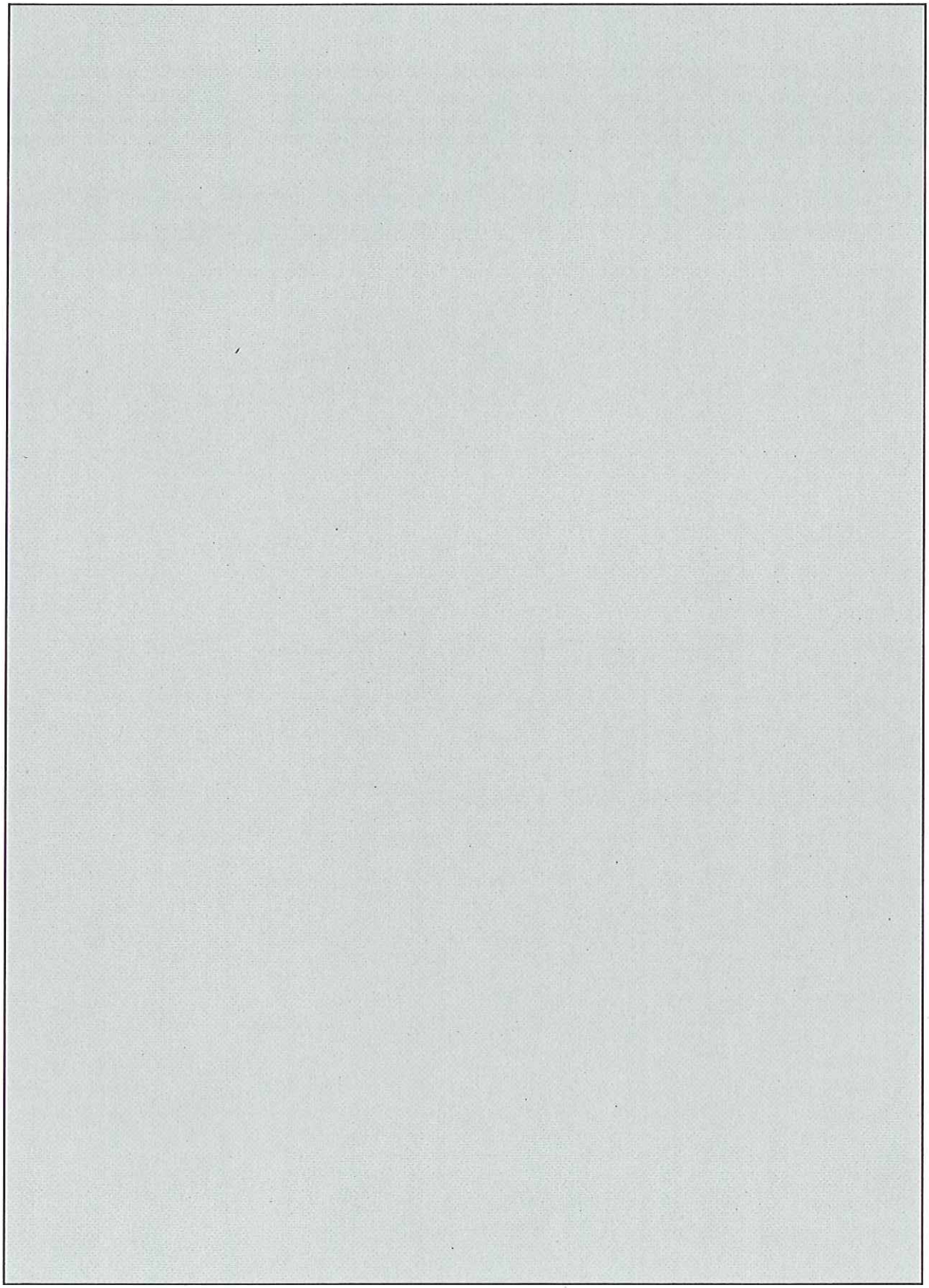
Network Planning	Criteria	Notes
Main Grid including Bulk Supply Transformation	10% PoE "Low", "Medium" and "High" forecasts	
Regional Grid including Zone Supply Transformation	50% PoE "Low", "Medium" and "High" forecasts	
N-1	All circuits within normal line ratings prior to contingency. All transformers within normal cyclic ratings prior to contingency All circuits within incremental line ratings following N-1 All transformers within emergency cyclic rating following N-1	Network switching (of 275/132/110kV transformers, 132kV and/or 110kV network) allowed to land within the post-contingent ratings Load transfers by the DNSP may be considered but must be pre-contingent Generation can be constrained to meet these objectives (within the limits of installed capacity), but the cumulative market impact needs to be considered

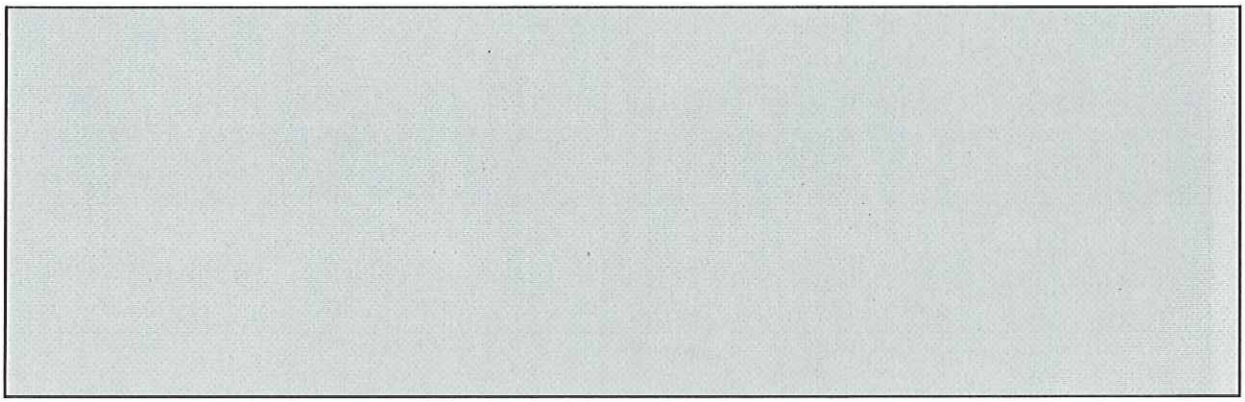


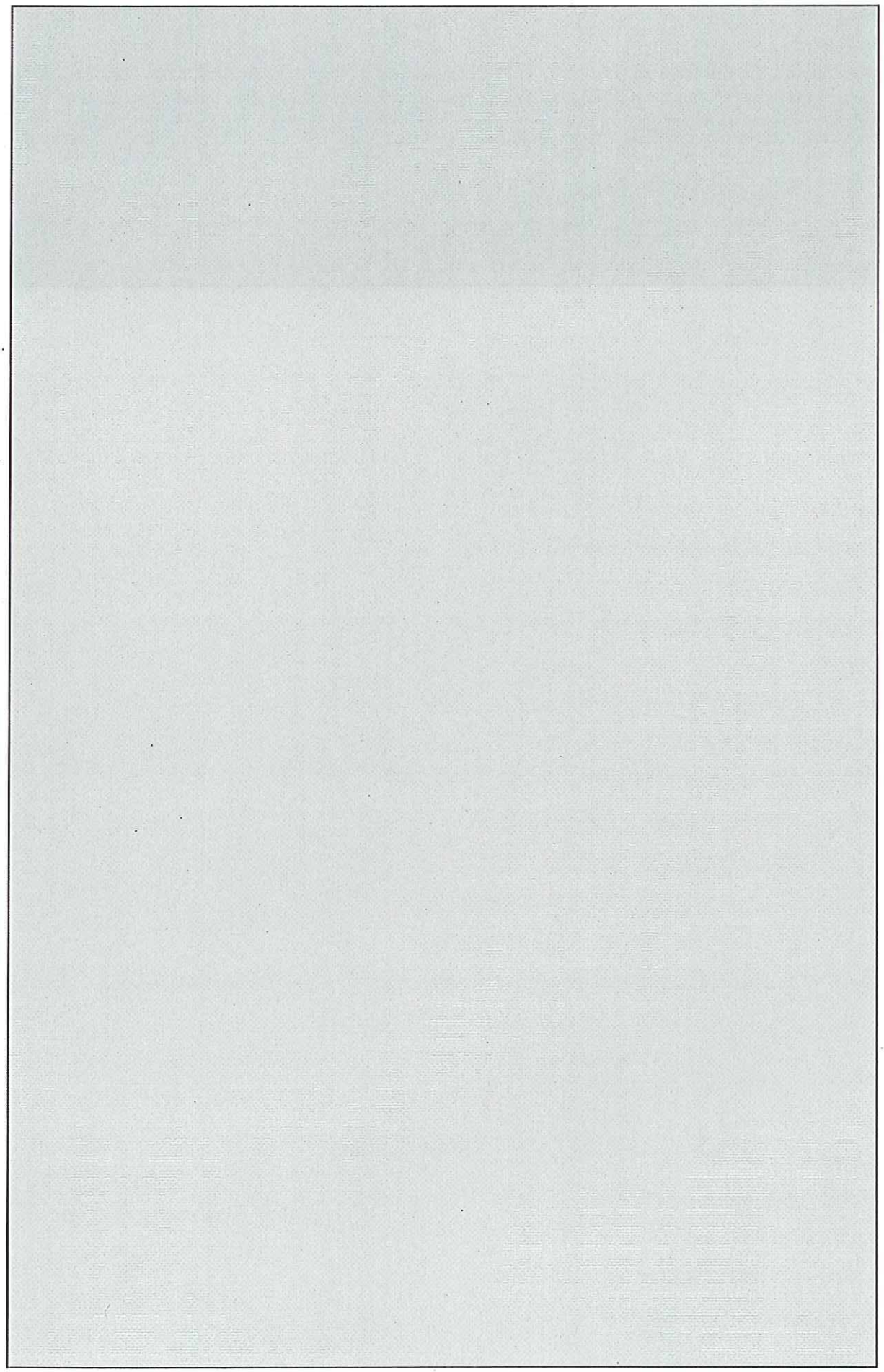


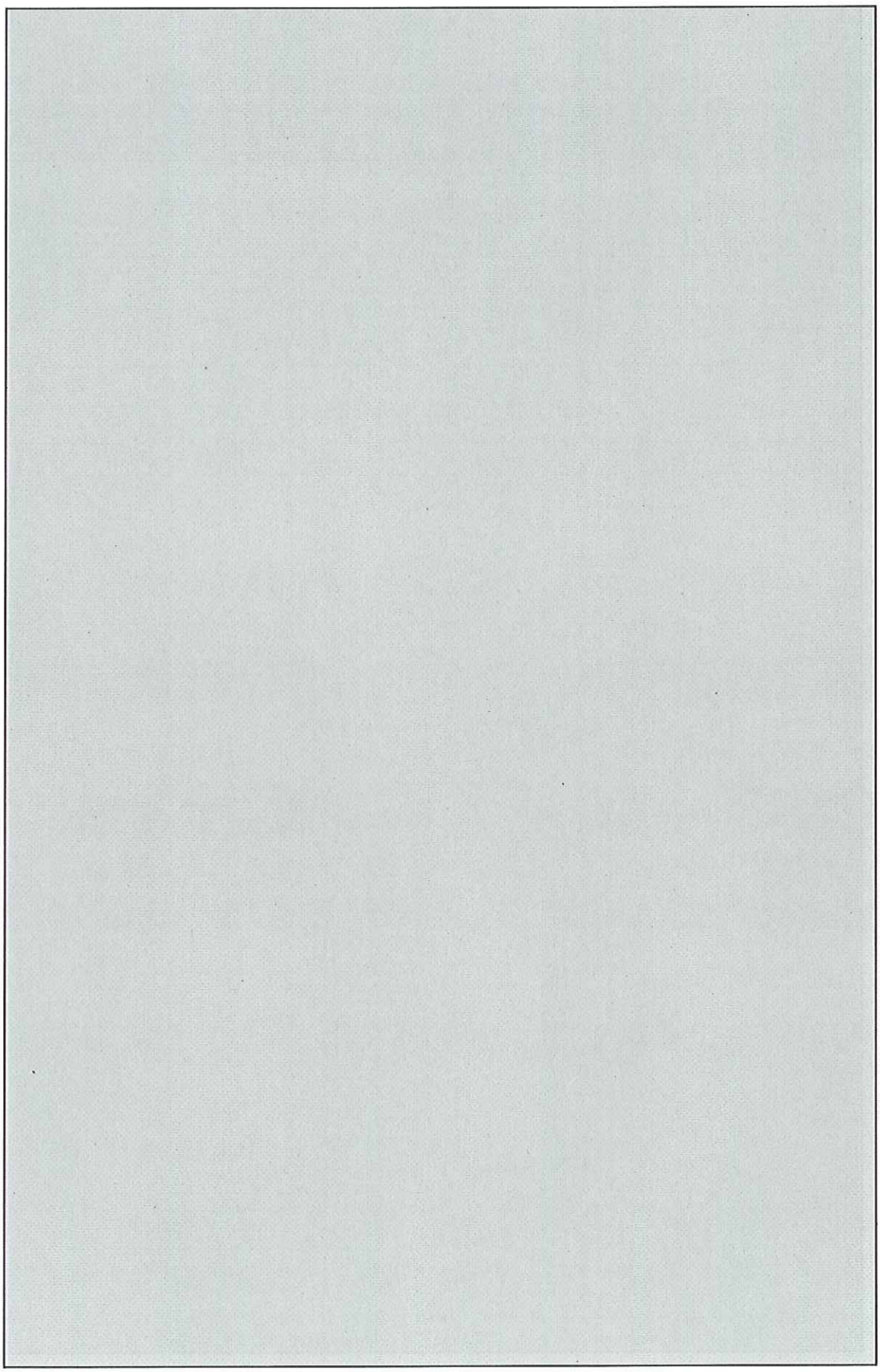


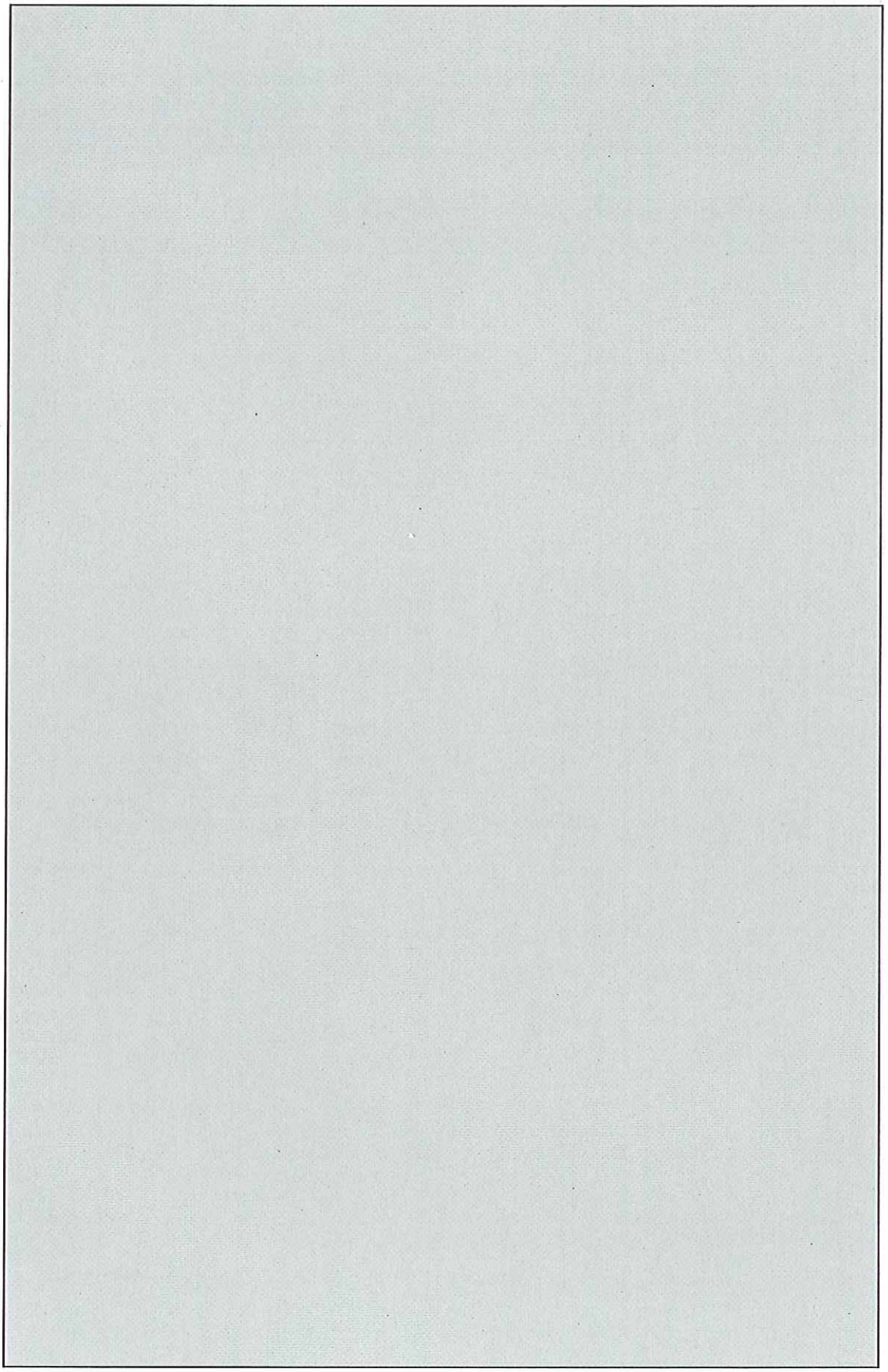


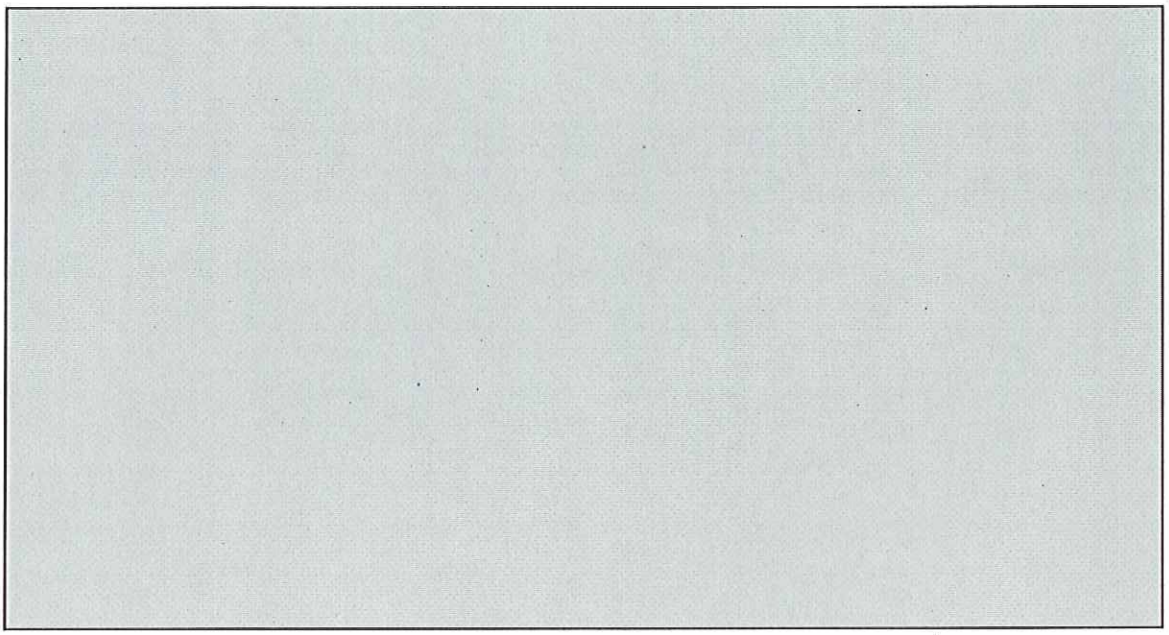


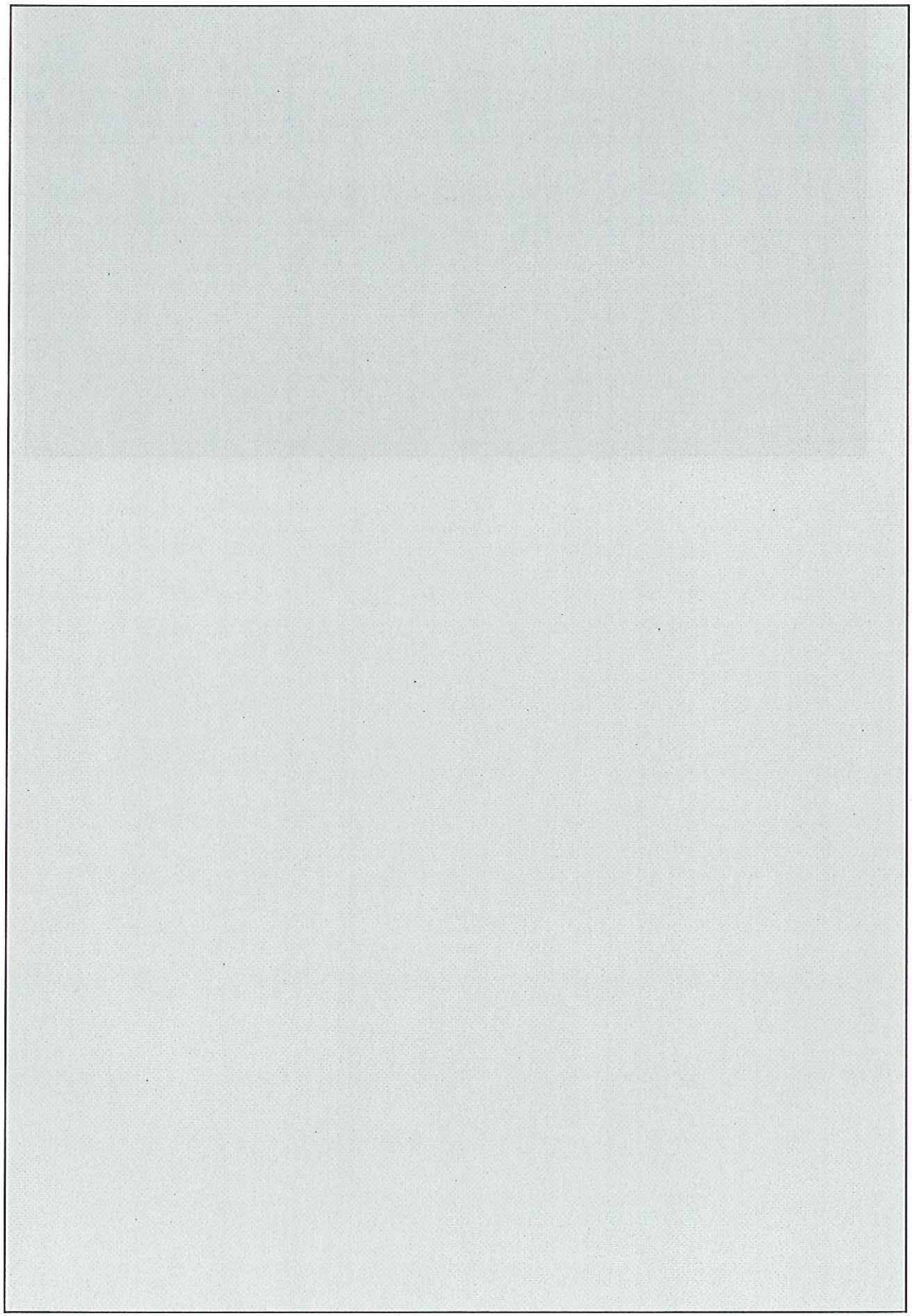


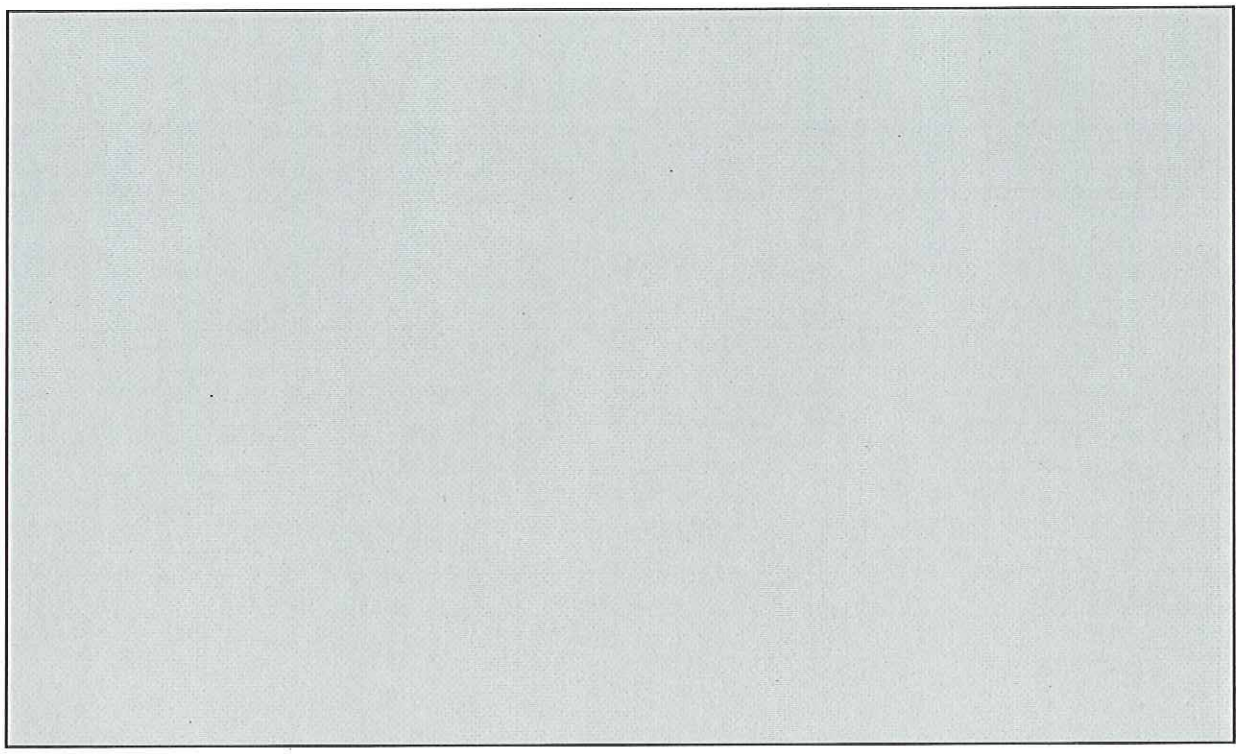


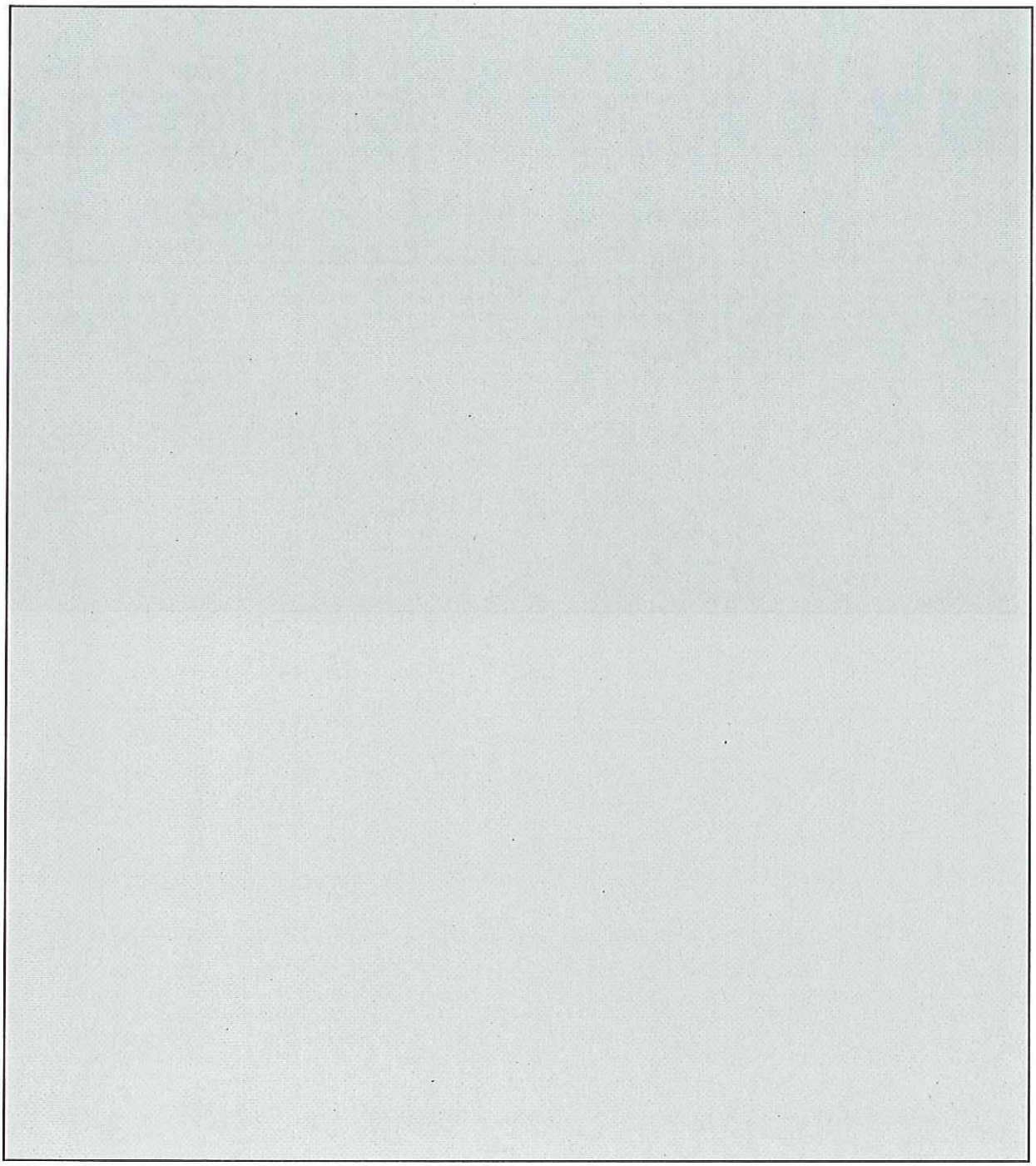


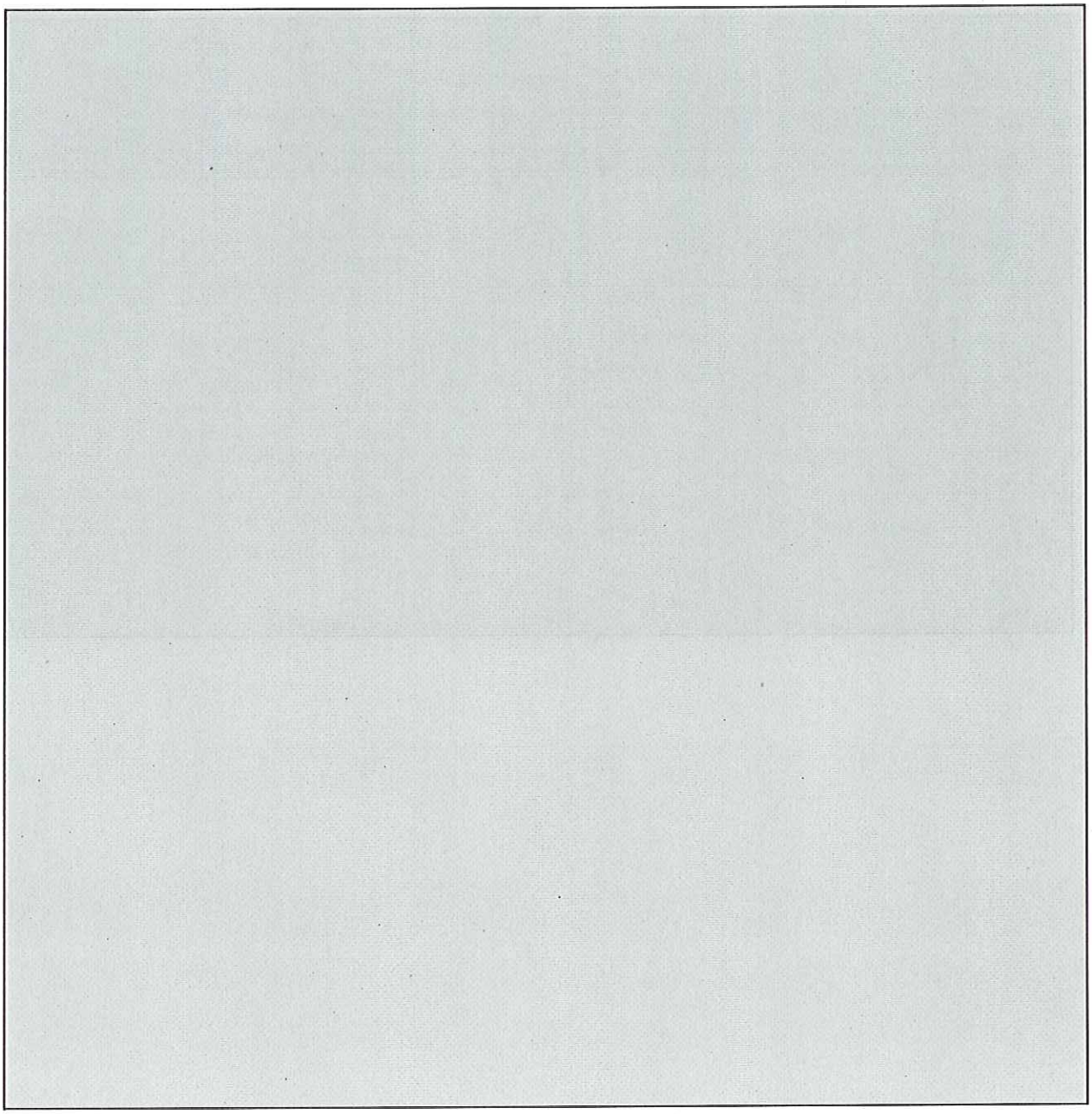


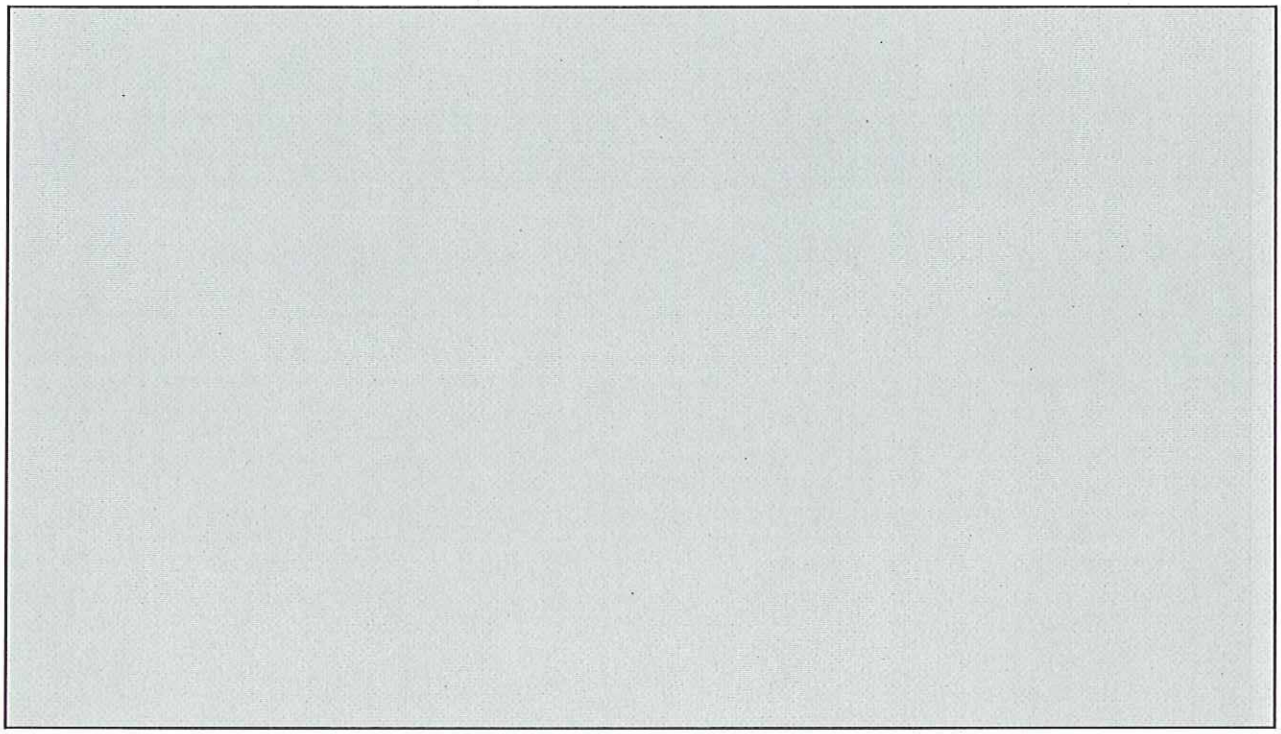


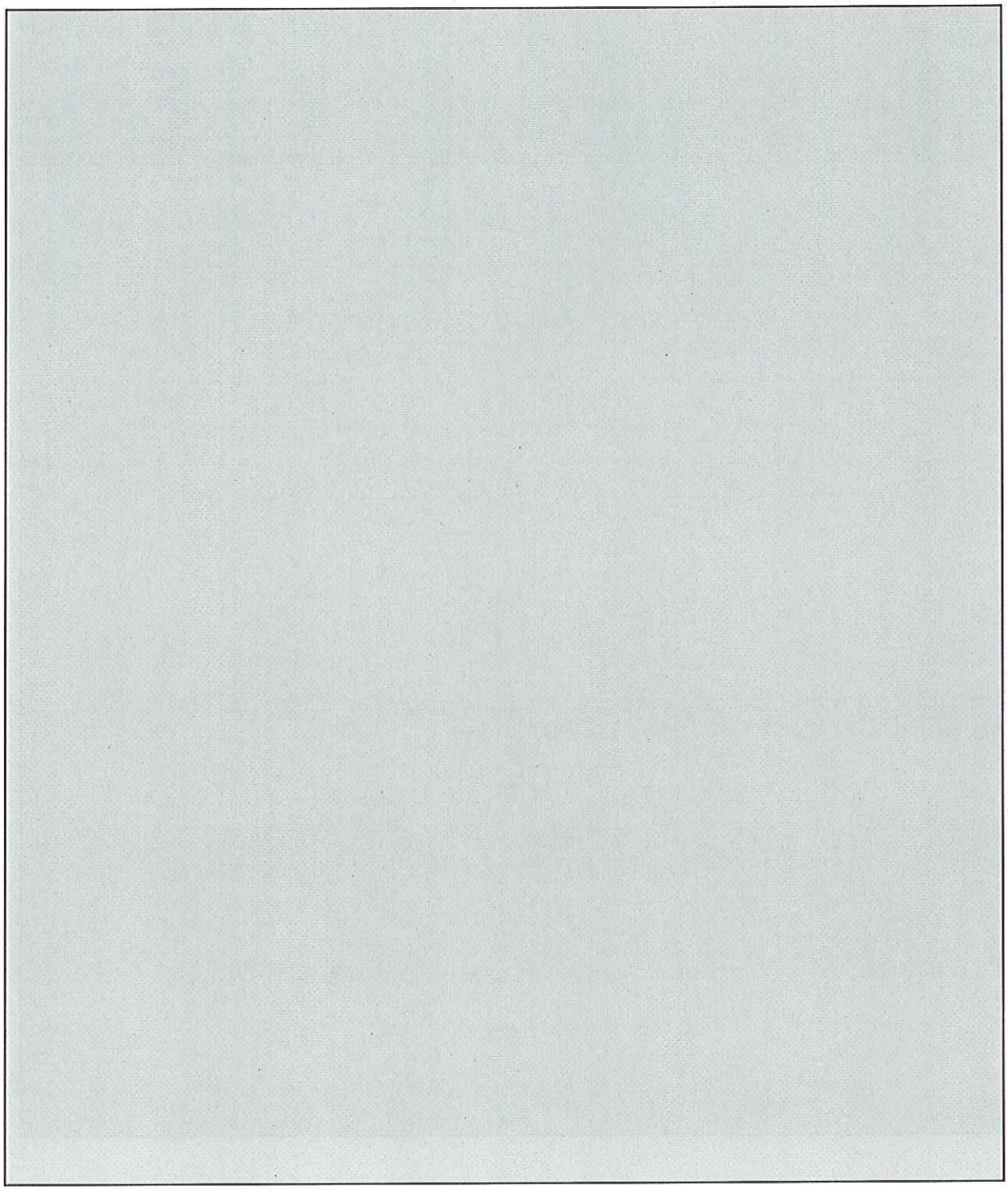


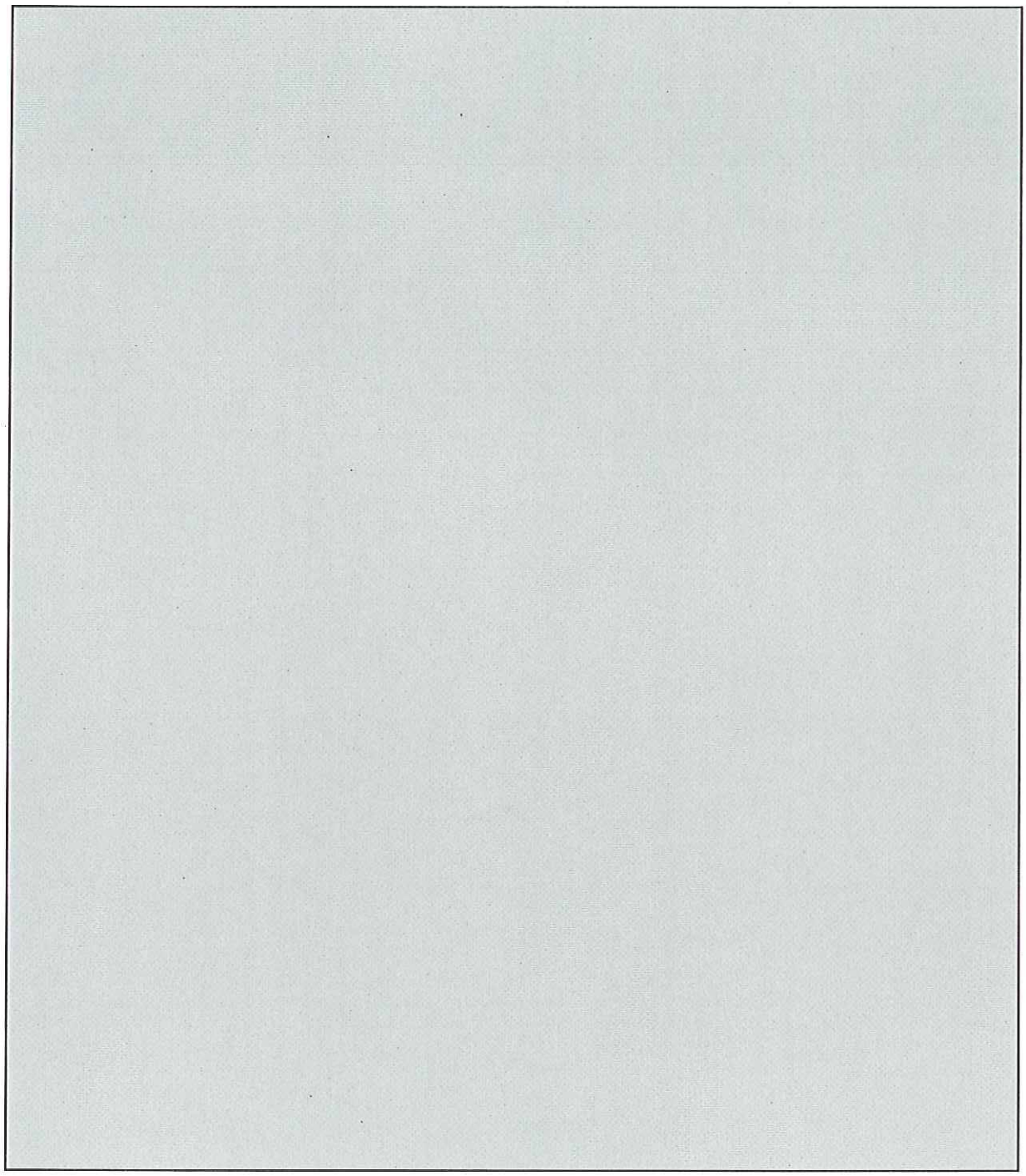


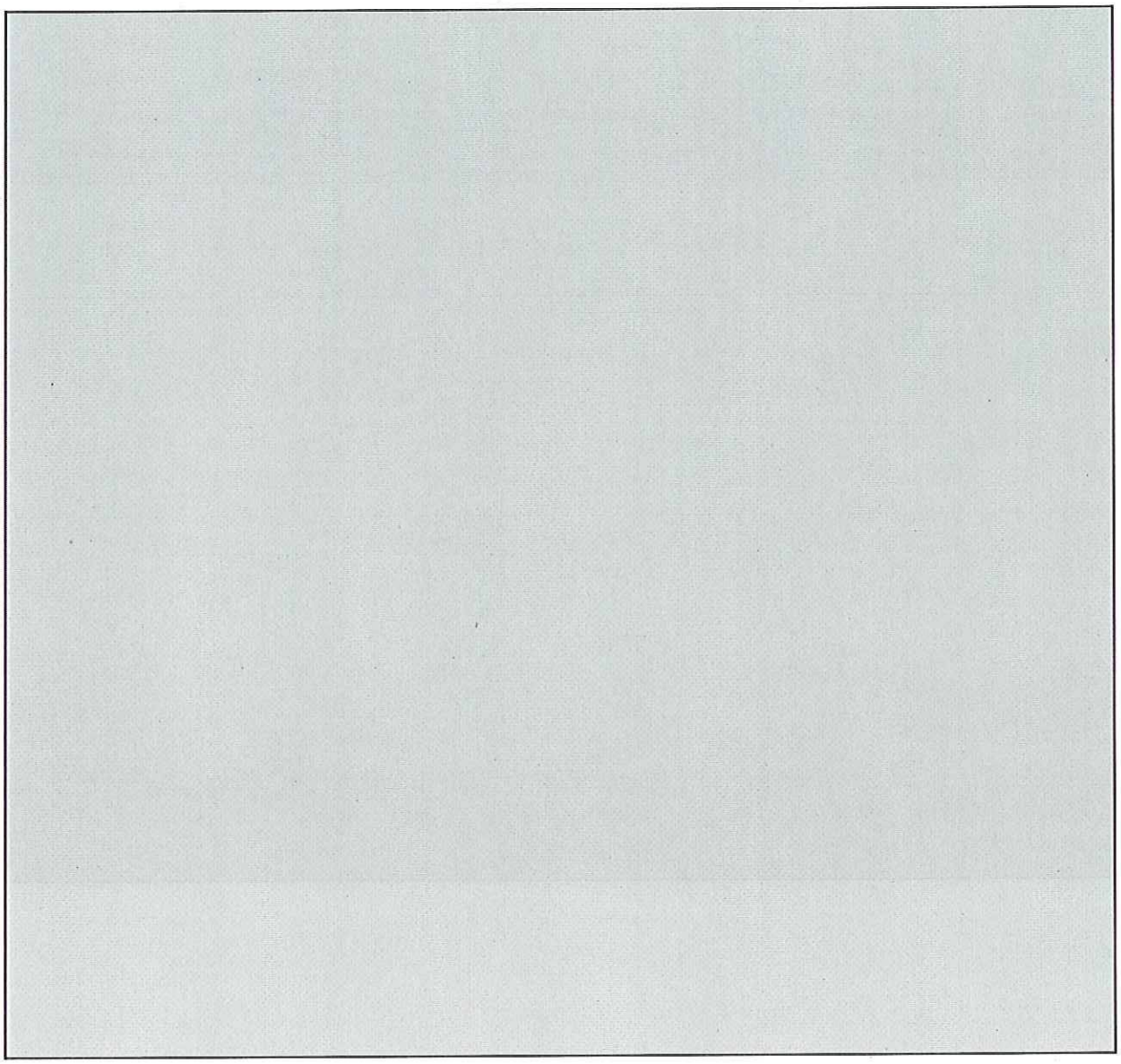


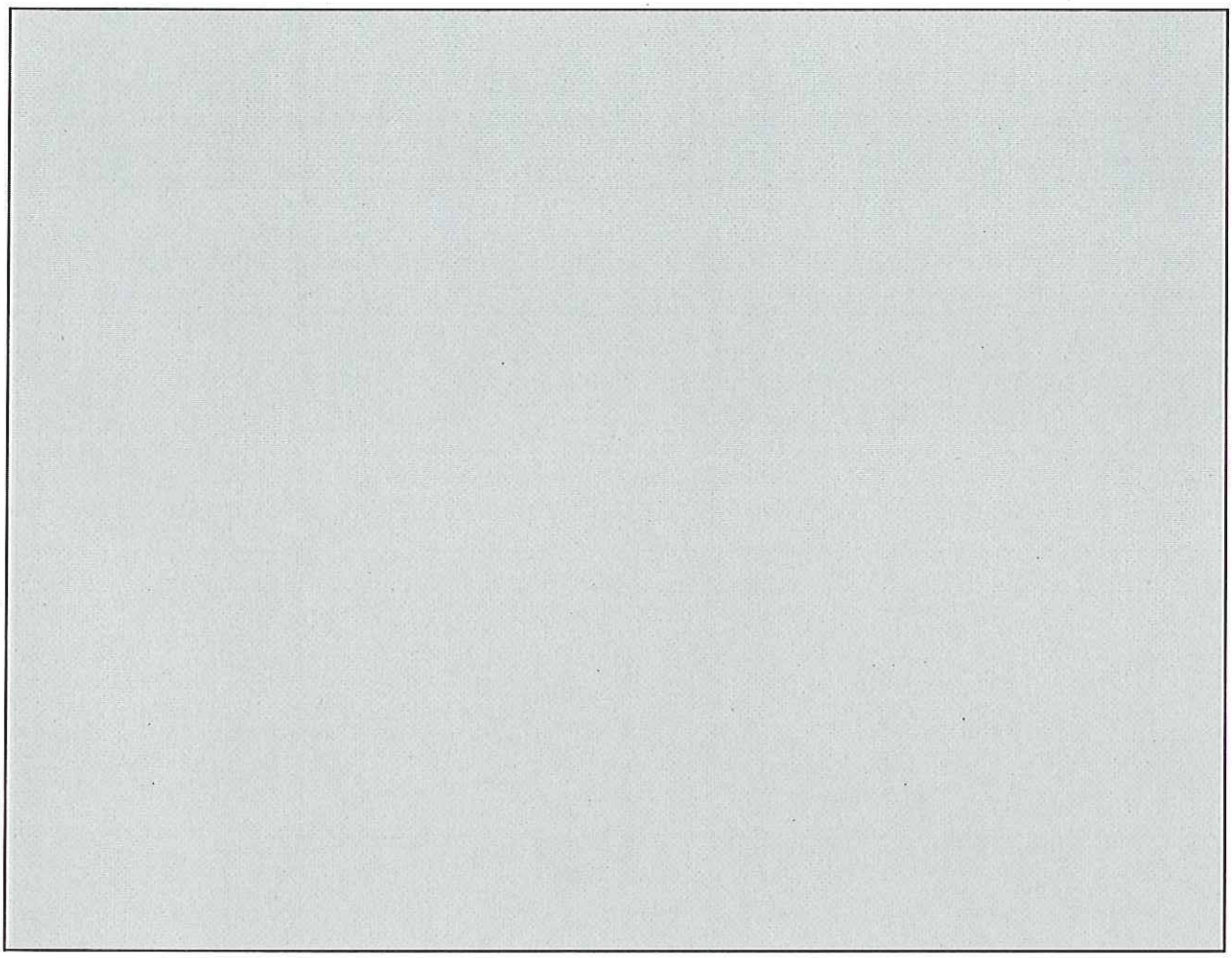


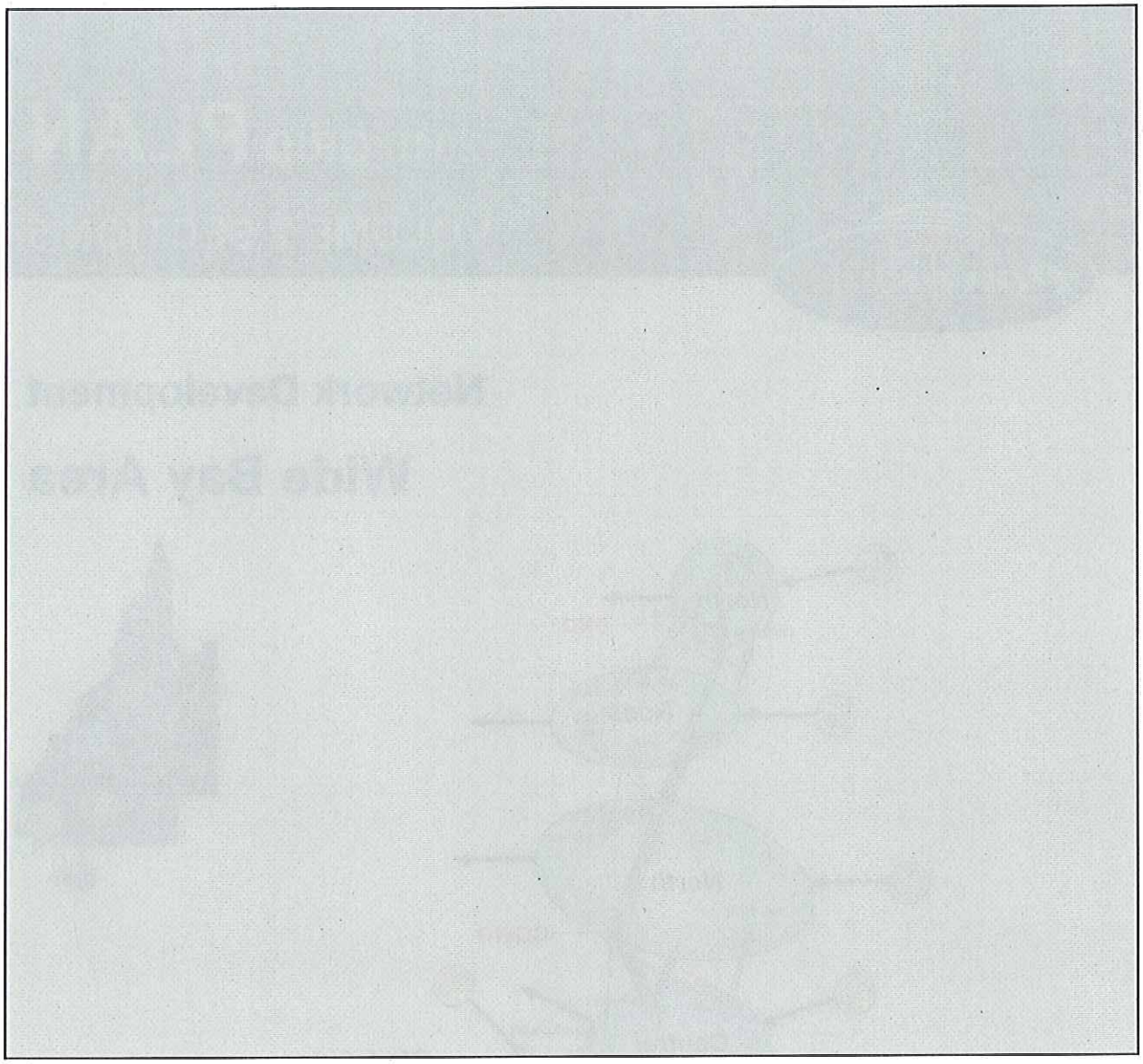










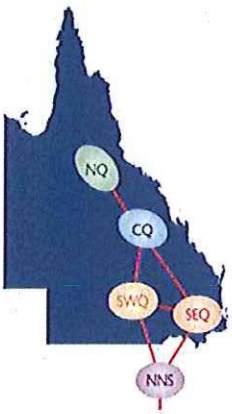


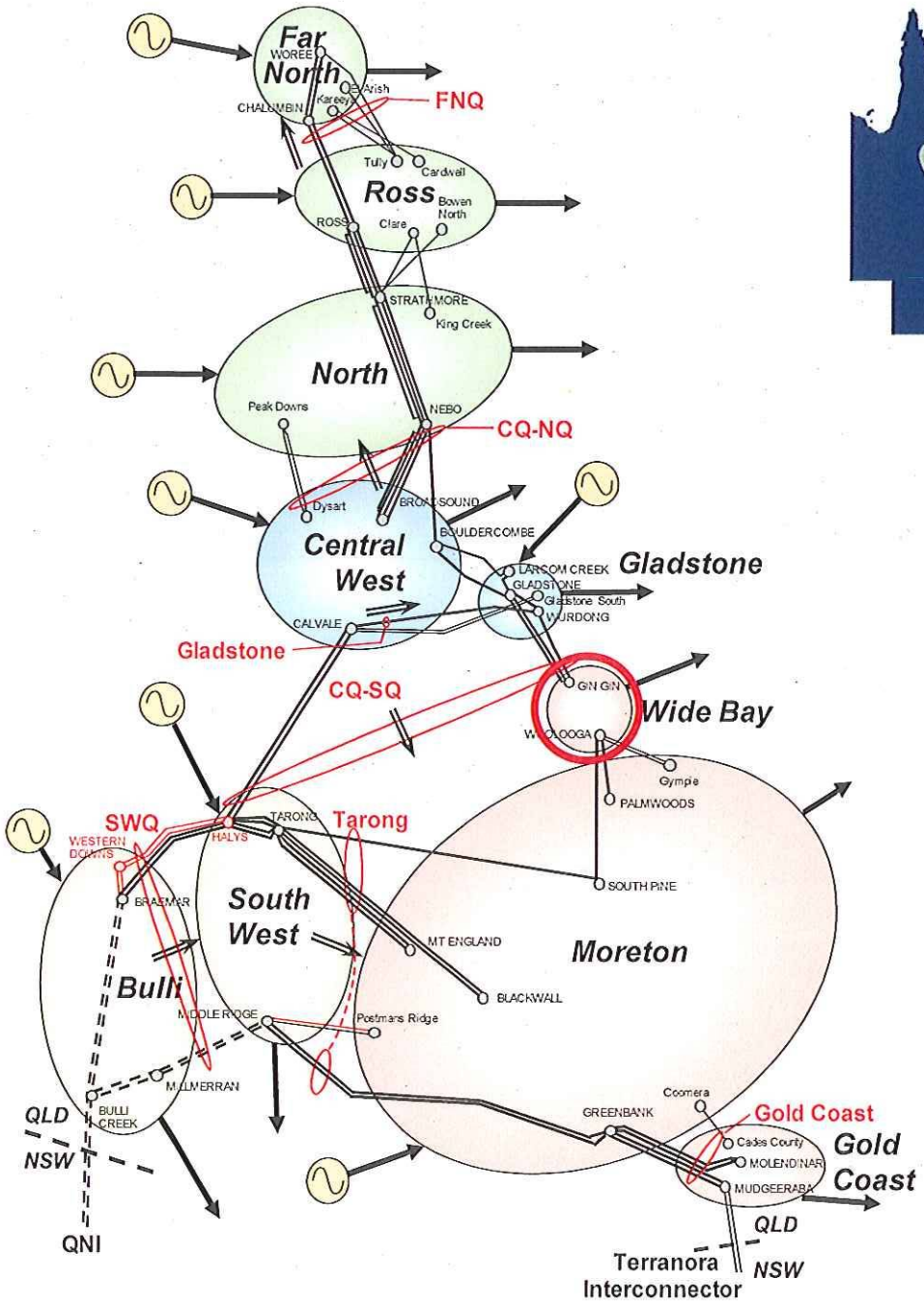
2010 GRID PLAN

VOLUME 2 SECTION 5

Network Development

Wide Bay Area





Wide Bay Area

1. Network Description

Wide Bay is a net importer of electricity. The Wide Bay zone is defined as the area south of Gin Gin (inclusive) and north of Woolooga (inclusive), and comprises of sugar cane farming, the commercial centres of Bundaberg and Maryborough, and residential and tourist destinations of Hervey Bay and Fraser Coast.

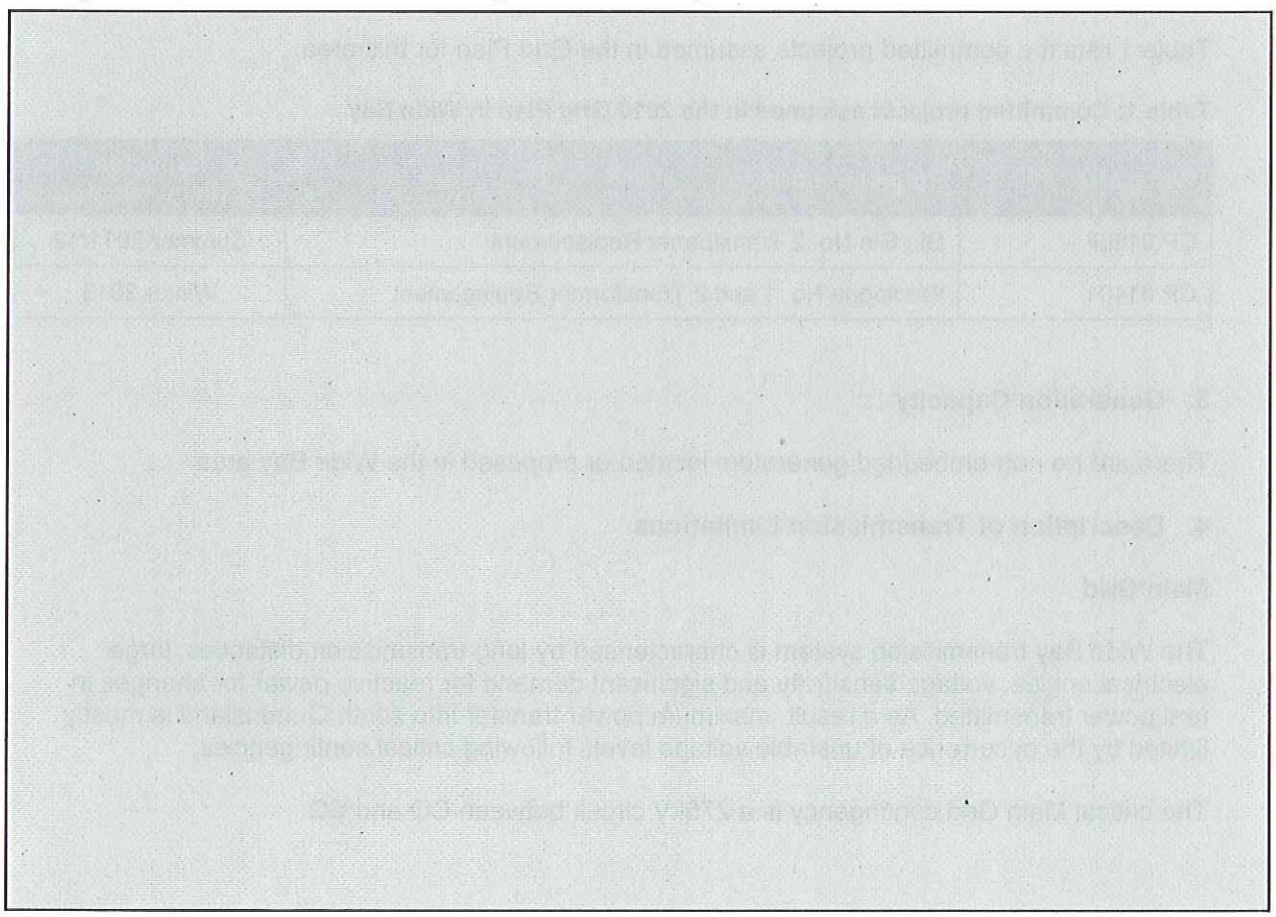
Import of electricity is predominantly via the 275kV network from Gladstone. The major injection points for the Wide Bay area are the Gin Gin, Teebar Creek and Woolooga 275/132kV substations.

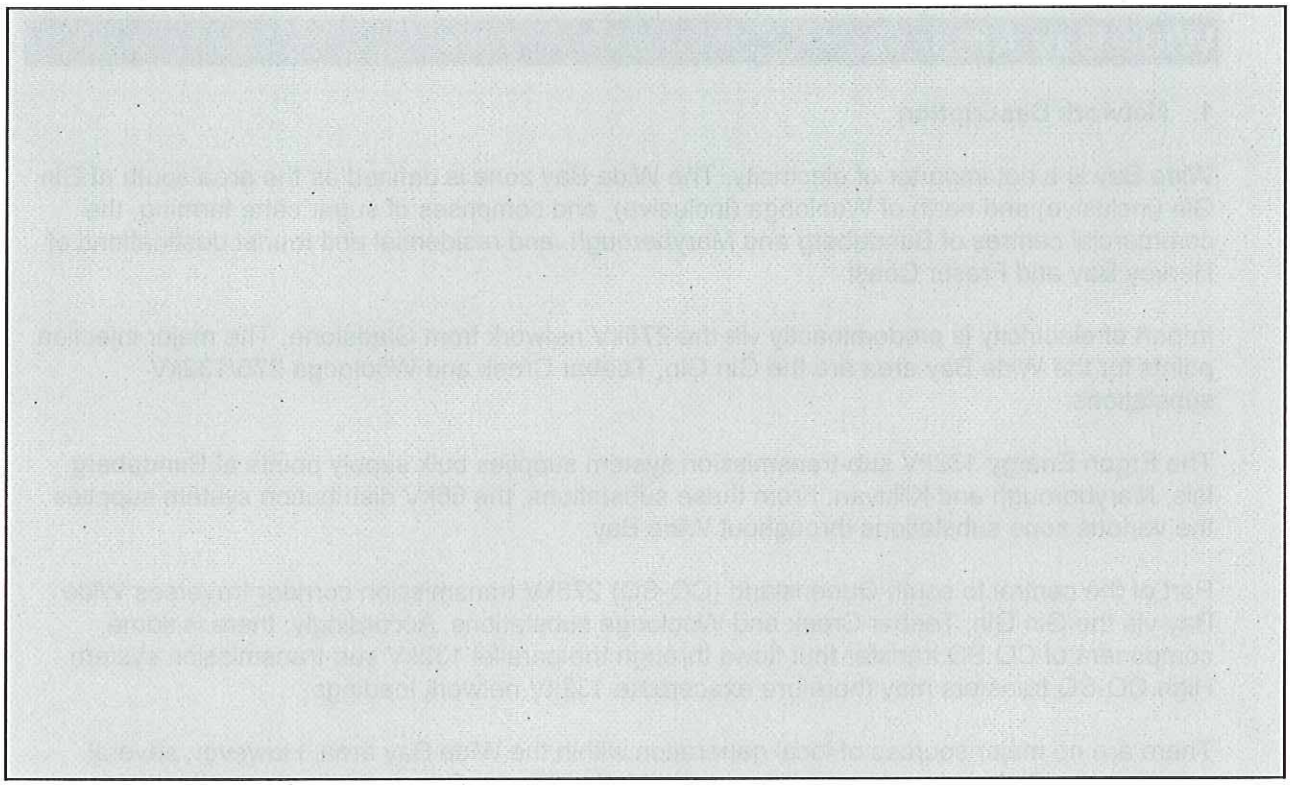
The Ergon Energy 132kV sub-transmission system supplies bulk supply points at Bundaberg, Isis, Maryborough and Kilkivan. From these substations, the 66kV distribution system supplies the various zone substations throughout Wide Bay.

Part of the central to south Queensland (CQ-SQ) 275kV transmission corridor traverses Wide Bay via the Gin Gin, Teebar Creek and Woolooga substations. Accordingly, there is some component of CQ SQ transfer that flows through the parallel 132kV sub-transmission system. High CQ-SQ transfers may therefore exacerbate 132kV network loadings.

There are no major sources of local generation within the Wide Bay area. However, several small sugar mill co-generation facilities embedded within the Ergon distribution network are located within this zone. The effects of these embedded generators are taken into account within the summer and winter peak forecasts.

The electricity supply system in Wide Bay is shown in Figure 1. Figure 2 shows a one line diagram representation of the existing transmission system.





2. Description of Committed Projects

The Gin Gin 275/132kV transformers will be replaced by summer 2011/12 and the Woolooga 275/132kV transformer by winter 2013. The replacements will provide adequate capacity to maintain supply whilst addressing condition related issues.

Table 1 lists the committed projects assumed in the Grid Plan for this area.

Table 1: Committed projects assumed in the 2010 Grid Plan in Wide Bay

Project ID	Project Description	Expected Commissioning
CP.01364	Gin Gin No. 2 Transformer Replacement	Summer 2011/12
CP.01401	Woolooga No. 1 and 2 Transformer Replacement	Winter 2013

3. Generation Capacity

There are no non-embedded generators located or proposed in the Wide Bay area.

4. Description of Transmission Limitations

Main Grid

The Wide Bay transmission system is characterised by long transmission distances, large electrical angles, voltage sensitivity and significant demand for reactive power for changes in real power transmitted. As a result, maximum power transfer into south Queensland is mostly limited by the occurrence of unstable voltage levels following critical contingencies.

The critical Main Grid contingency is a 275kV circuit between CQ and SQ.

Regional Grid

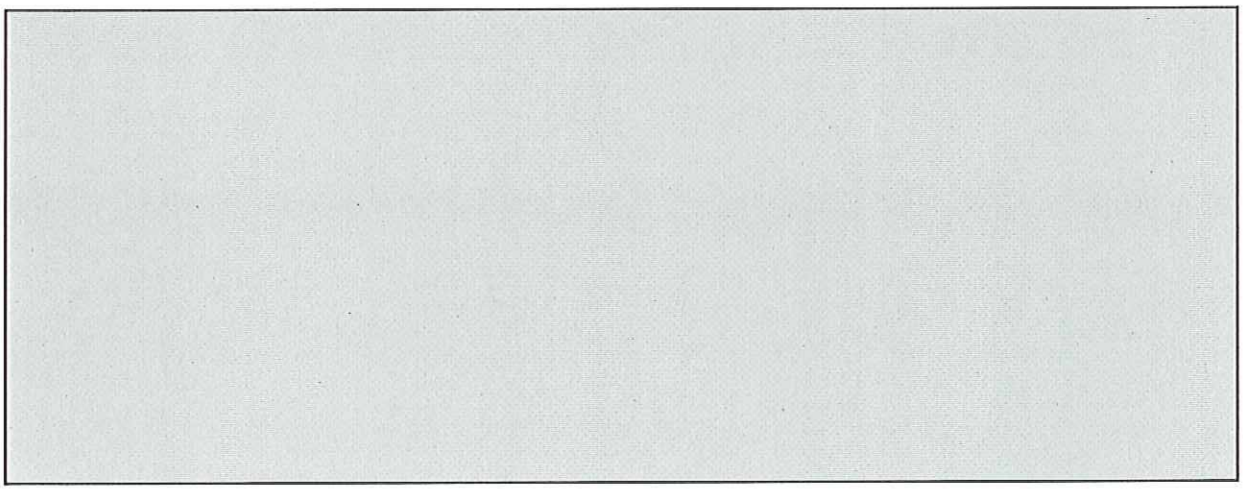
Load growth in the Wide Bay area is not expected to trigger any further regional grid augmentation projects in the regulatory period 2013-17 due to committed projects providing sufficient capacity. On the Ergon sub-transmission system the identified limitations are to be addressed by projects within the sub-transmission system.

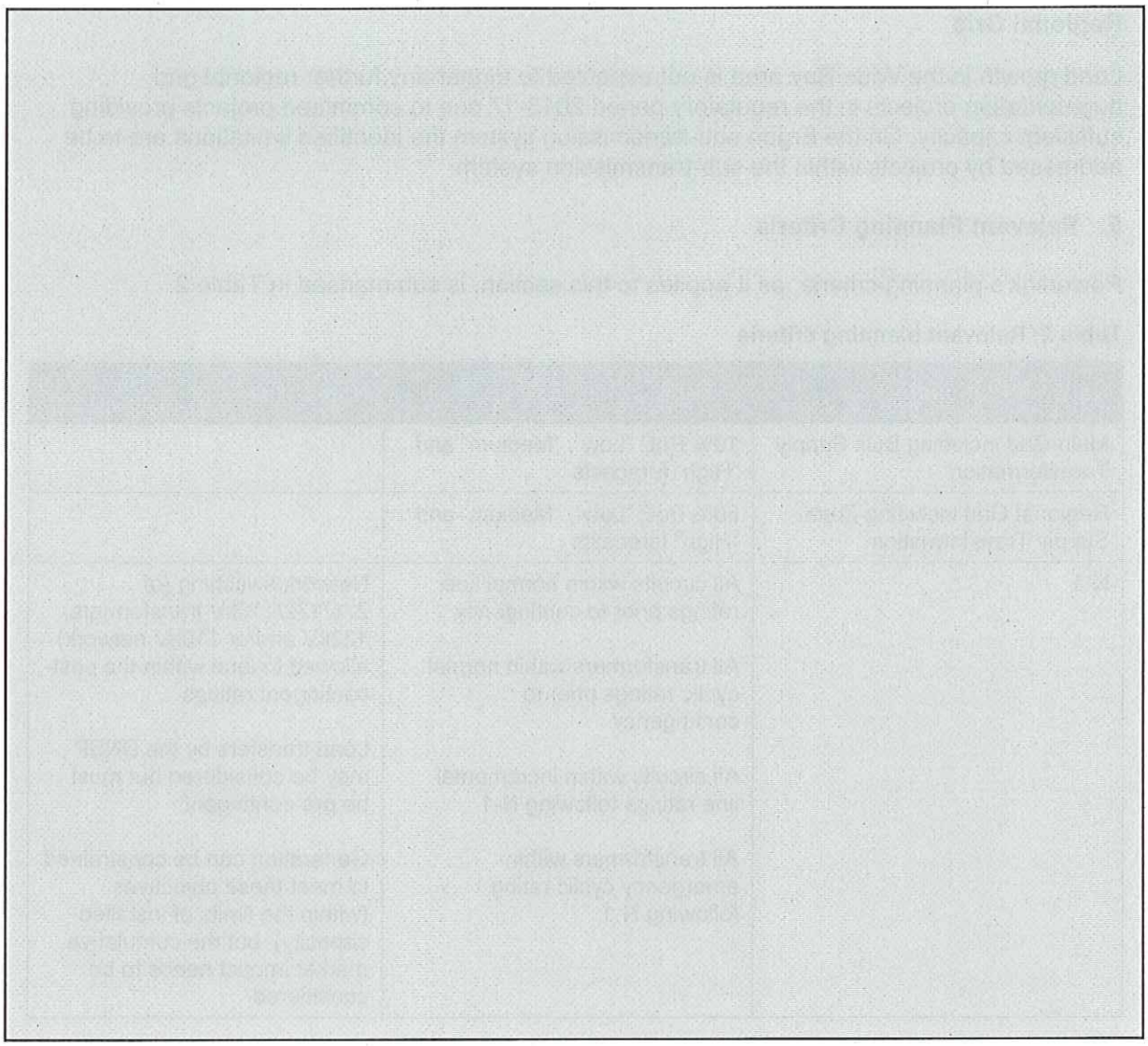
5. Relevant Planning Criteria

Powerlink's planning criteria, as it applies to this section, is summarised in Table 2.

Table 2: Relevant planning criteria

Network Planning	Criteria	Notes
Main Grid including Bulk Supply Transformation	10% PoE "Low", "Medium" and "High" forecasts	
Regional Grid including Zone Supply Transformation	50% PoE "Low", "Medium" and "High" forecasts	
N-1	All circuits within normal line ratings prior to contingency All transformers within normal cyclic ratings prior to contingency All circuits within incremental line ratings following N-1 All transformers within emergency cyclic rating following N-1	Network switching (of 275/132/110kV transformers, 132kV and/or 110kV network) allowed to land within the post-contingent ratings Load transfers by the DNSP may be considered but must be pre-contingent Generation can be constrained to meet these objectives (within the limits of installed capacity), but the cumulative market impact needs to be considered



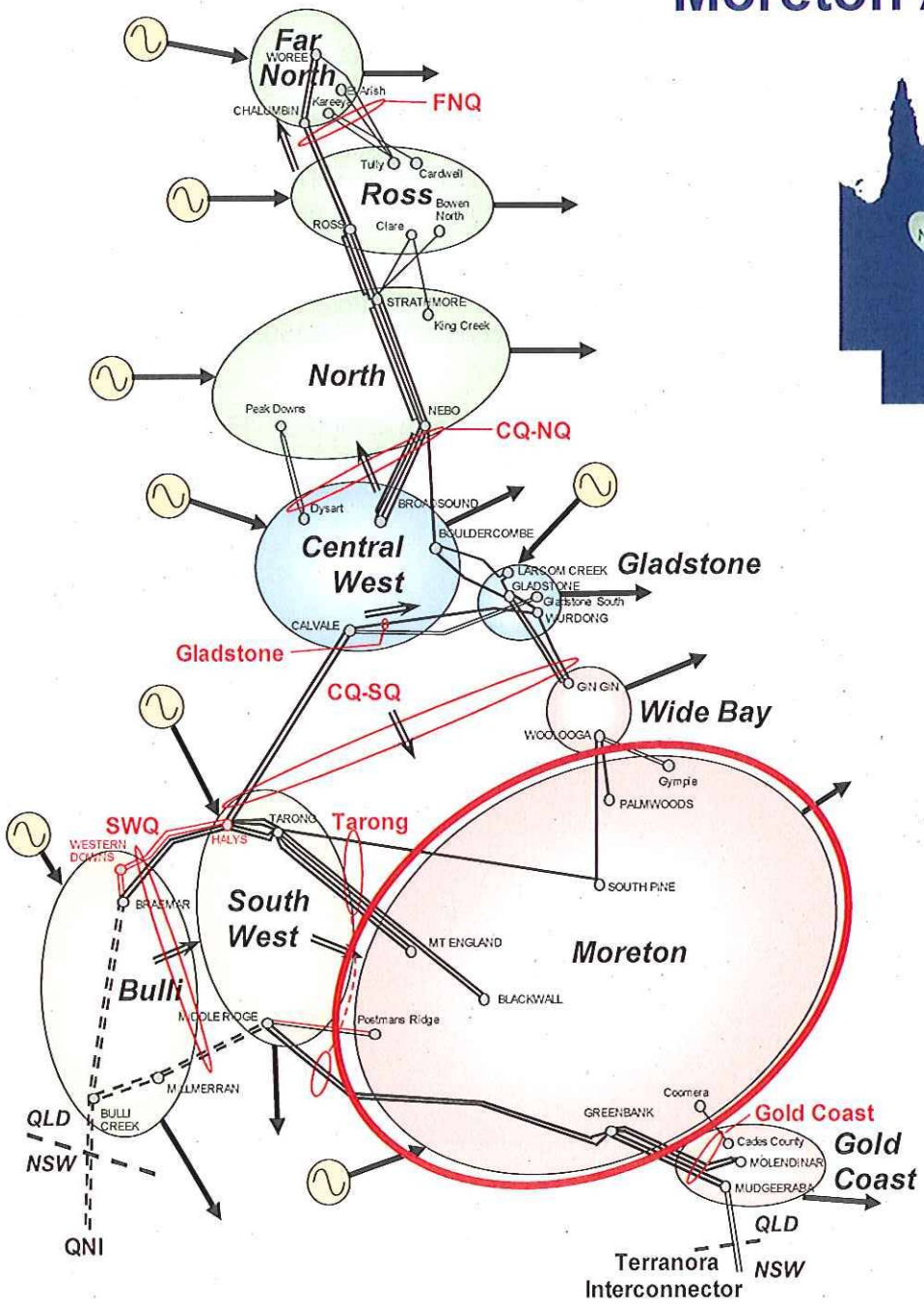


2010 GRID PLAN

VOLUME 2 SECTION 6

Network Development

Moreton Area



Moreton Area

1. Network Description

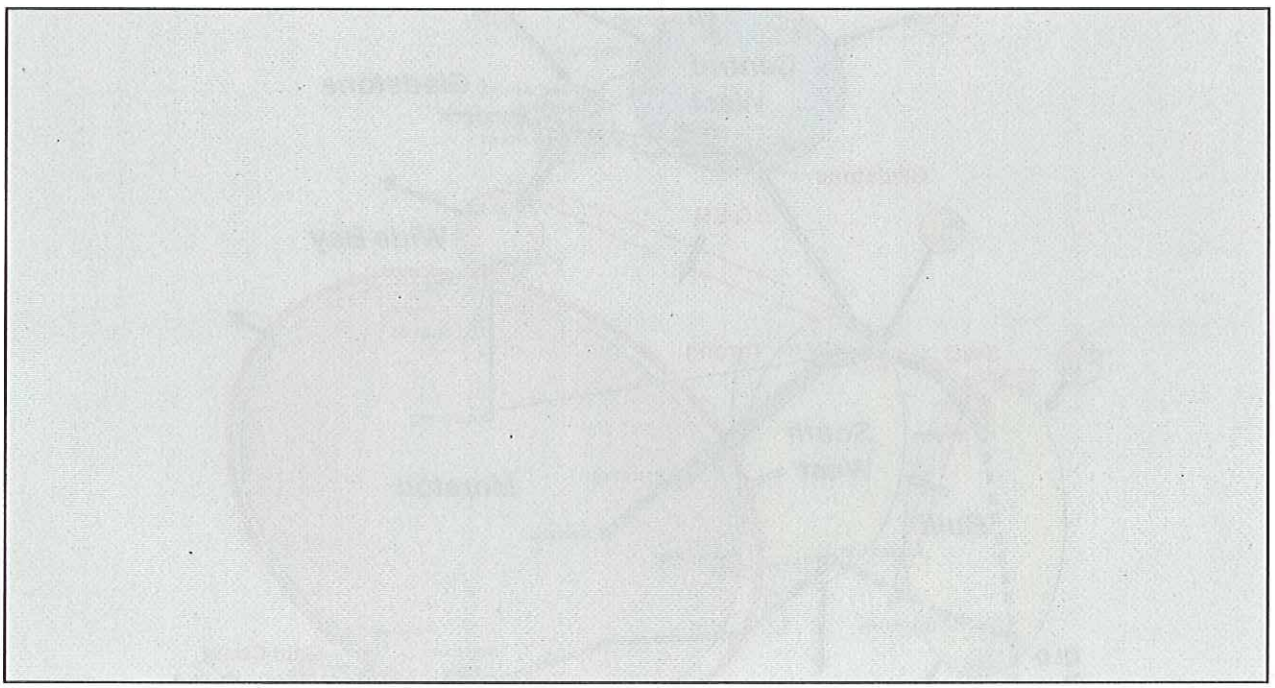
Moreton is a net importer of electricity. The South East Queensland area (including Brisbane, Ipswich, Gold Coast and Sunshine Coast) is the most densely populated part of Queensland. This area is heavily reliant on the 330kV and 275kV transmission system for the supply of base load coal and gas fired generation from south west and central Queensland.

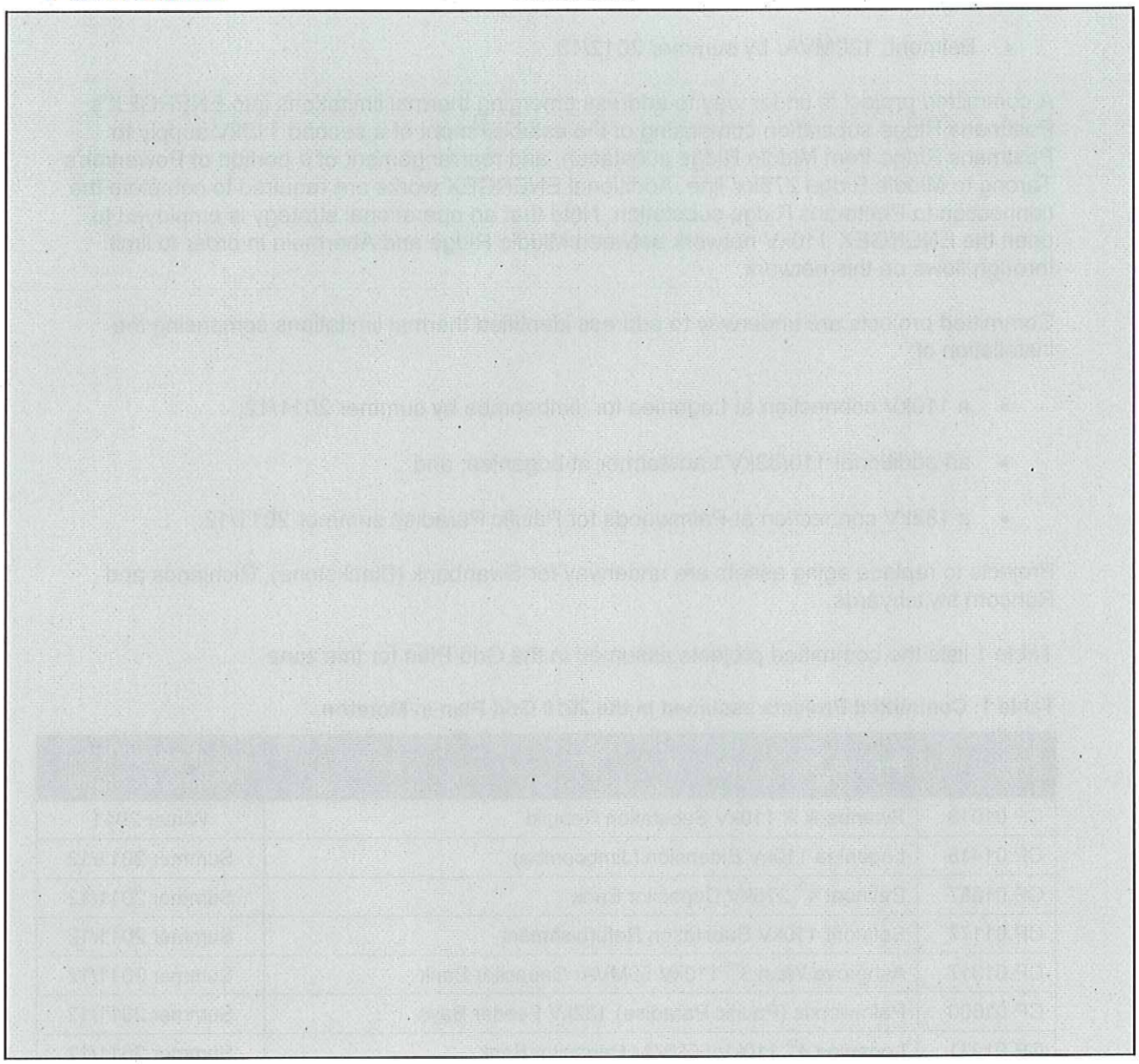
The inland central to south Queensland transmission system consists of long 275kV double circuit lines between Calvale and Tarong substations constructed of twin Sulphur conductor. These circuits were commissioned in 1998. The transmission corridor from Tarong contains five 275kV transmission circuits to South Pine, Mt England and Blackwall substations. The Tarong to South Pine is a single circuit line constructed using twin Paw Paw conductor, whereas the other lines are double circuits constructed using twin Sulphur.

The coastal central to south Queensland transmission system was commissioned in the 1970s and consists of three 275kV single circuits between Gladstone, Gin Gin and Woolooga, and two single circuits between Woolooga and South Pine substations. One of the Gin Gin to Woolooga single circuits turns into Teebar Creek Substation, and one of the Woolooga to South Pine single circuits turns into Palmwoods Substation. The coastal circuits are constructed using twin Goat conductor (except for the short twin Phosphorus turn into Palmwoods).

Construction of a double circuit 275kV transmission line from Middle Ridge to Greenbank using twin Sulphur conductor, and installation of second 330/275kV1500MVA transformer at Middle Ridge was completed in 2008.

The electricity supply system within Moreton is shown in Figure 1. Figure 2 shows a one line diagram representation of the existing transmission system.





Major 275kV substations exist at Blackwall, South Pine, Rocklea, Belmont, Murarrie, Goodna, Loganlea, Swanbank (Blackstone) and Greenbank. The Moreton area has aging equipment at Swanbank, Richlands, Runcorn, Loganlea and Caboolture substations. Low capacity 275kV conductor within existing circuits hinders the full potential across these corridors. The twin Goat circuit sections have thermal ratings substantially lower than the more recently built twin Phosphorus and twin Sulphur circuits, and are the limiting elements of transfer from Blackwall towards Goodna and Belmont.

2. Description of Committed Projects

Emerging transfer limits into the Moreton area are being addressed with additional shunt compensation and the construction of a new 500kV double circuit line between Halys and Blackwall substations, initially operated at 275kV, by summer 2014/15. In deferring this augmentation additional reactive compensation is committed and underway at:

- Ashgrove West, 50MVAr by summer 2011/12;
- Loganlea, 50MVAr by summer 2011/12; and

- Belmont, 120MVAr by summer 2012/13.

A committed project is under way to address emerging thermal limitations into ENERGEX's Postmans Ridge substation comprising of the establishment of a second 110kV supply to Postmans Ridge from Middle Ridge substation, and rearrangement of a portion of Powerlink's Tarong to Middle Ridge 275kV line. Additional ENERGEX works are required to complete the connection to Postmans Ridge substation. Note that an operational strategy is employed to open the ENERGEX 110kV network between Middle Ridge and Abermain in order to limit through flows on this network.

Committed projects are underway to address identified thermal limitations comprising the installation of:

- a 110kV connection at Loganlea for Jimboomba by summer 2011/12;
- an additional 110/33kV transformer at Loganlea; and
- a 132kV connection at Palmwoods for Pacific Paradise summer 2011/12.

Projects to replace aging assets are underway for Swanbank (Blackstone), Richlands and Runcorn switchyards.

Table 1 lists the committed projects assumed in the Grid Plan for this zone.

Table 1: Committed Projects assumed in the 2010 Grid Plan in Moreton

Project ID	Project Description	Expected Commissioning
CP.01018	Swanbank A 110kV Substation Rebuild	Winter 2011
CP.01415	Loganlea 110kV Extension (Jimboomba)	Summer 2011/12
CP.01887	Belmont 4th 275kV Capacitor Bank	Summer 2011/12
CP.01177	Belmont 110kV Substation Refurbishment	Summer 2011/12
CP.01317	Ashgrove West 3rd 110kV 50MVAr Capacitor Bank	Summer 2011/12
CP.01600	Palmwoods (Pacific Paradise) 132kV Feeder Bays	Summer 2011/12
CP.01931	Loganlea 4th 110kV 50MVAr Capacitor Bank	Summer 2011/12
CP.01658	Richlands Primary and Secondary Plant Replacement	Summer 2012/13
CP.01732	Runcorn 110kV Substation Replacement	Summer 2012/13
CP.01163	Swanbank B 275kV Substation Rebuild	Summer 2012/13
CP.01788	Palmwoods Primary Plant Replacement Stage 1	Summer 2012/13
CP.01399	Loganlea 110/33kV Transformer Augmentation	Summer 2013/14
CP.02207	Loganlea 110kV Substation Rebuild	Summer 2013/14
CP.01875	Halys - Blackwall 500kV operating at 275kV	Summer 2014/15

3. Existing Generation Capacity

Local generation available to supply the Moreton area will be reduced following the announcement from CS Energy that Swanbank "B" Power Station will be progressively closed. Units 4 and 2 were closed in May and June 2010, and Unit 1 closed in April 2011. Unit 3 is scheduled to close in April 2012. This announcement was captured in ROAM's scenarios and

increases the required power transfer into South East Queensland to meet reliability of supply obligations.

The major remaining sources of generation within the Moreton zone is the Swanbank "E" combined cycle gas fired generator (350MW) and Wivenhoe power station. Wivenhoe is a pumped storage hydro generating station with an installed capacity of 500MW. Energy limitations exist at Wivenhoe due to the need to pump water for later generation and the capacity of the Splityard Creek dam.

4. Generation Scenarios

ROAM did not identify new entrants in the Moreton zone. Powerlink's view is that while there have been generator connection enquiries in south east Queensland, none of these proposals have committed in recent years while there have been a large number of new generators establish in the south west. One reason for this may be that including gas transport costs, as well as environmental and town planning constraints, it is more cost effective for plant to locate in the south west area.

The following factors significantly impact the practicality of future power stations in and around urban and sensitive areas:

- The Queensland Government strategy for improving air quality by reducing combustion-based industrial plant within SEQ;
- Growth in Queensland cities and town planning activities which have constrained land use, and this has eliminated many opportunities for power stations in urban areas;
- Lack of localised fuel sources or access to remote sources of fuel where existing transportation infrastructure is fully committed and the scale of investment needed to increase capacity is significant;
- Fault level constraints in parts of the network impacting the practicality of connection of future generators;
- Market competition from new generators entering the market, beyond demand and reserve capacity levels in relation to co-opted emerging industries such as LNG, resulting in earlier than predicted retirement of older less efficient generators;
- Demonstrated community opposition to previously proposed power stations;
- Lack of committed generator projects, lack of evidence of future generator prospects and lack of interest by proponents across some areas; and
- Federal Government regulations pertaining to locating of infrastructure, such as control of developments in the vicinity of defence force assets, national parks, world heritage areas, rail corridors, major highways, and height restrictions and exhaust flume around airports.

5. Description of Transmission Limitations

Brisbane CBD

Presently, ENERGEX's CBD 110kV sub-transmission network is supplied Brisbane from Belmont and Murarrie substations (CBD East) and Ashgrove West Substation (CBD West) and Rocklea Substation (CBD South). ENERGEX has identified thermal capacity limitations on the CBD East 110kV network under contingency conditions.

Powerlink has identified emerging thermal capacity limitations on the 275kV circuits from Blackwall to Goodna and South Pine, as well as 275/110kV transformers at South Pine and Rocklea substations.

A major joint planning study has been undertaken to ensure that the solution implemented is the most efficient option, considering these identified limitations and the effect of options to reinforce the 110kV supply into the CBD. In conjunction with ENERGEX, a set of development themes have been developed to ensure a cost effective development strategy is followed. Options to overcome local limitations (such as transformers) have been treated separately where possible, with the preferred option considered as an input to the CBD study.

A network solution to address the identified thermal limitations is to establish new 110kV circuits from Rocklea substation to ENERGEX's Wellington Road substation, transferring load from CBD East (Belmont and Murarrie) to Rocklea. Subsequent limitations on the Blackwall to South Pine and Rocklea 275kV circuits, Rocklea 275/110kV transformers, and the 110kV network between Rocklea and Belmont would be addressed by rearranging the 275kV circuits east of Blackwall and establishing a new 275/110kV substation at Larapinta.

Limitations on the 275/110kV transformers at South Pine would initially be managed by load shifts on ENERGEX's sub-transmission network. Subsequent limitations on ENERGEX's South Pine to Nudgee 110kV circuits, as well as a re-occurrence of the South Pine transformer limit, would be addressed by establishing a new 275/110kV substation at Nudgee.

The critical Brisbane CBD contingencies include:

- 275kV circuit between Blackwall and Belmont;
- 275kV circuit between Mt England and South Pine;
- 275/110kV transformers at South Pine and Rocklea;
- 110kV circuits on ENERGEX's CBD East network;
- 110kV circuits on ENERGEX's CBD West network;
- 110kV circuits to Nudgee; and
- 110kV circuits between Rocklea and Belmont.

Main Grid

Growing demand results in higher reactive power loadings, as well as greater reactive losses in the system due to increased transmission over long distances and transformer loadings. The combined effect is an annual increase in reactive demand above that already being supplied through existing reactive devices. This increasing reactive demand must be met by an acceptable balance between static and dynamic reactive power compensation in South East Queensland to maintain voltage stability. Augmentation of supply is required to ensure adequate reserves of reactive power over the period to summer 2011/12. This limitation is being addressed by a number of committed projects listed in Section 2.

Sufficient thermal capability is forecast to be available within Moreton area until summer 2016/17 under the majority of medium economic scenarios, from which time thermal limitations are expected to occur on the 275kV transmission circuits from Blackwall to Goodna and Larapinta without action to augment supply.

A network solution to address the identified thermal limitation is the construction of a new 275kV transmission line from the Bundamba area to a point west of the transmission corridor between Loganlea and Belmont substations together with rearranging and reconductoring sections of the existing 275kV transmission lines in the local area.

The critical Main Grid contingencies include:

- 275kV circuits between Bulli, SWQ and Moreton;
- 275kV circuit between Blackwall and Goodna;
- 275kV circuit between Blackwall and Larapinta;
- 275kV circuit between Greenbank and Loganlea;
- 275kV circuit between Mt England and South Pine; and
- 275/110kV transformers at Palmwoods, South Pine, Rocklea and Loganlea.

Contingent projects are also proposed for a potential reclassification of loads and connection of a significant load in the Ebenezer/Willowbank area.

Regional Grid

Bulk supply to the Sunshine Coast area is provided from the Woolooga and Palmwoods 275/132kV substations. Electricity is then transferred over the ENERGEX 132kV and 110kV network to supply Gympie, Cooroy, Nambour, Sunshine Coast and Caboolture substations. Taking into account ENERGEX committed minor upgrades, sufficient capability is forecast to be available until summer 2014/15. From summer 2014/15, thermal limitations are expected to occur on the Palmwoods 275/132kV transformers.

Additionally, limits on the Rocklea and South Pine East 275/110kV transformers are expected to occur from 2013/14 onwards, and on the Loganlea 275/110kV transformers from 2017/18 onwards.

The critical Regional Grid contingencies include:

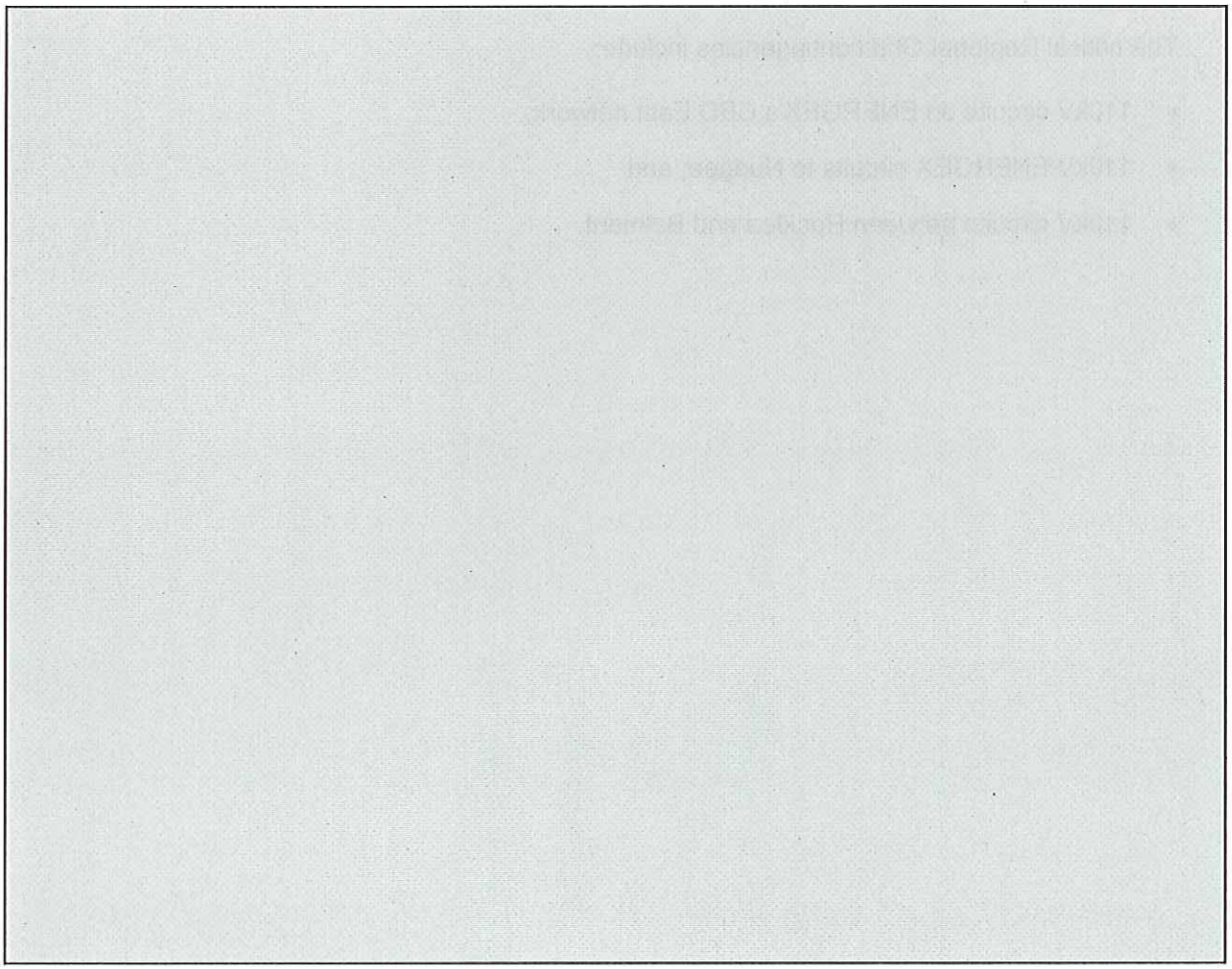
- 110kV circuits on ENERGEX's CBD East network;
- 110kV ENERGEX circuits to Nudgee; and
- 110kV circuits between Rocklea and Belmont.

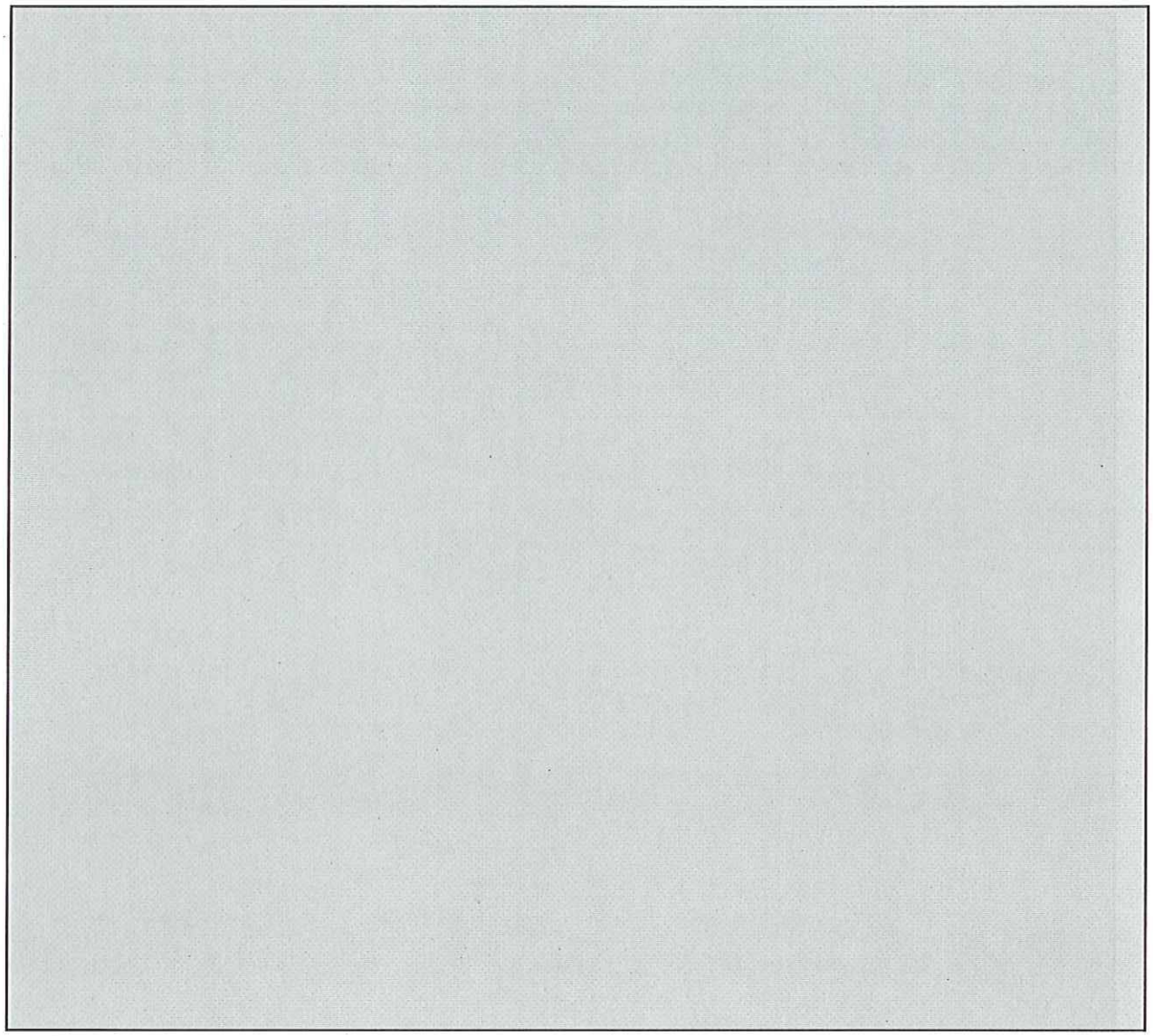
6. Relevant Planning Criteria

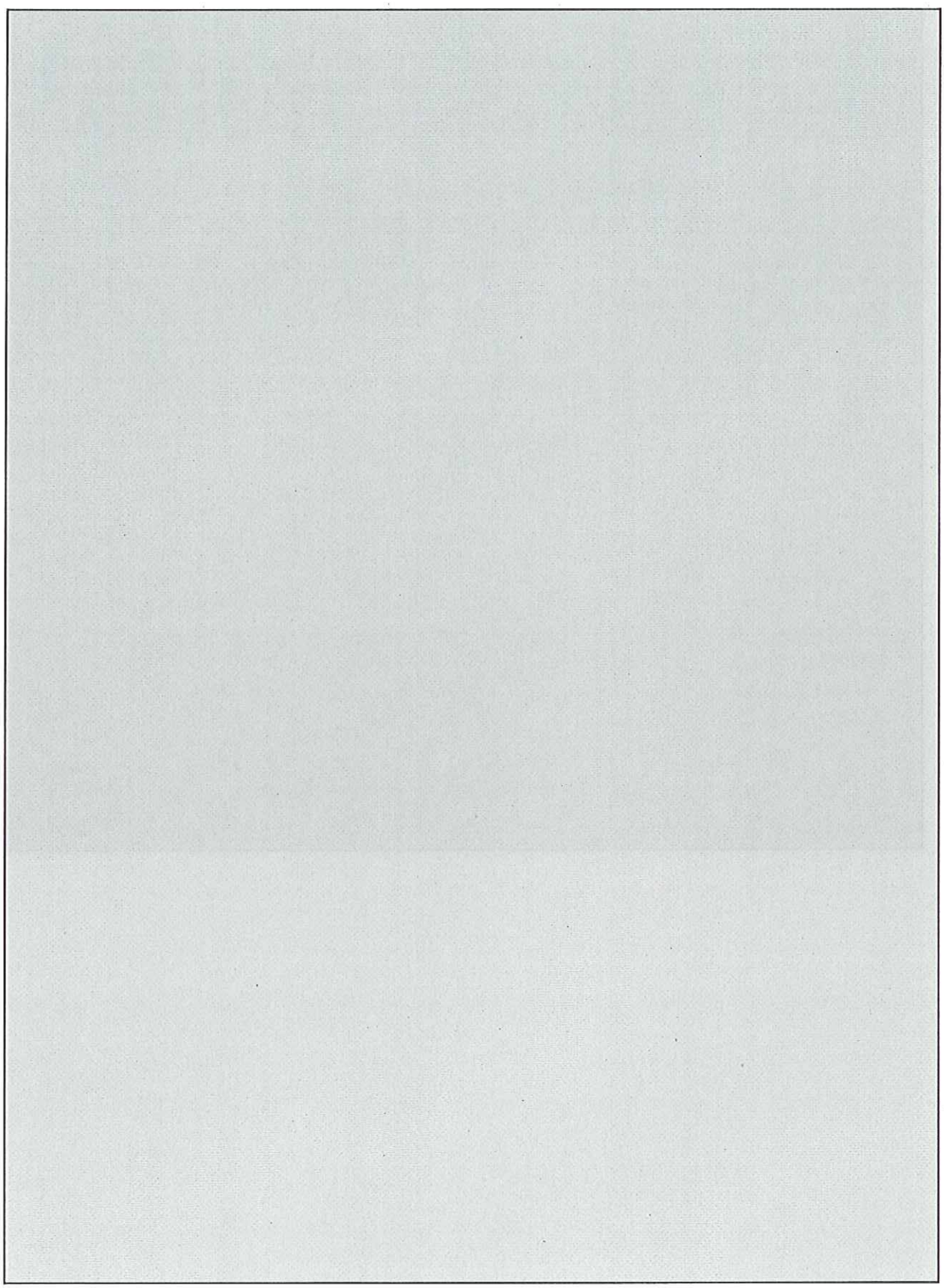
Powerlink's planning criteria, as it applies to this section, is summarised in Table 2.

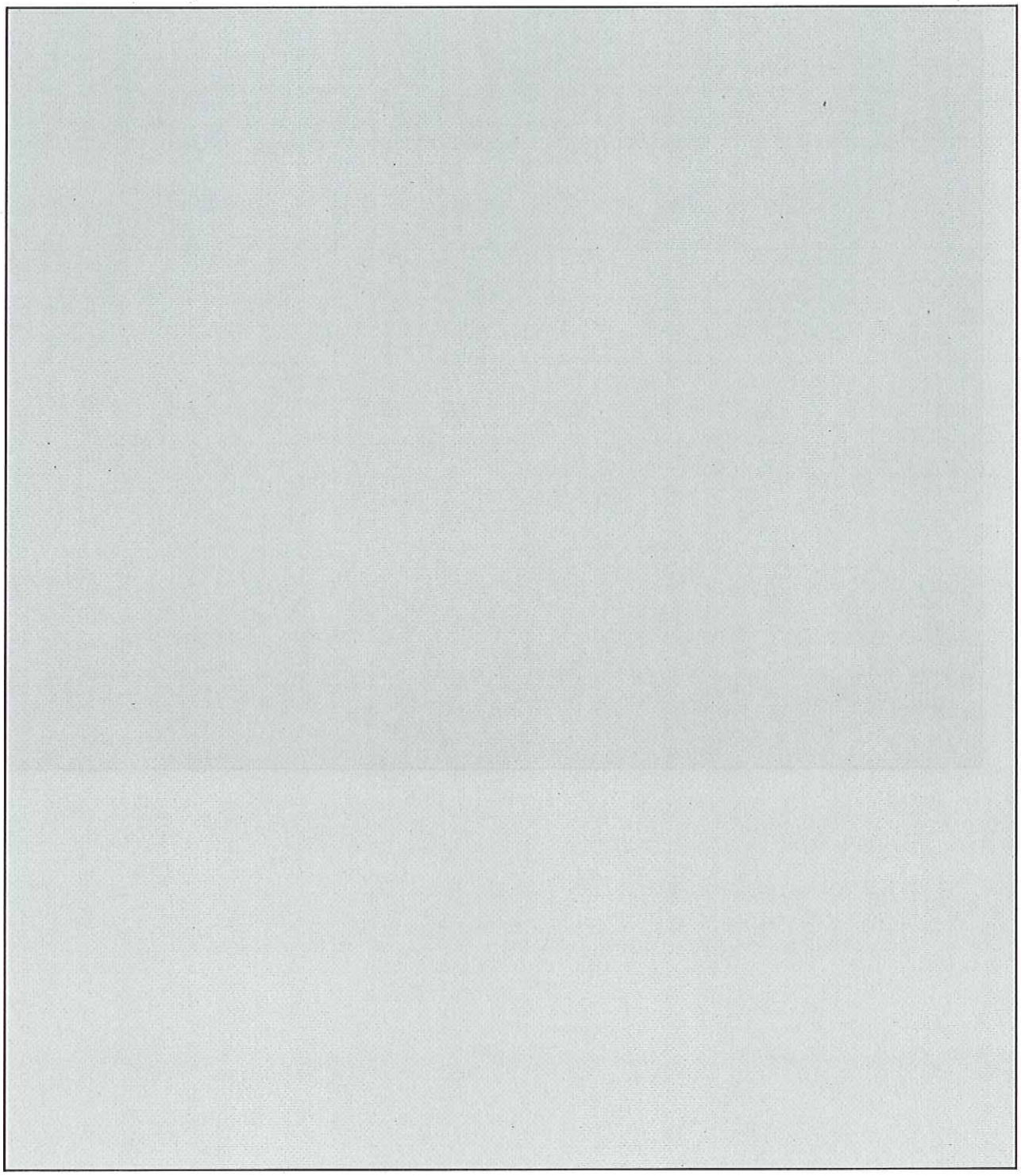
Table 2: Relevant planning criteria

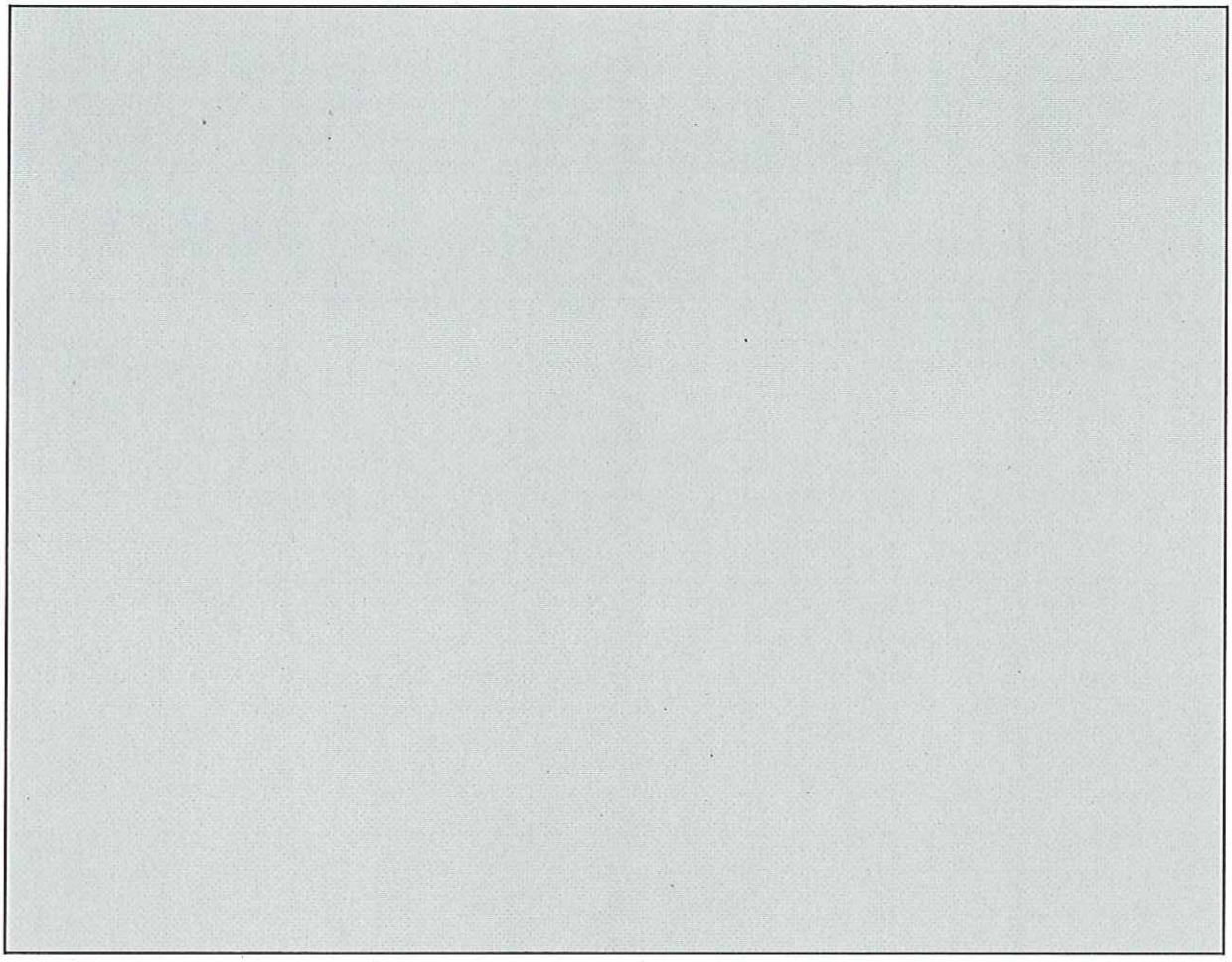
Network Planning	Criteria	Notes
Main Grid including Bulk Supply Transformation	10% PoE "Low", "Medium" and "High" forecasts	
Regional Grid including Zone Supply Transformation	50% PoE "Low", "Medium" and "High" forecasts	
N-1	All circuits within normal line ratings prior to contingency All transformers within normal cyclic ratings prior to contingency All circuits within incremental line ratings following N-1 All transformers within emergency cyclic rating following N-1	Network switching (of 275/132/110kV transformers, 132kV and/or 110kV network) allowed to land within the post-contingent ratings Load transfers by the DNSP may be considered but must be pre-contingent Generation can be constrained to meet these objectives (within the limits of installed capacity), but the cumulative market impact needs to be considered

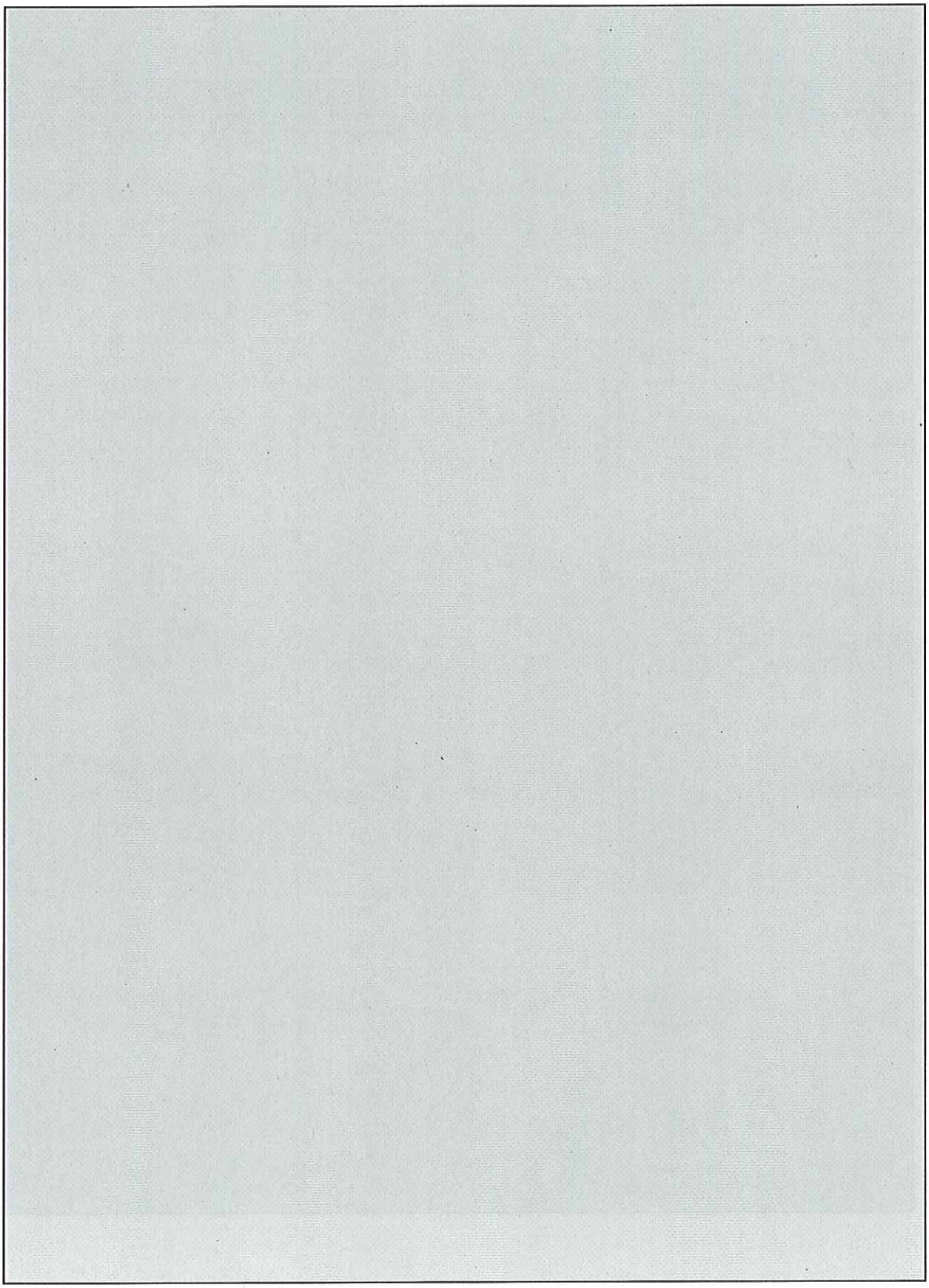


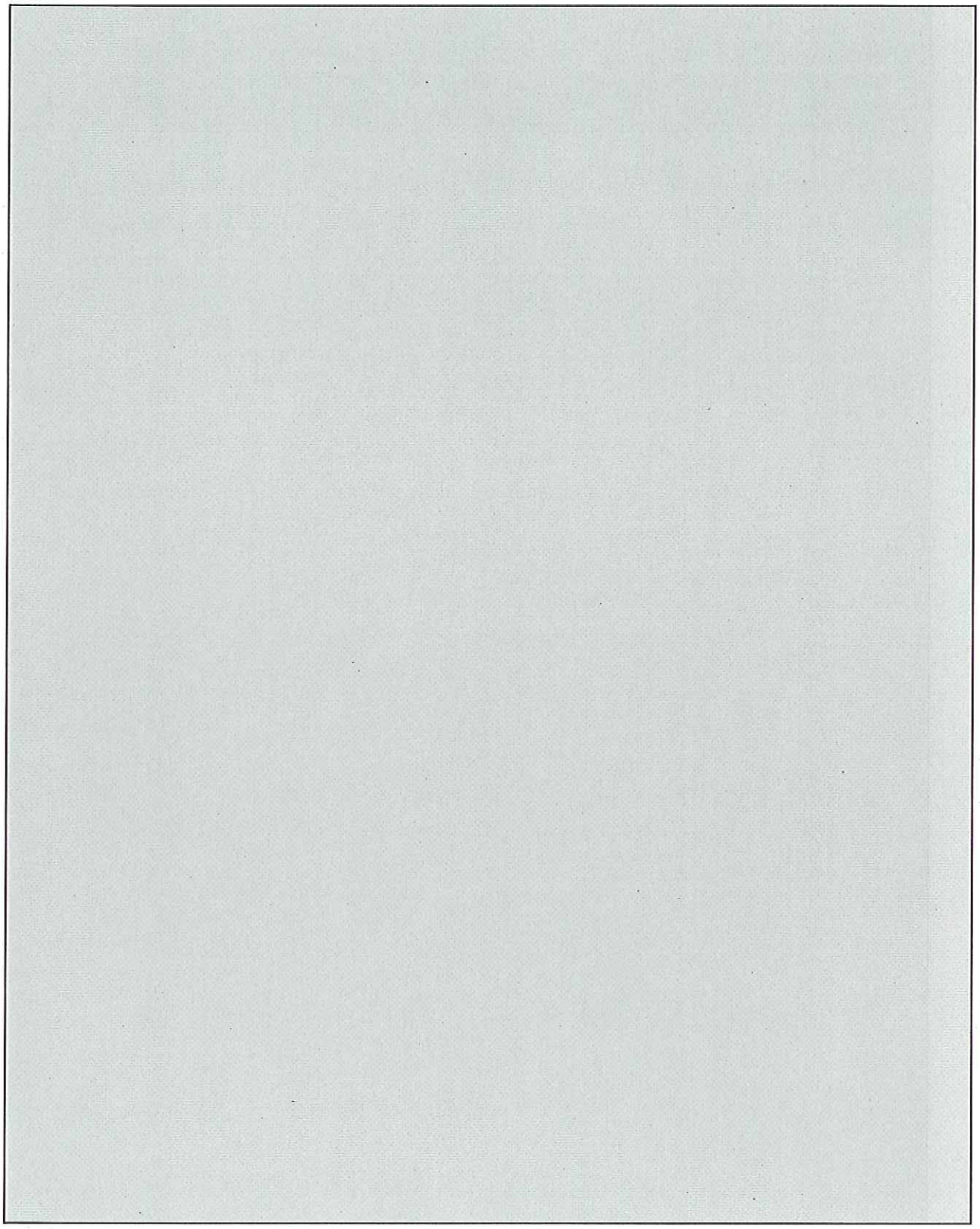


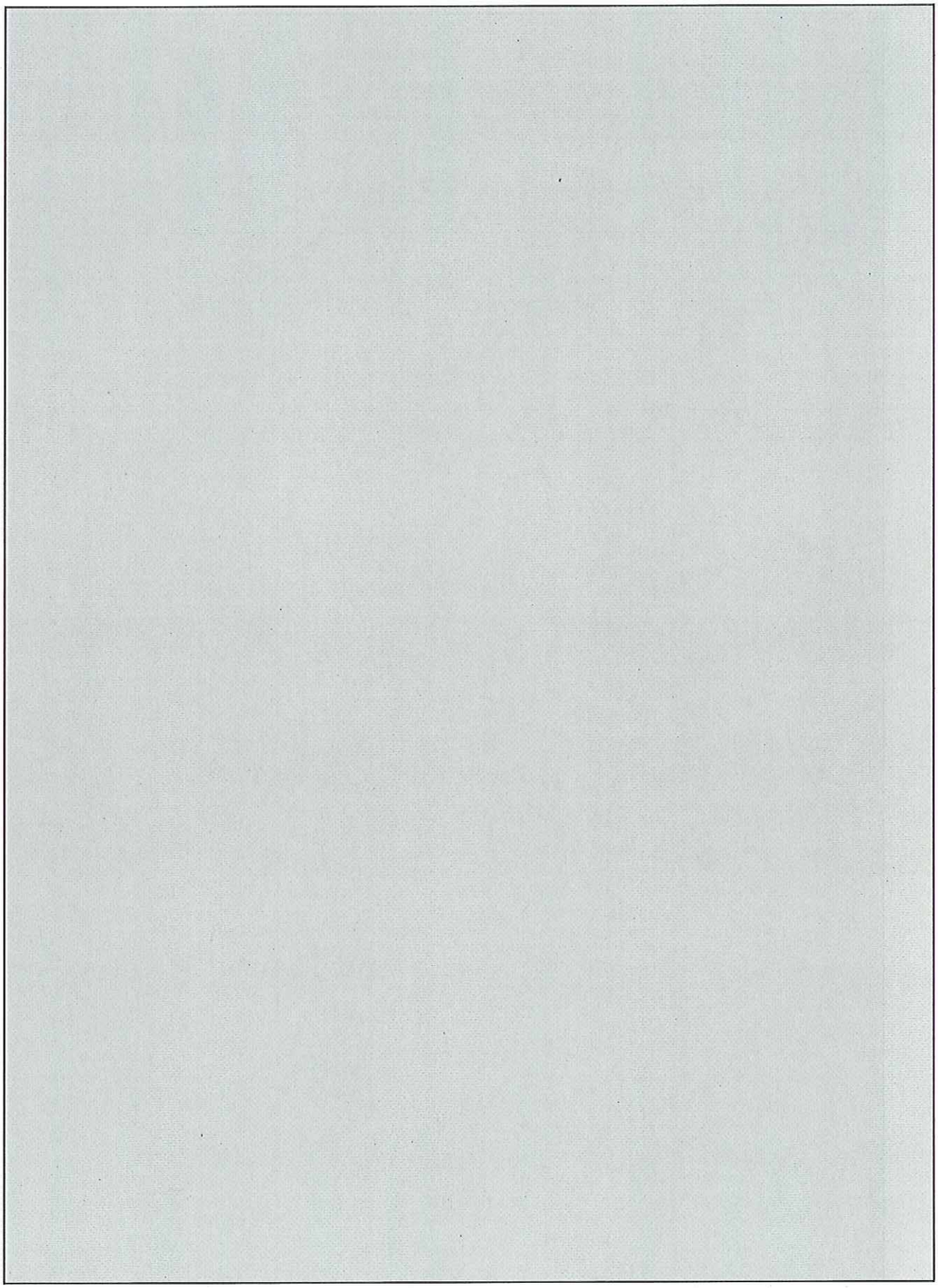


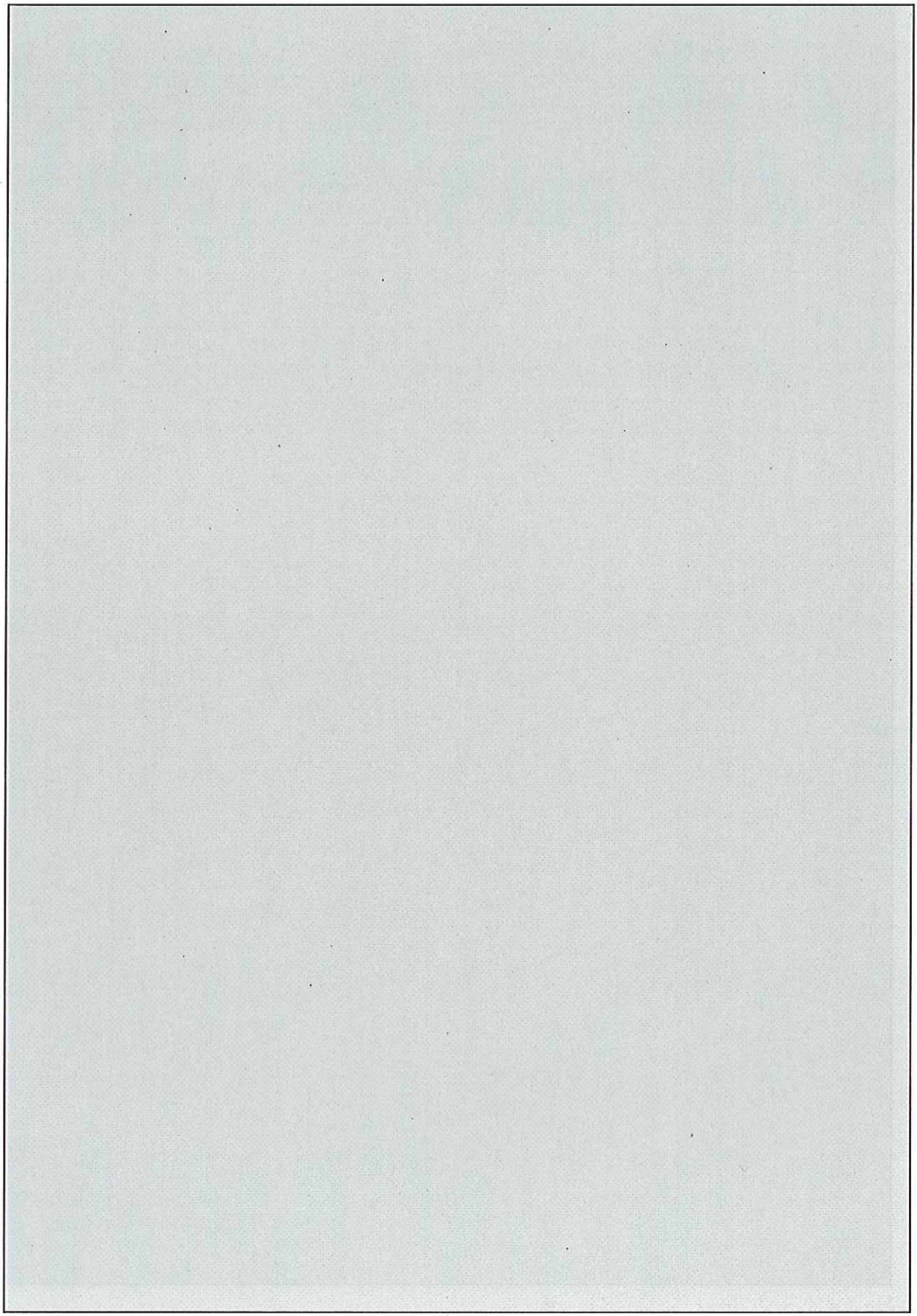


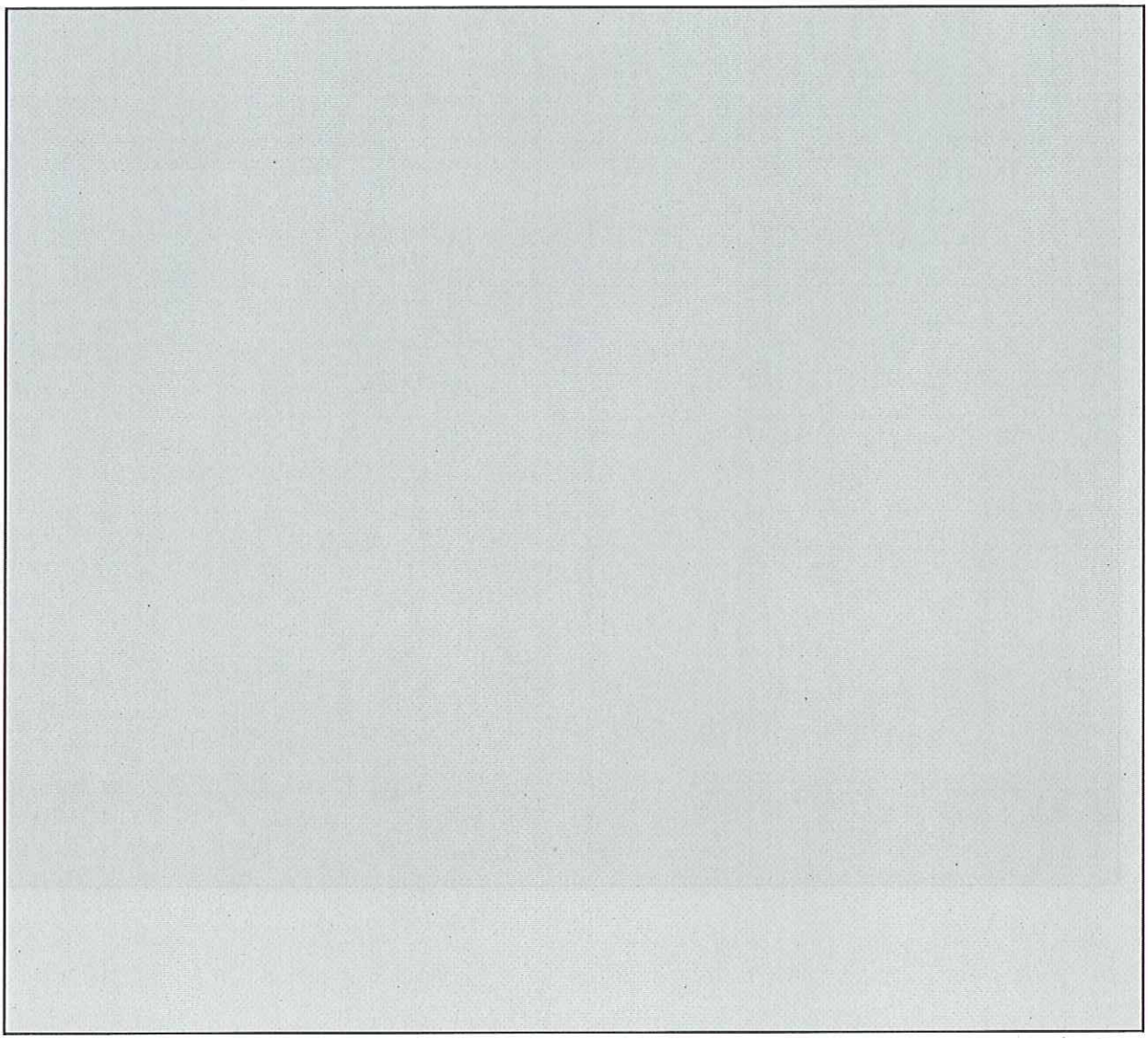


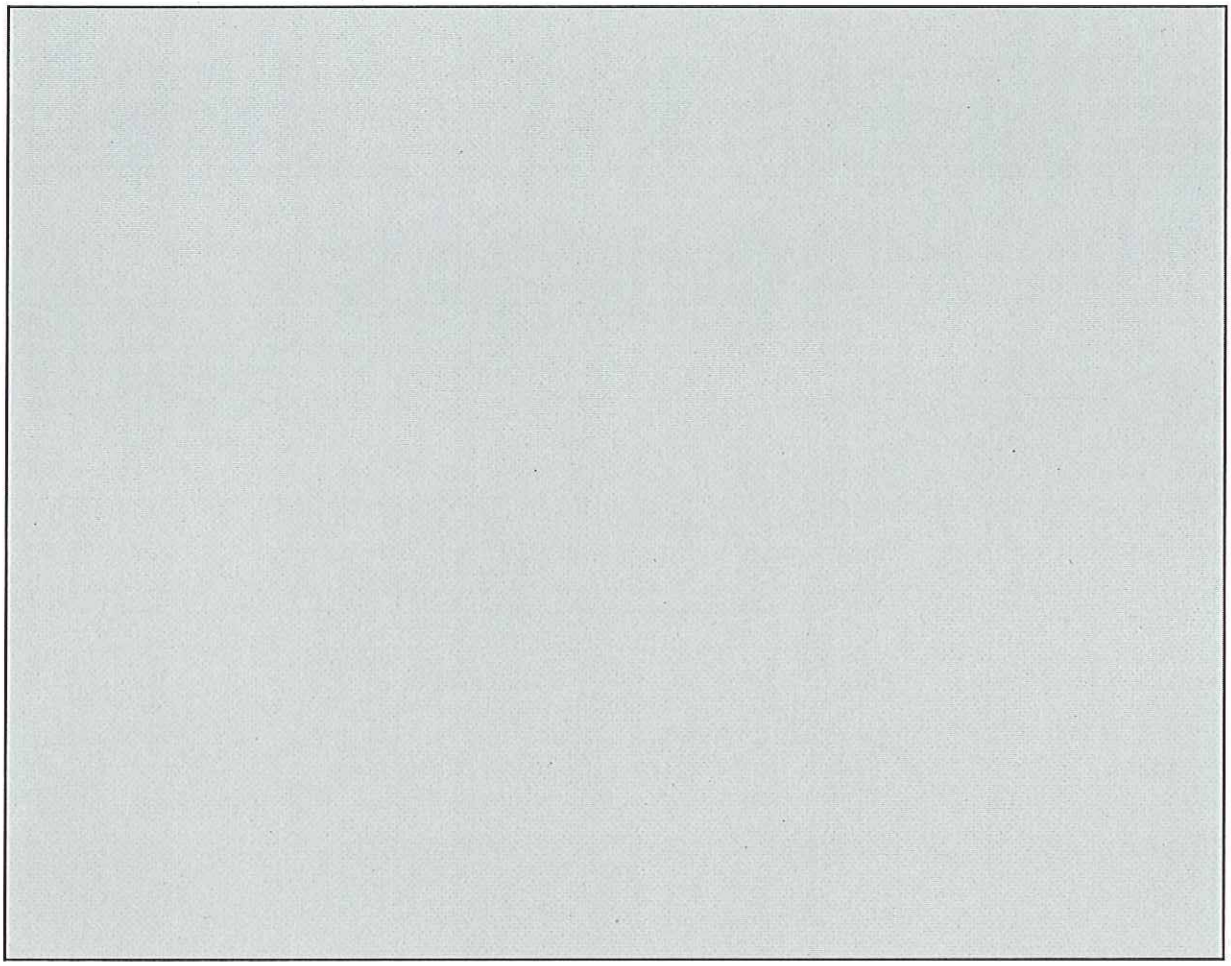


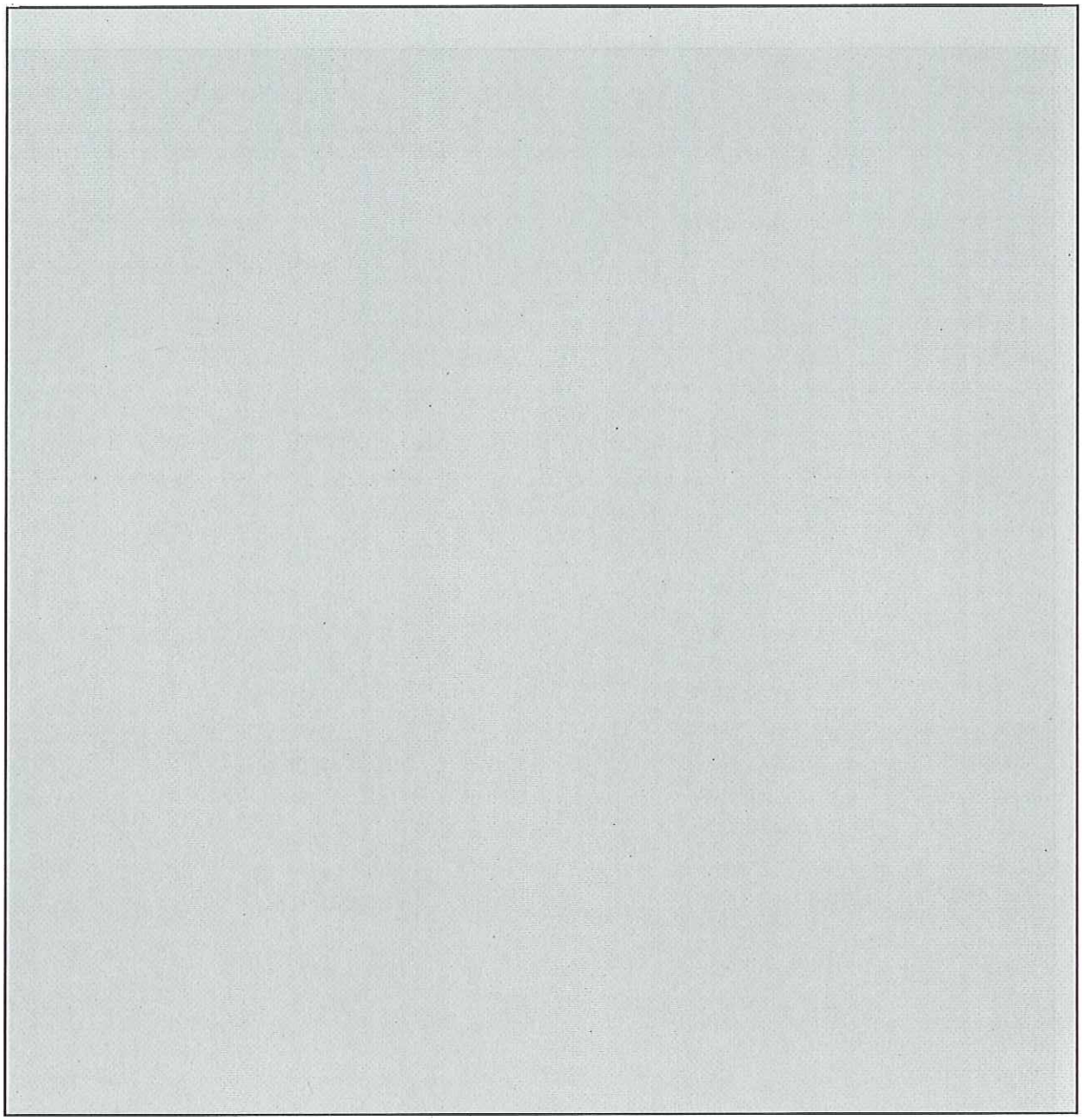


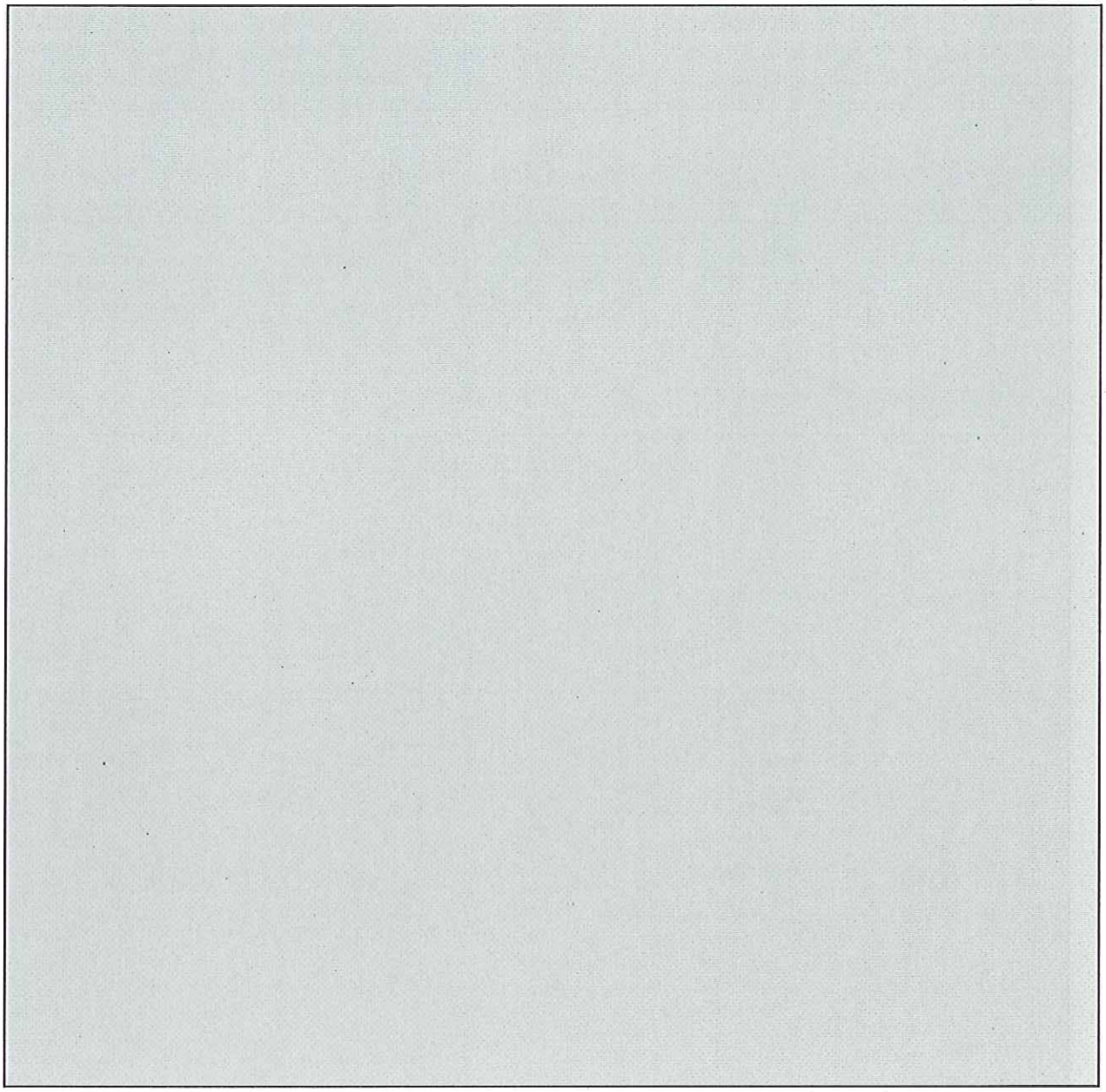


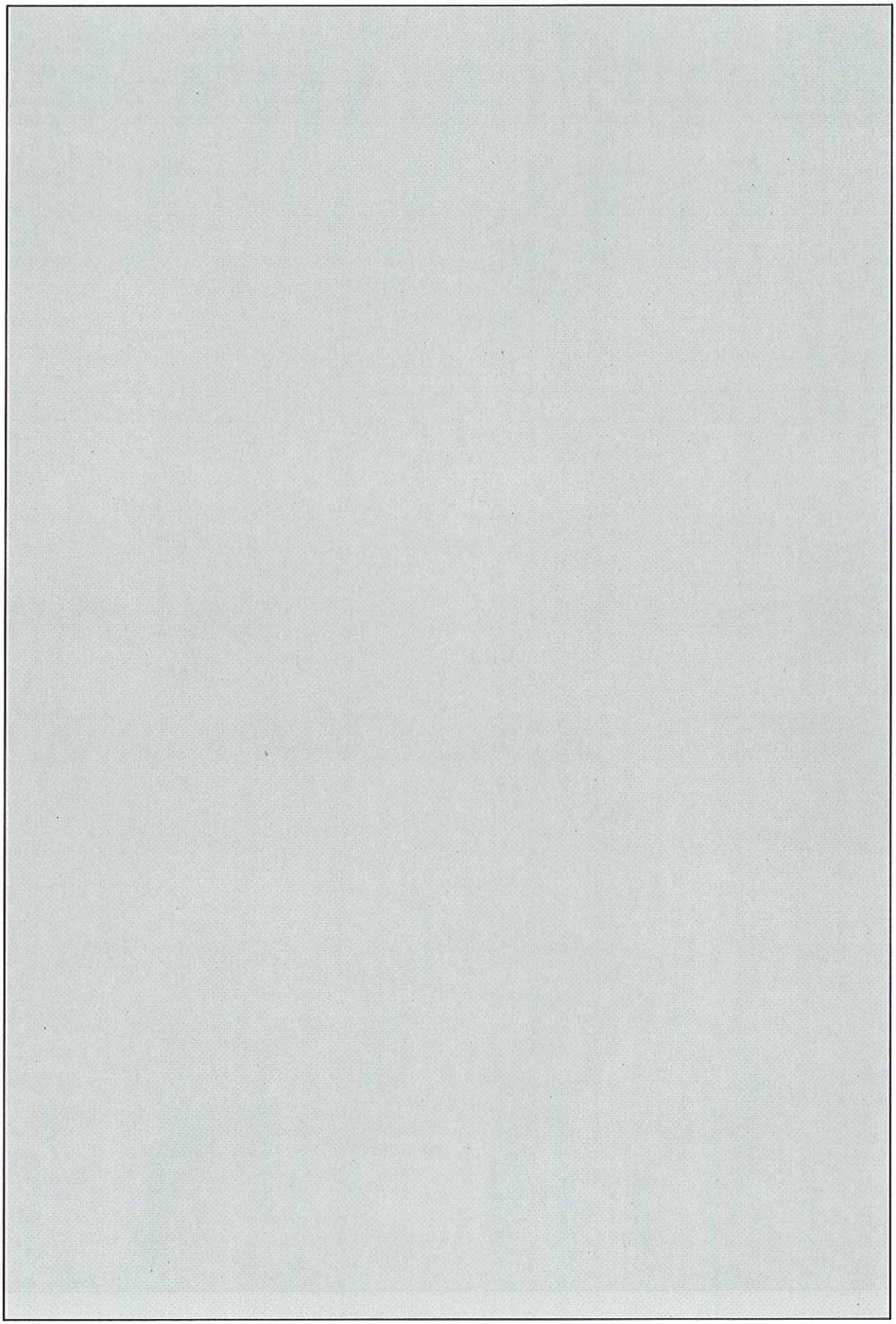


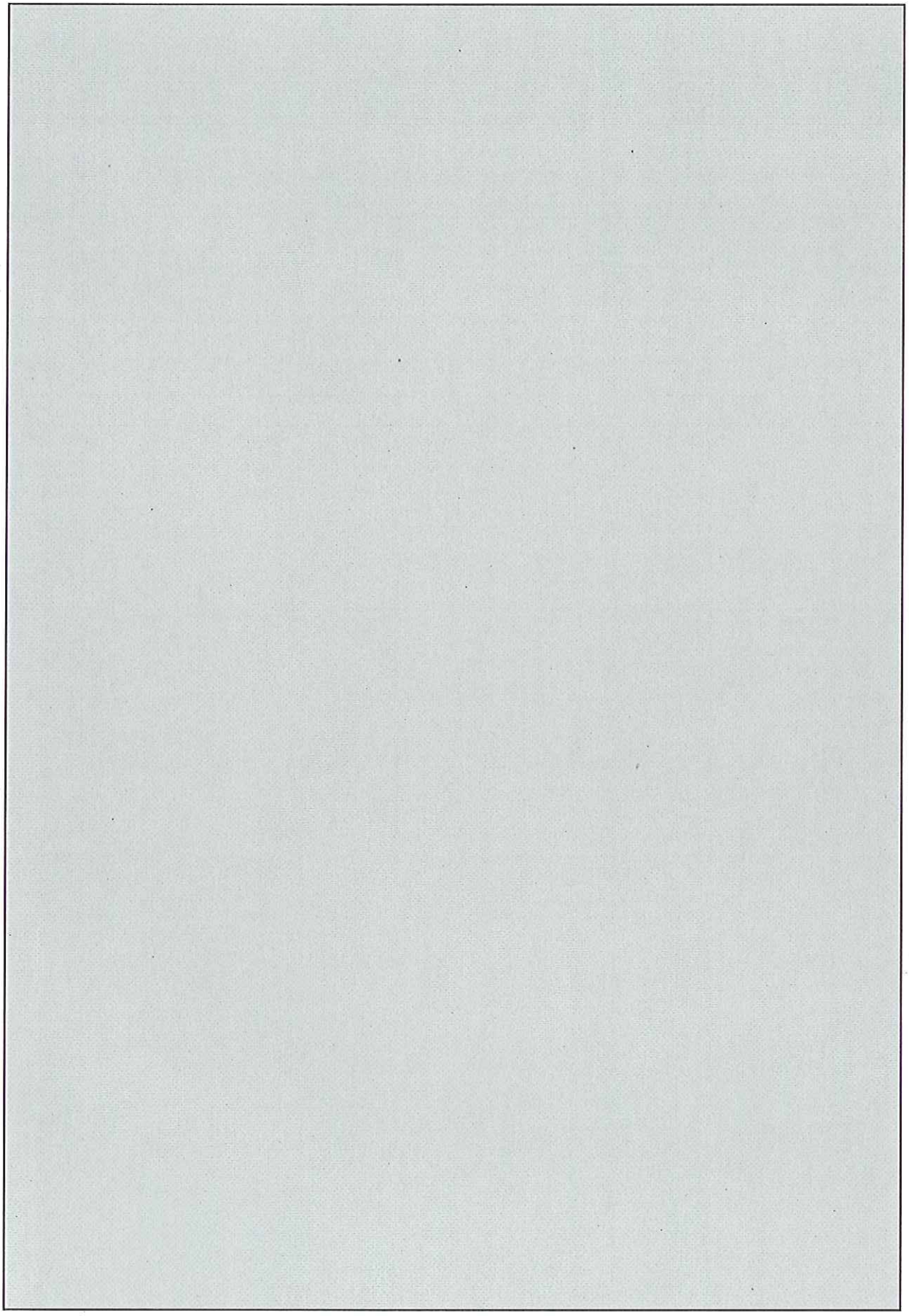


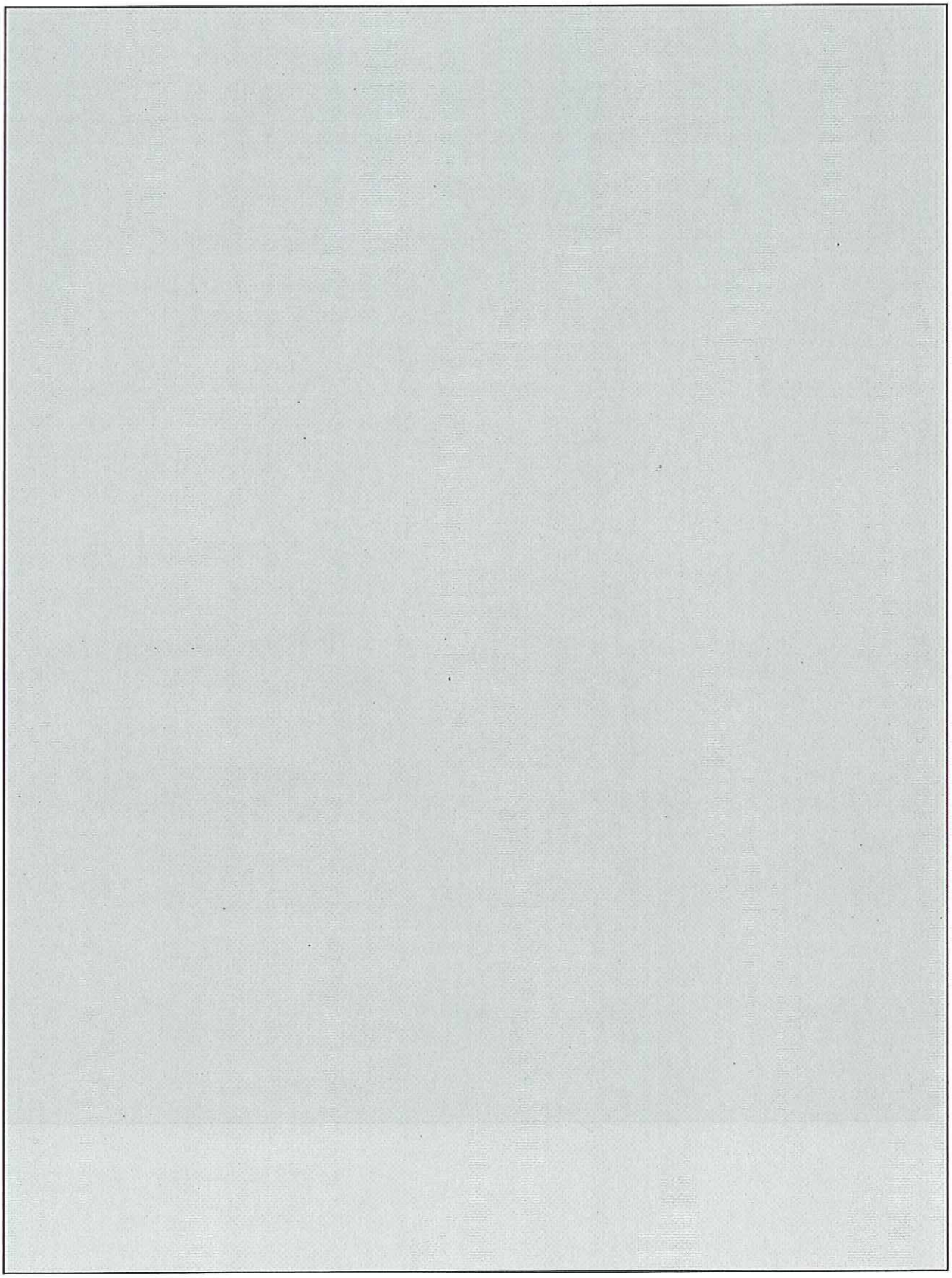


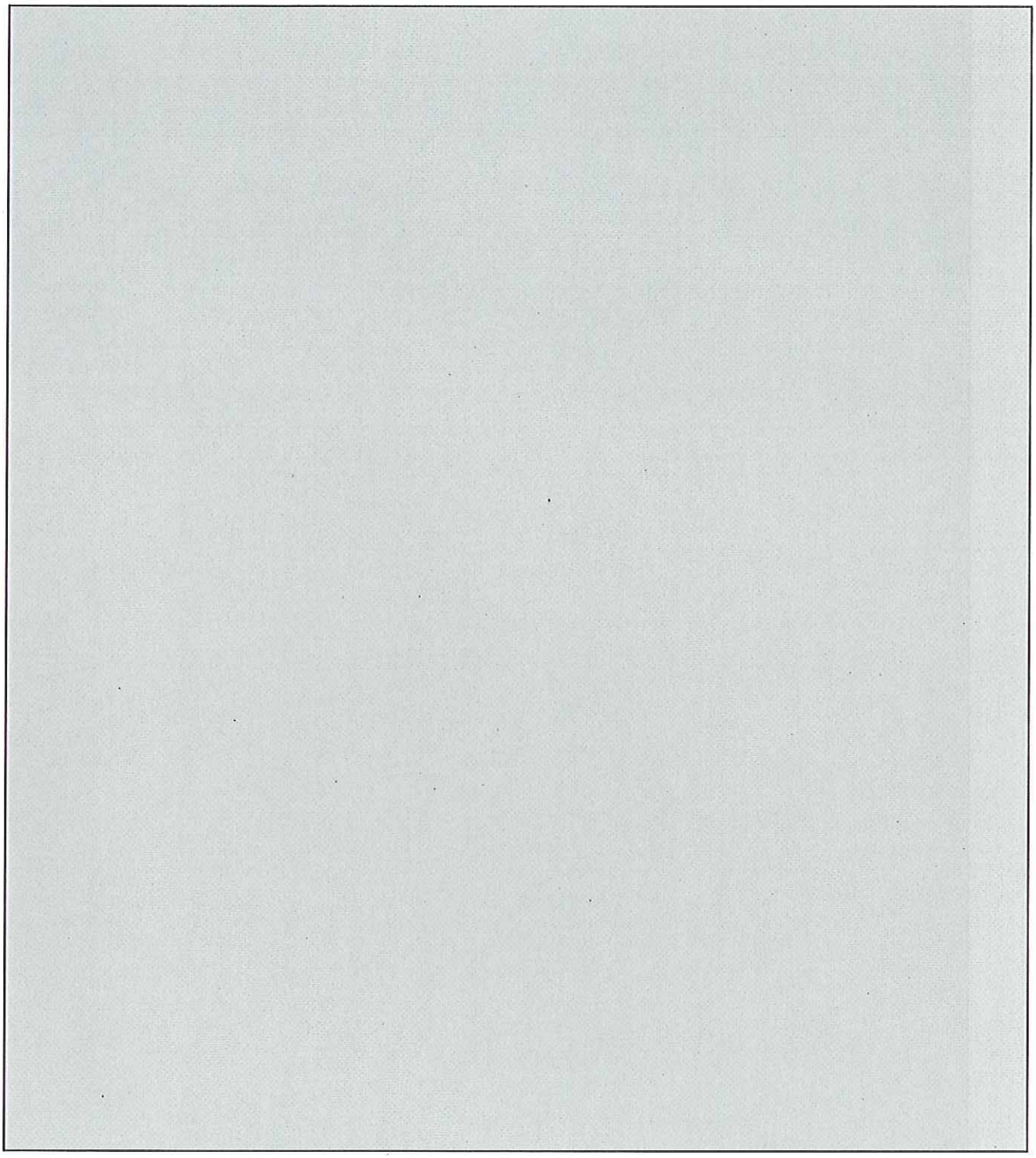


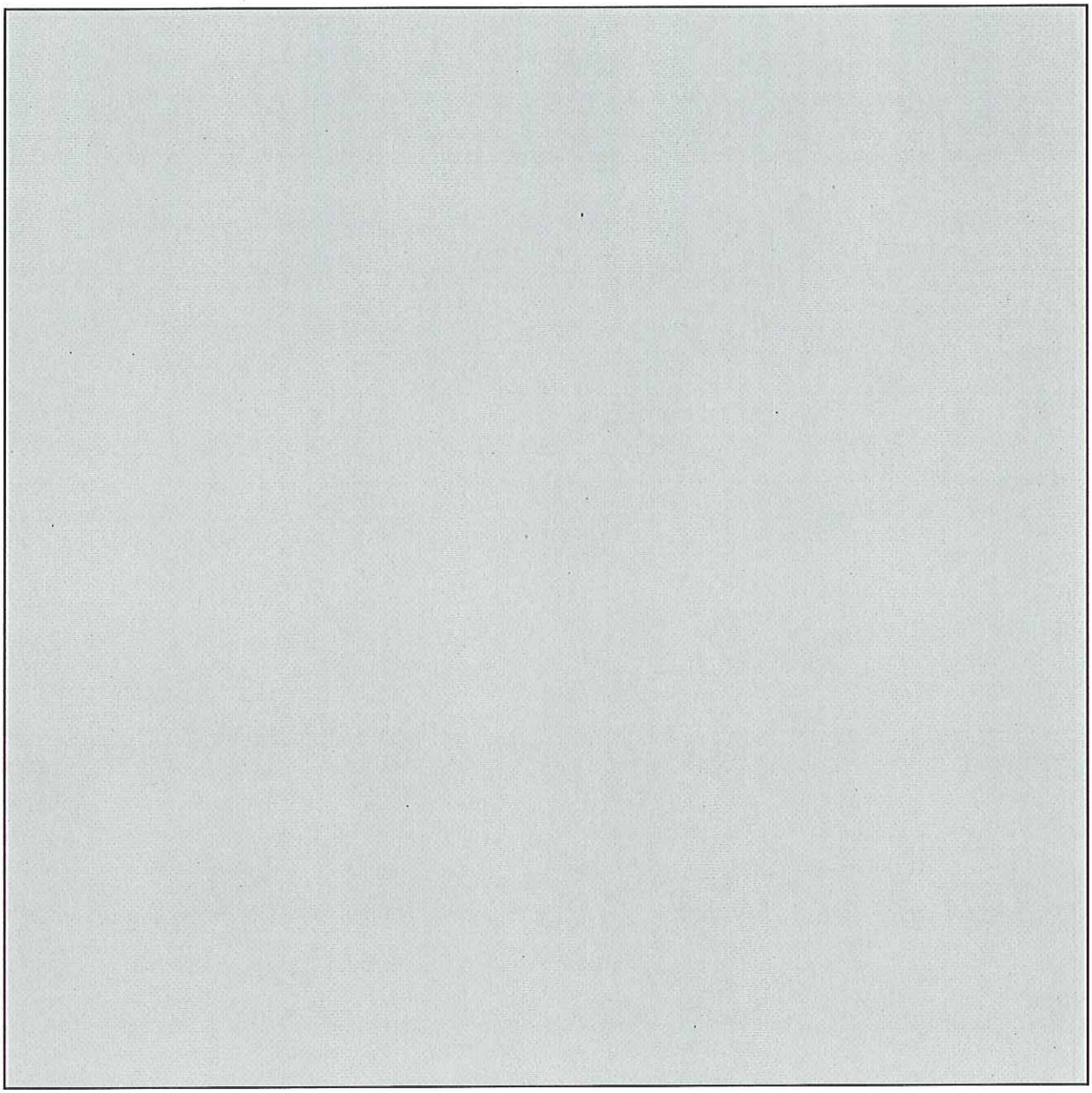


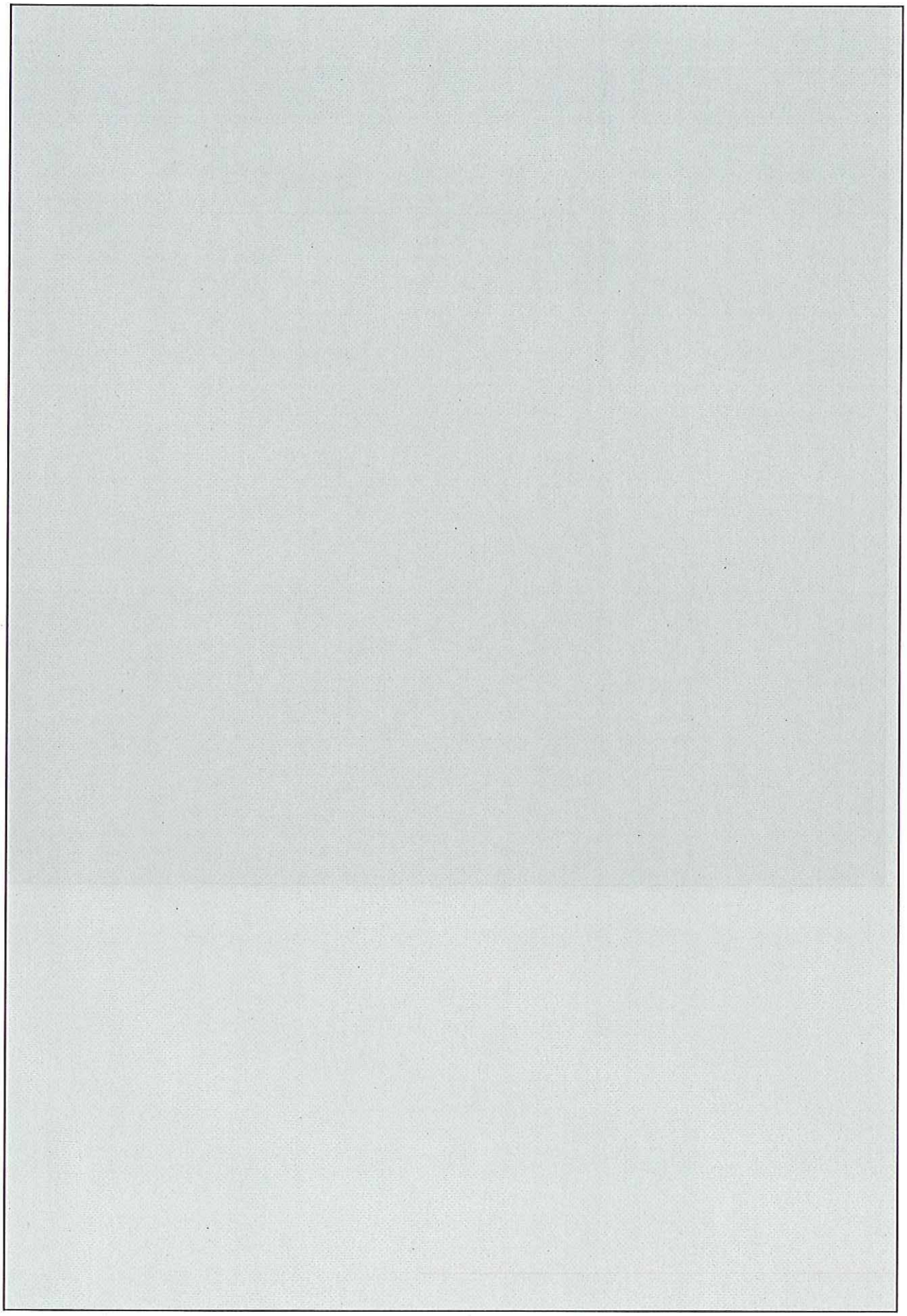


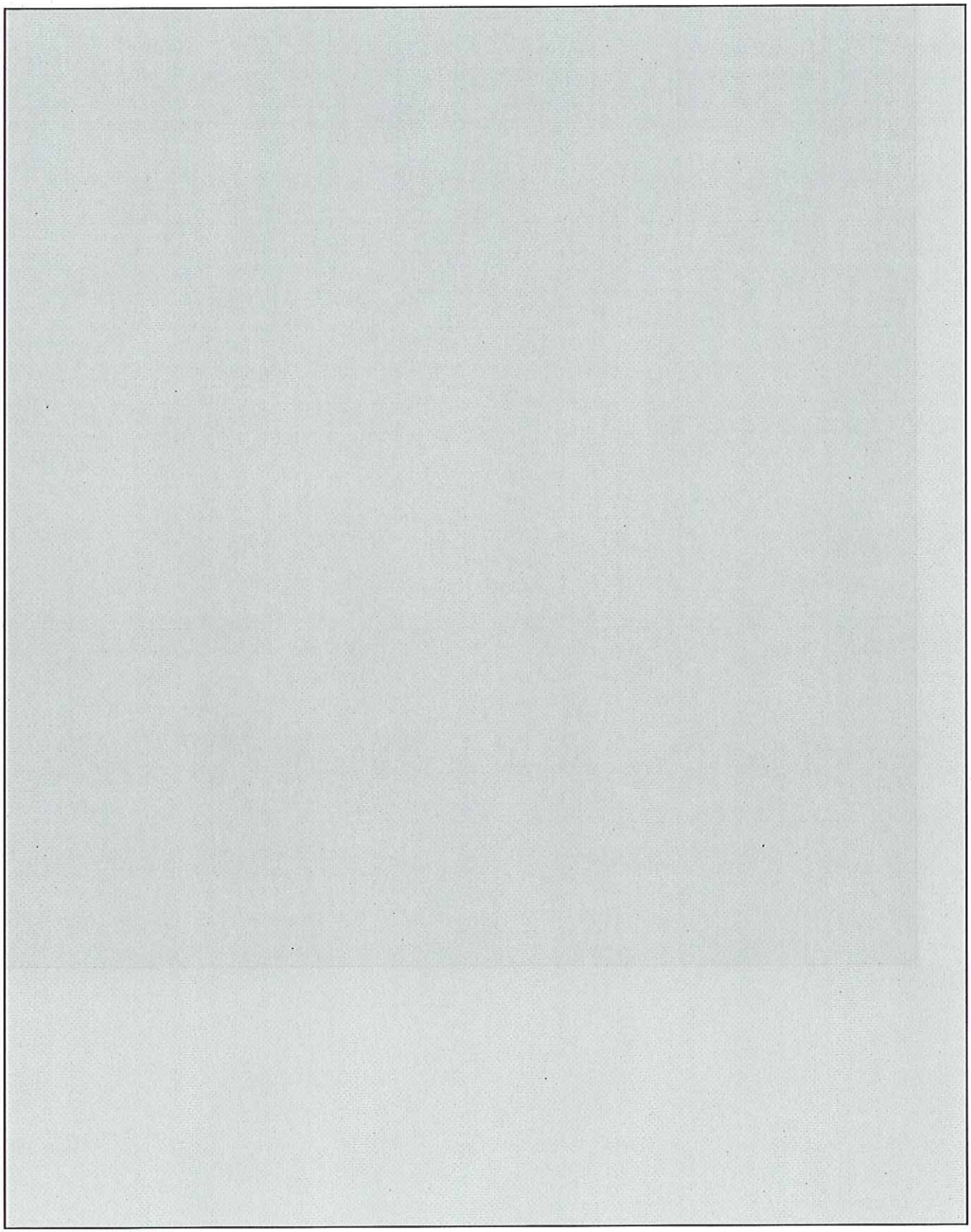


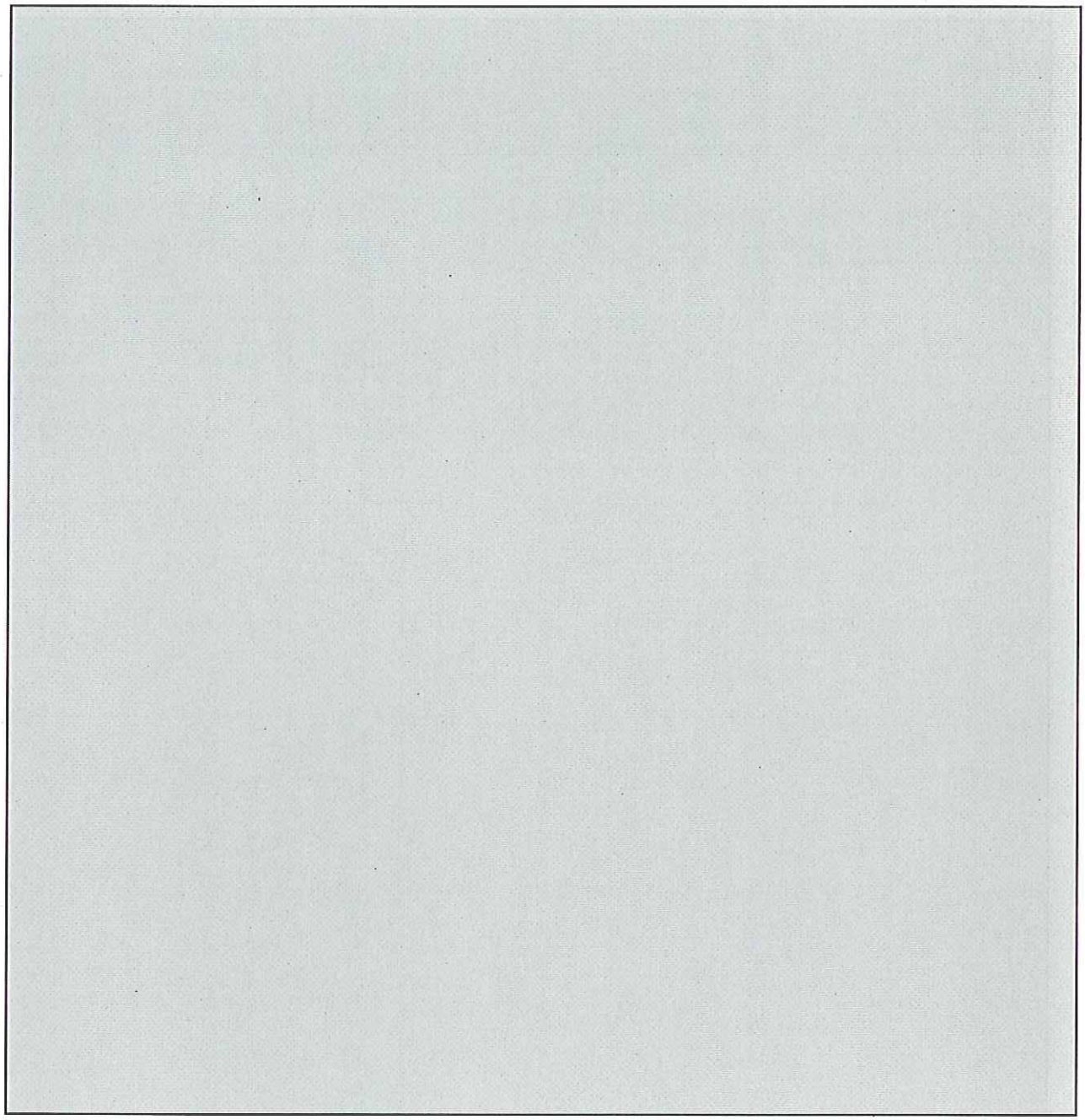


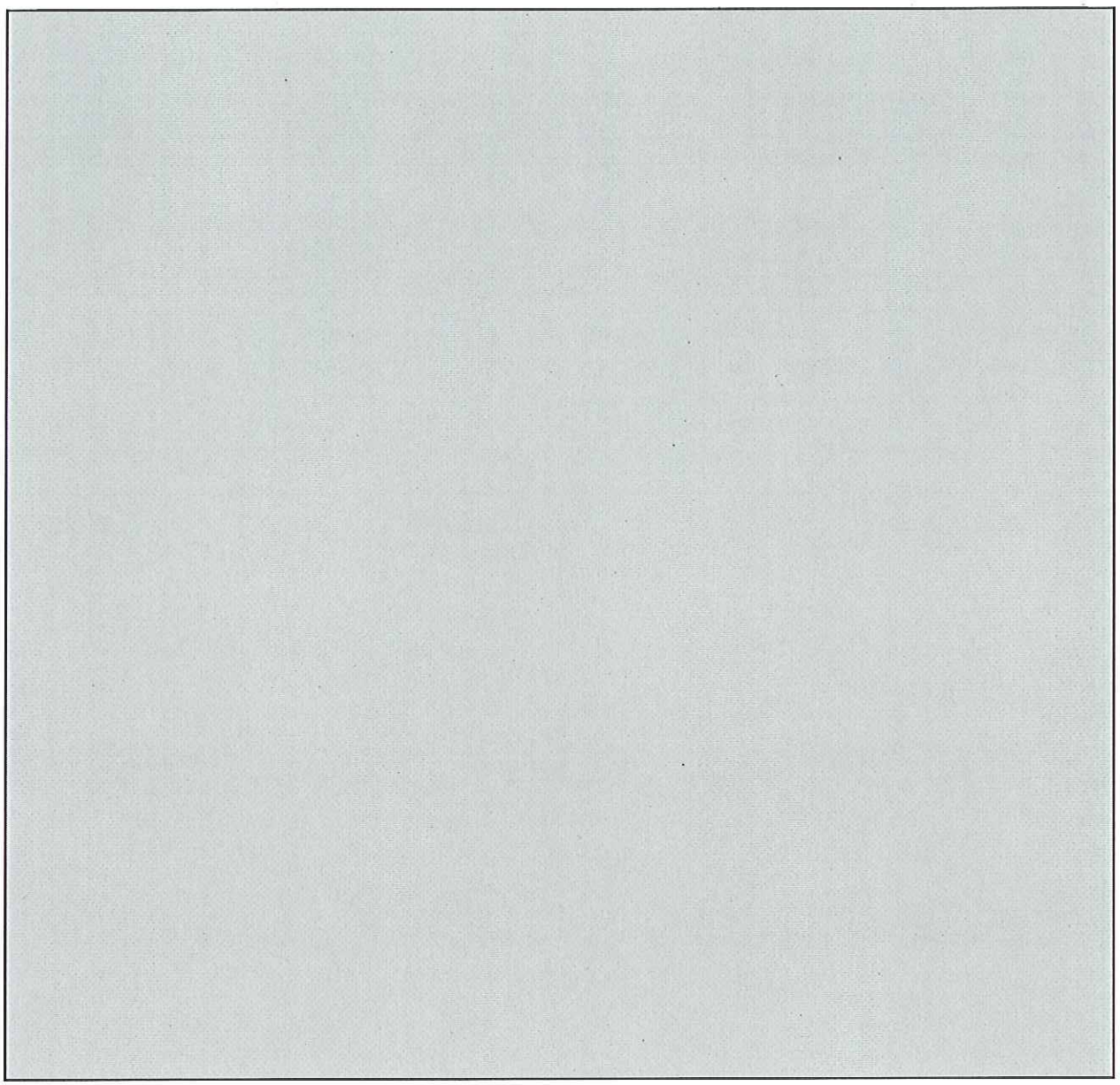


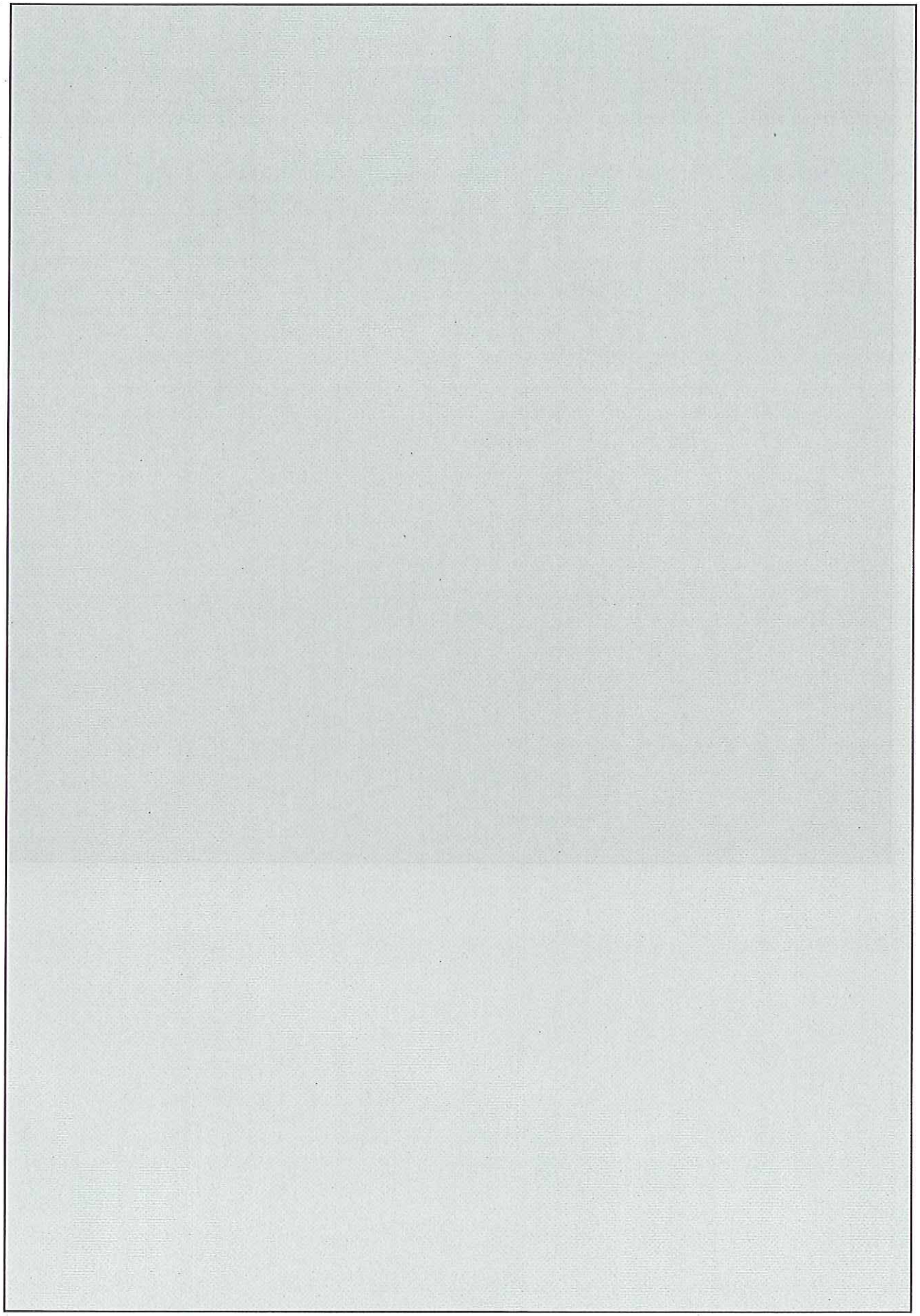


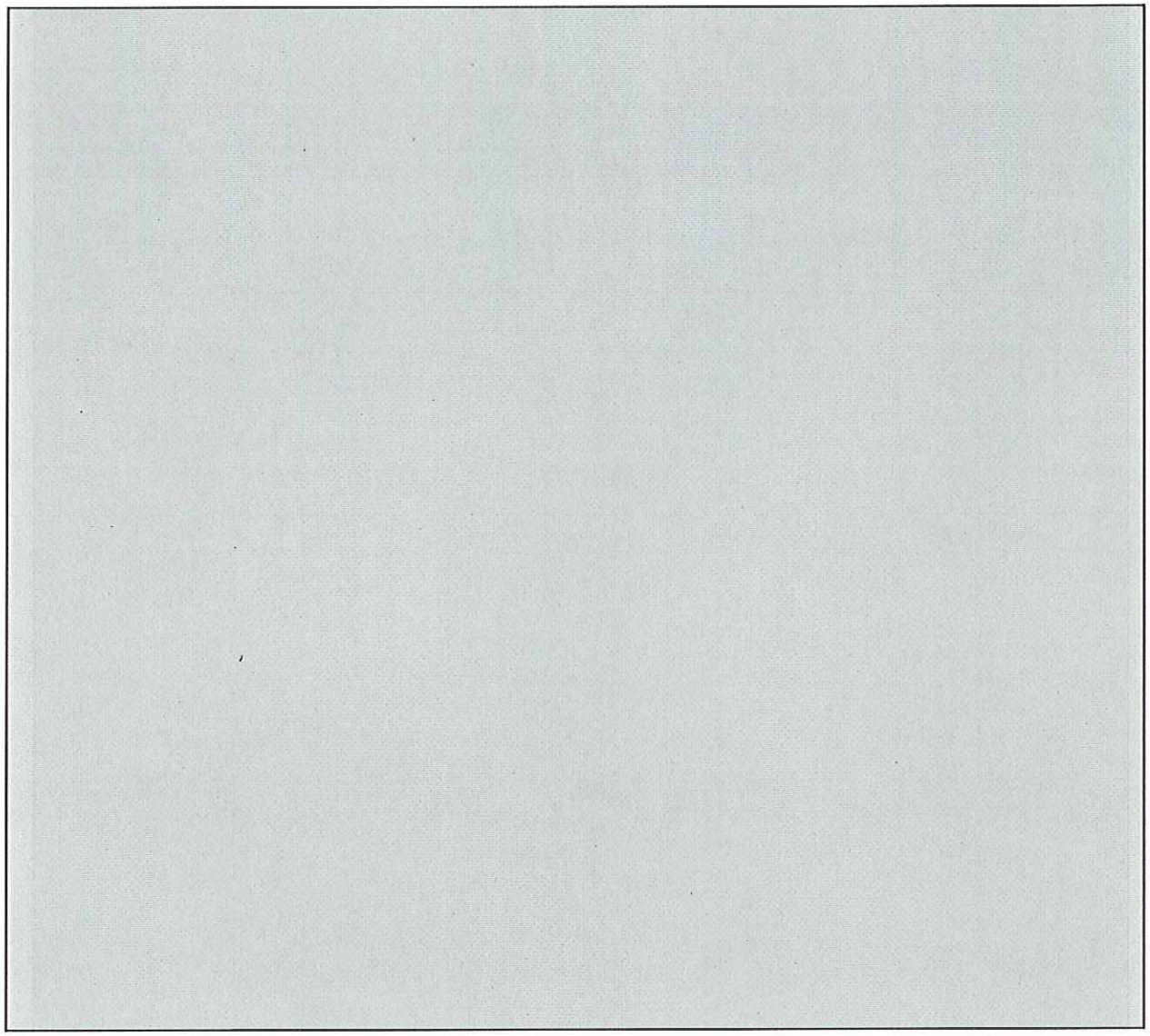


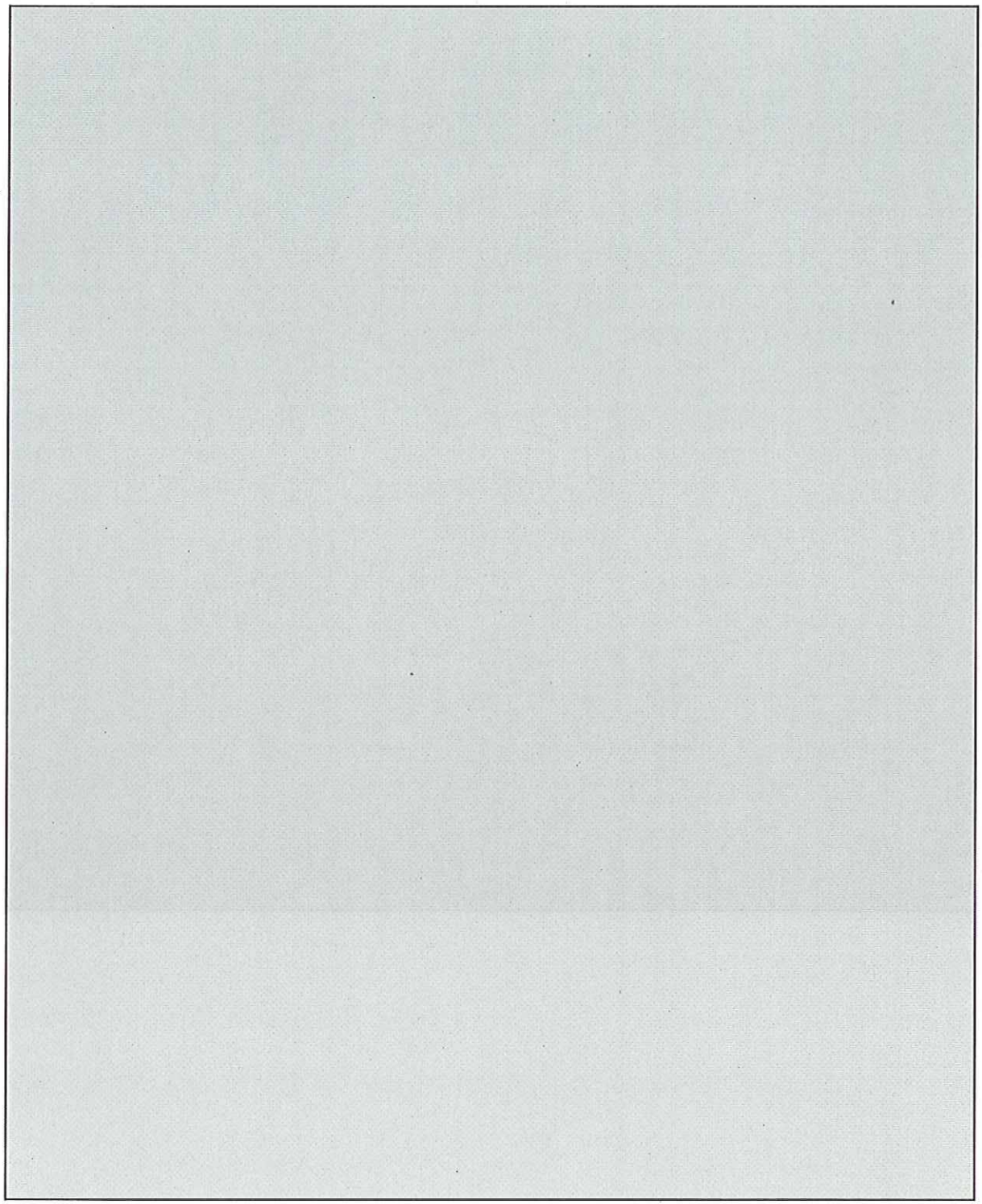










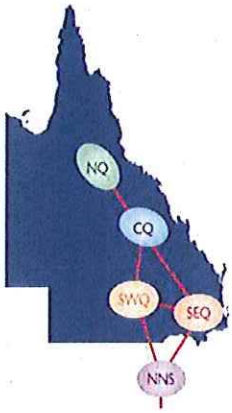


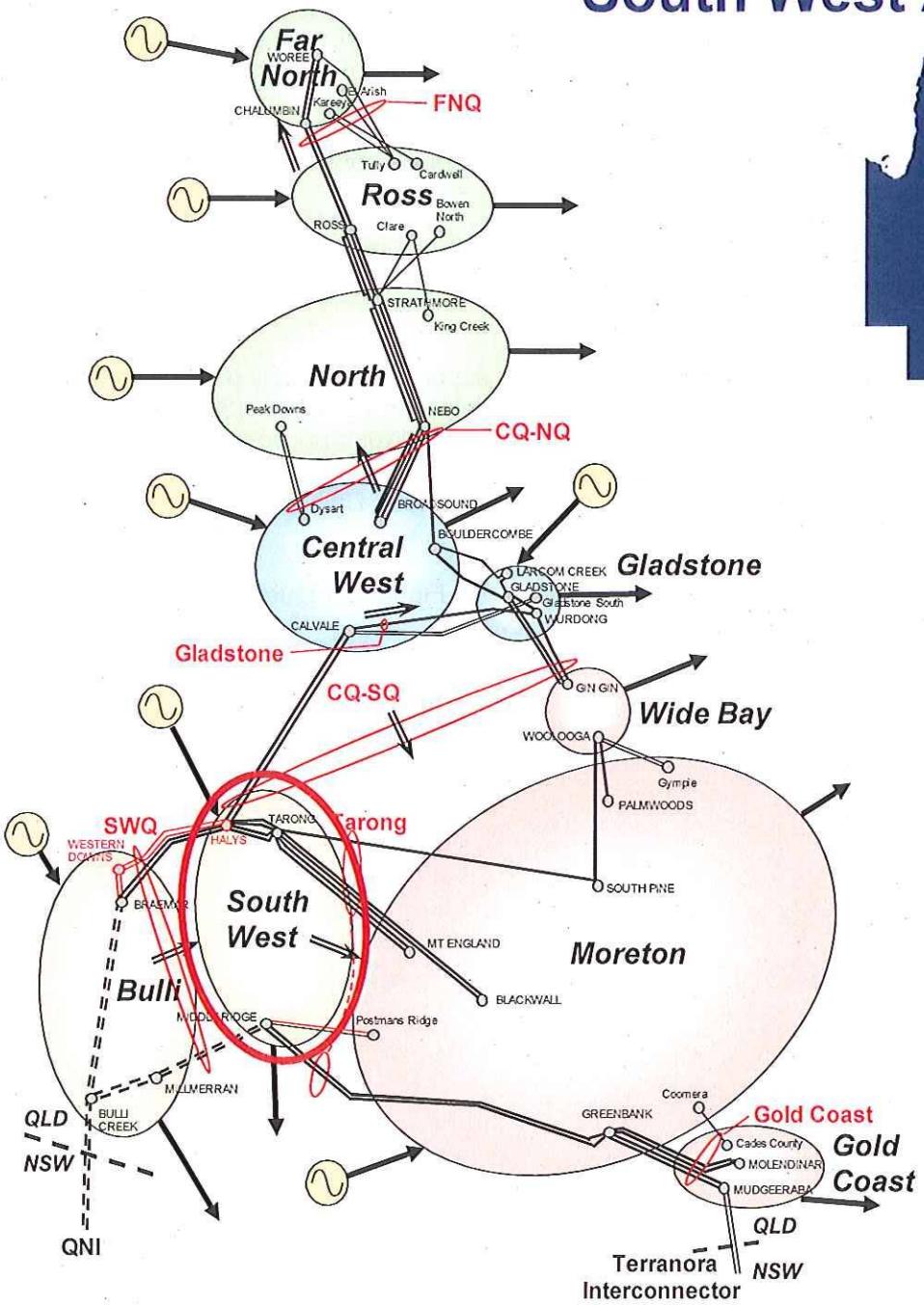
2010 GRID PLAN

VOLUME 2 SECTION 7

Network Development

South West Area





South West Area

1. Network Description

South West Queensland (SWQ) is a net exporter of electricity. Export of electricity is predominantly via five 275kV circuits from Tarong and two 275kV circuits from Middle Ridge to SEQ.

The SWQ area is defined as the area west of Swanbank and Lockrose, south of Calvale, north of Western Downs and east of Millmerran. The area comprises of the farming and commercial centres of Toowoomba, Dalby, Warwick, Oakey and Chinchilla, and the Granite Belt district around Stanthorpe.

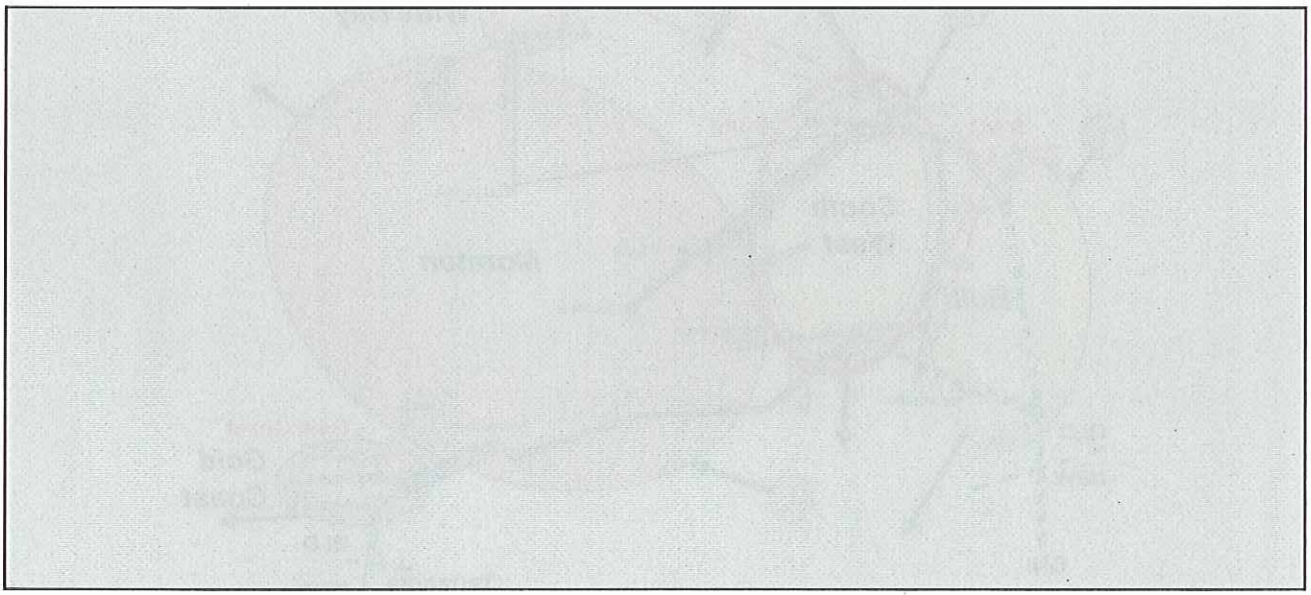
The major injection points into the south west Queensland load centres are the Tarong 275/132kV and Middle Ridge 275/110kV substations. The area also incorporates several local power stations connected to the sub-transmission system. Oakey power station, commissioned in early 2000, comprises of two open cycle gas turbines with total capacity of around 275MW capable of being powered by natural gas or liquid fuel (oil).

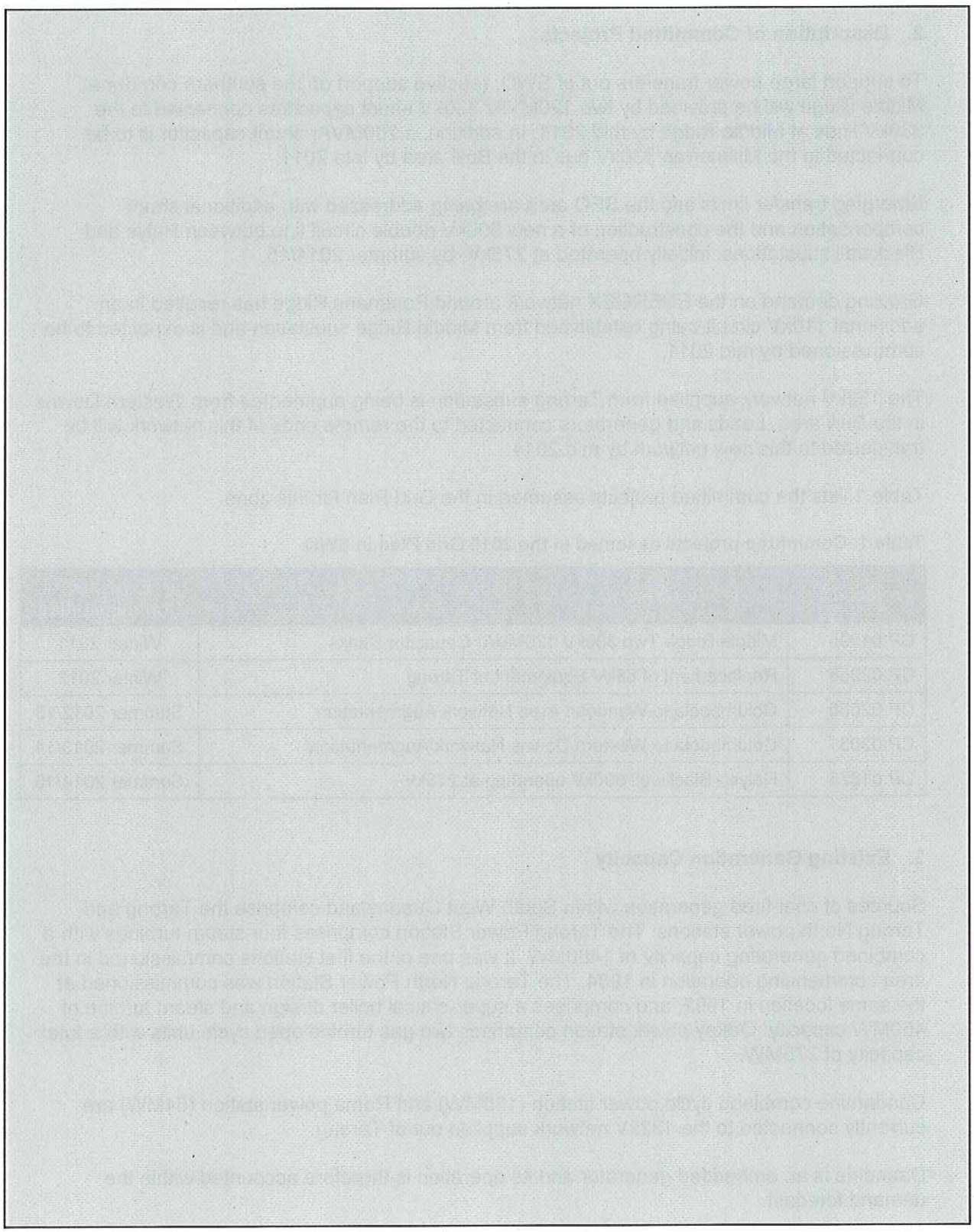
Roma power station is a scheduled market generator embedded within the Ergon Energy 132kV network commissioned in mid 1999. The station comprises of two open cycle gas turbines with total capacity of 54MW.

Daandine is a 33MW embedded generator in the township of Dalby. The station was commissioned in 2006, and is powered by coal seam methane gas from Arrow's Daandine fields.

A 132kV and 110kV sub-transmission system supplies bulk supply points within the area from Tarong and Middle Ridge substations respectively. The Chinchilla 132/110kV transformer historically allowed the connection of the 132kV and 110kV networks, although the Chinchilla to Dalby 110kV circuit was normally opened to manage loadings. These networks can no longer operate closed due to the use of the Chinchilla to Dalby line for 33kV distribution purposes.

The electricity supply system in SWQ is shown in Figure 1. Figure 2 shows a one line diagram representation of the existing transmission system.





The majority of the distribution system in south west Queensland are Ergon Energy assets. The Surat Basin north-west area is defined as the area north west of Braemar Substation. The area has significant development potential given the vast reserves of gas and coal fields. Electricity demand in the area is forecast to grow substantially due to new developments of liquefied natural gas (LNG) upstream processing facilities and a large coal mine together with the supporting infrastructure and services.

2. Description of Committed Projects

To support large power transfers out of SWQ, reactive support on the southern corridor at Middle Ridge will be provided by two 120MVAr 330kV shunt capacitors connected to the 330kV lines at Middle Ridge by mid 2011. In addition, a 200MVAr shunt capacitor is to be connected to the Millmerran 330kV bus in the Bulli area by late 2011.

Emerging transfer limits into the SEQ area are being addressed with additional shunt compensation and the construction of a new 500kV double circuit line between Halys and Blackwall substations, initially operated at 275kV, by summer 2014/15.

Growing demand on the ENERGEX network around Postmans Ridge has resulted in an additional 110kV circuit being established from Middle Ridge substation and is expected to be commissioned by mid 2011.

The 132kV network supplied from Tarong substation is being augmented from Western Downs in the Bulli area. Loads and generators connected to the remote ends of this network will be transferred to this new network by mid 2014.

Table 1 lists the committed projects assumed in the Grid Plan for this zone.

Table 1: Committed projects assumed in the 2010 Grid Plan in SWQ

Project ID	Project Description	Expected Commissioning
CP.01995	Middle Ridge Two 330kV 120MVAr Capacitor Banks	Winter 2011
CP.02058	Replacement of 66kV Equipment at Tarong	Winter 2012
CP.02030	Columboola to Wandoan Area Network Augmentation	Summer 2012/13
CP.02031	Columboola to Western Downs Network Augmentation	Summer 2013/14
CP.01875	Halys - Blackwall 500kV operating at 275kV	Summer 2014/15

3. Existing Generation Capacity

Sources of coal-fired generation within South West Queensland comprise the Tarong and Tarong North power stations. The Tarong Power Station comprises four steam turbines with a combined generating capacity of 1400MW. It was one of the first stations commissioned in the area commencing operation in 1984. The Tarong North Power Station was commissioned at the same location in 1999, and comprises a super-critical boiler design and steam turbine of 450MW capacity. Oakey power station comprises two gas turbine open cycle units with a total capacity of 275MW.

Condamine combined cycle power station (135MW) and Roma power station (54MW) are currently connected to the 132kV network supplied out of Tarong.

Daandine is an embedded generator and its operation is therefore accounted within the demand forecast.

4. Generation Scenarios

Generation scenarios nominated within this area may impact transmission developments in South West and South East Queensland.

Table 2 lists potential new entrants (in addition to existing plant) as identified by ROAM.

Table 2: ROAM new entrants in SWQ

Generator	Capacity (MW)	Assumed Point of Connection	Cumulative Probability of Proceeding by 2021/22
Crows Nest 1 Wind	150	Tarong – Middle Ridge 275kV	100%
Crows Nest 2 Wind	50	Tarong – Middle Ridge 275kV	56%
Spring Gully 1 CCGT	500	Wandoan South 275kV	100%
Spring Gully 2 CCGT	500	Wandoan South 275kV	100%
Kogan Solar Thermal	23	Columboola 132kV	96%
Wandoan 1 Coal	334	Wandoan South 275kV	45%
Mini 1 Solar Thermal	20	Columboola 275kV	68%
Mini 2 Solar Thermal	20	Columboola 275kV	26%
New Entrant 4 OCGT	300	Columboola 275kV	18%
New Entrant 6 OCGT	300	Wandoan South 275kV	17%
New Entrant 6 CCGT	500	Columboola 275kV	11%
Wandoan 2 Coal	334	Wandoan South 275kV	32%

5. Description of Transmission Limitations

Main Grid

The South East Queensland area is the most densely populated part of Queensland. Growing demand results in increasing transmission and transformer loadings. This causes higher reactive power loadings, as well as greater reactive losses. The combined effect is an annual increase in reactive demand above that already being supplied through existing reactive devices.

The increasing real and reactive power demand must be met by an acceptable balance between transmission line capacity and static and dynamic reactive power compensation in South East Queensland to maintain voltage stability.

Maximum power transfer across the SWQ to SEQ grid section is limited by the occurrence of unstable voltages and the thermal capability of transmission plant following critical contingencies.

Voltage instability results from exhaustion of reactive power reserves in Southern Queensland. The critical contingency is the loss of a 275kV circuit between Central and Southern Queensland, one of the seven 275kV circuits between SWQ and SEQ or an outage of Swanbank E generating unit when operating at high output.

Voltage stability limitations into SEQ have been progressively addressed for many years. Over time, the voltage stability limit has been increased to meet growing demand through the construction of new 275kV circuits into SEQ and through installation of static and dynamic reactive power compensation.

With respect to reactive compensation, Powerlink recently commissioned Static VAr Compensators (SVCs) at Greenbank and South Pine substations, together with several static capacitor banks in SEQ as detailed in Annual Planning Reports and Regulatory Test consultation documents.

Transmission line augmentations have included double circuit 275kV lines between Tarong and Blackwall substations (commissioned summer 2000/01), between Middle Ridge and Greenbank substations (commissioned summer 2007/08) and between Halys and Blackwall substations (500kV line planned to be commissioned summer 2014/15, but operated at 275kV).

Notwithstanding the commissioning of the Halys to Blackwall double circuit transmission line, voltage stability limitations are forecast to re-emerge in SEQ for several scenarios within the next regulatory period.

Regional Grid

Load growth in the SWQ area is predominantly driven by the establishment of LNG export from South West Queensland, and continuing load growth will result in network overloads and voltage limitations under contingency conditions.

The critical Regional Grid contingencies include:

- 275kV circuits between Wandoan South and Western Downs;
- 275/132kV transformers at Wandoan South; and
- 132/110kV transformer at Chinchilla.

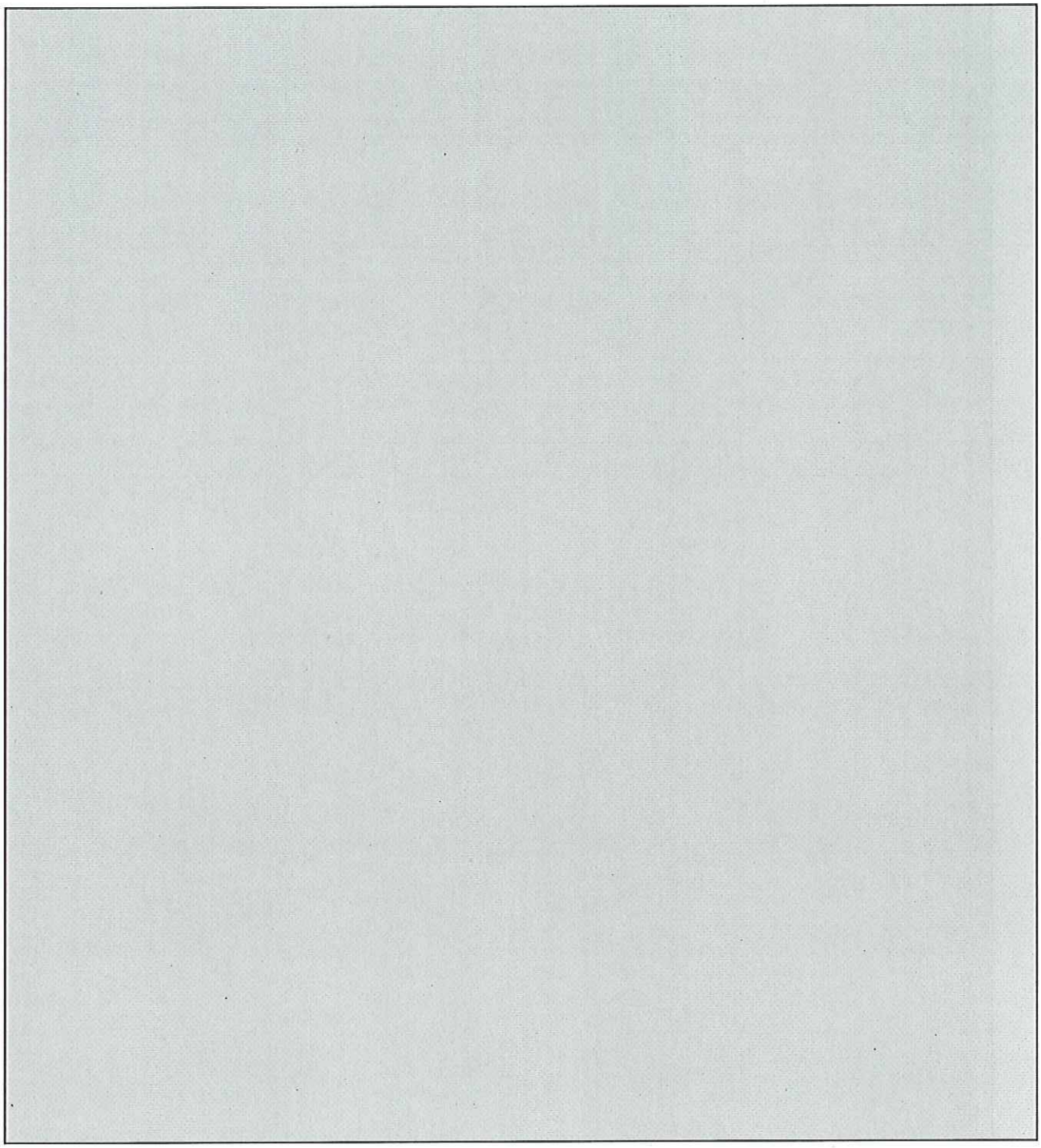
Powerlink considers that possible load growth will exceed the thermal rating of the committed developments under contingency conditions. The availability of gas in the area may similarly drive significant generation to establish in the area, which can also lead to network limitations. Powerlink is thus proposing two contingent projects to ensure that it is able to supply this burgeoning industry.

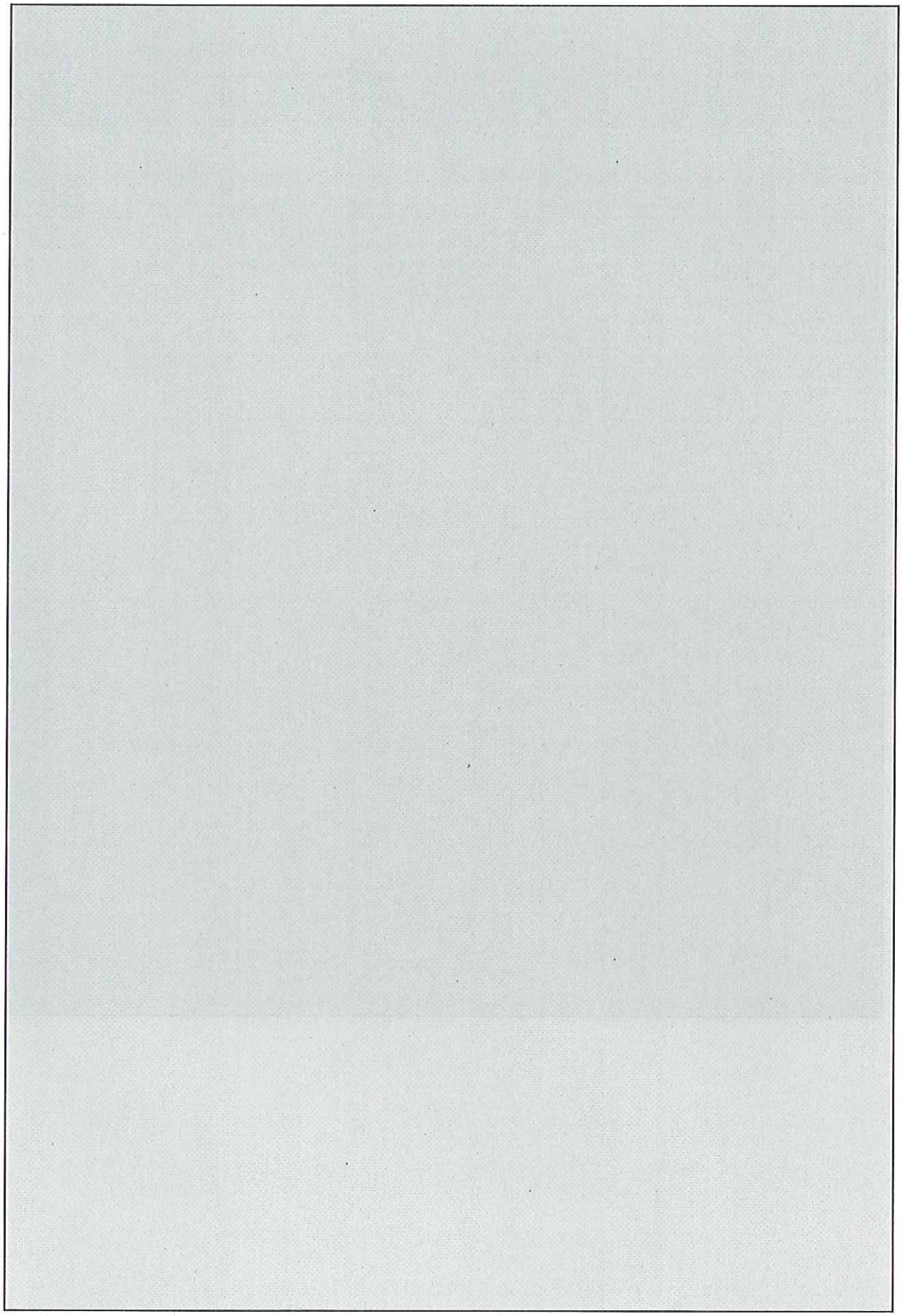
6. Relevant Planning Criteria

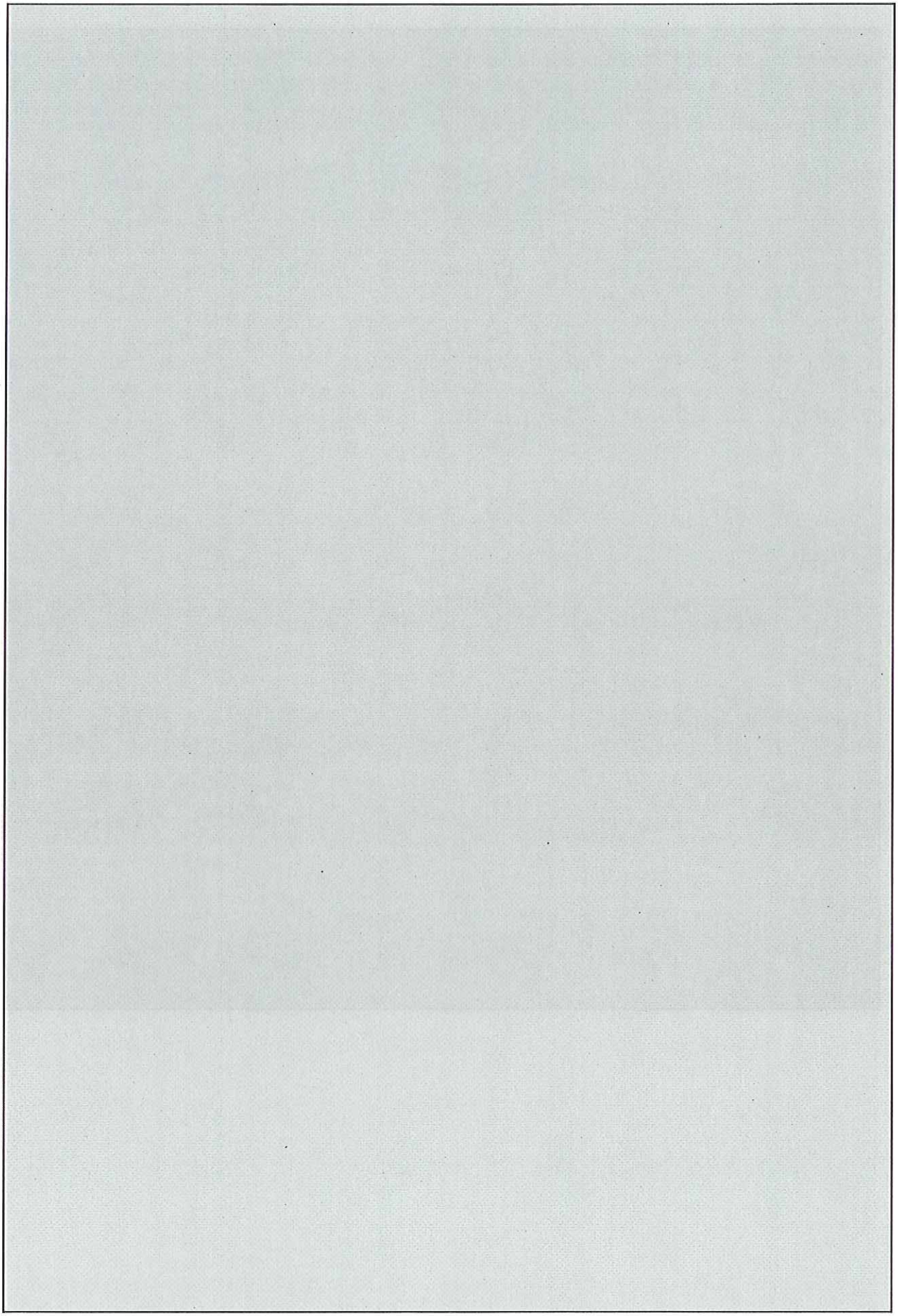
Powerlink's planning criteria, as it applies to this section, is summarised in Table 3.

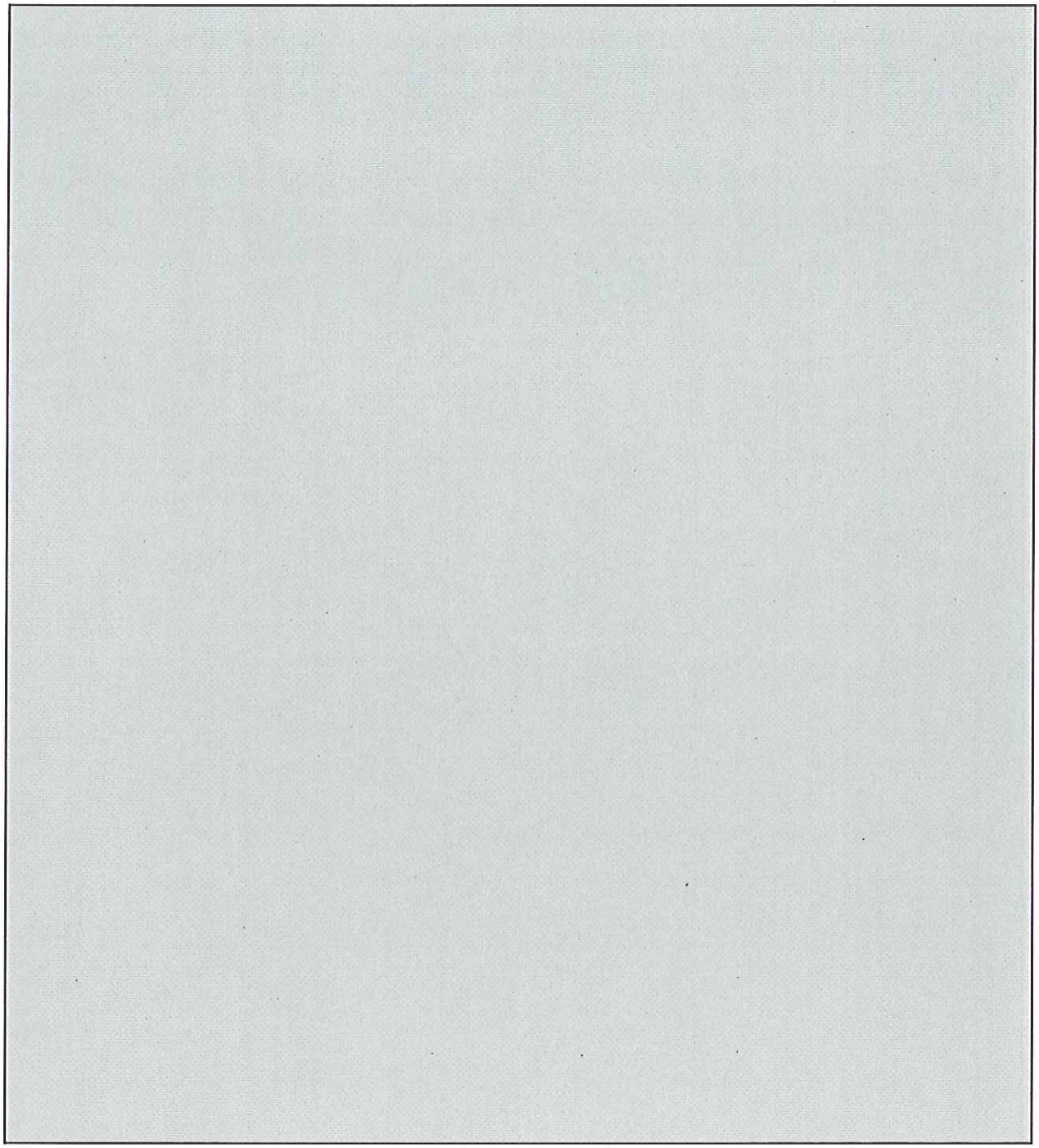
Table 3: Relevant planning criteria

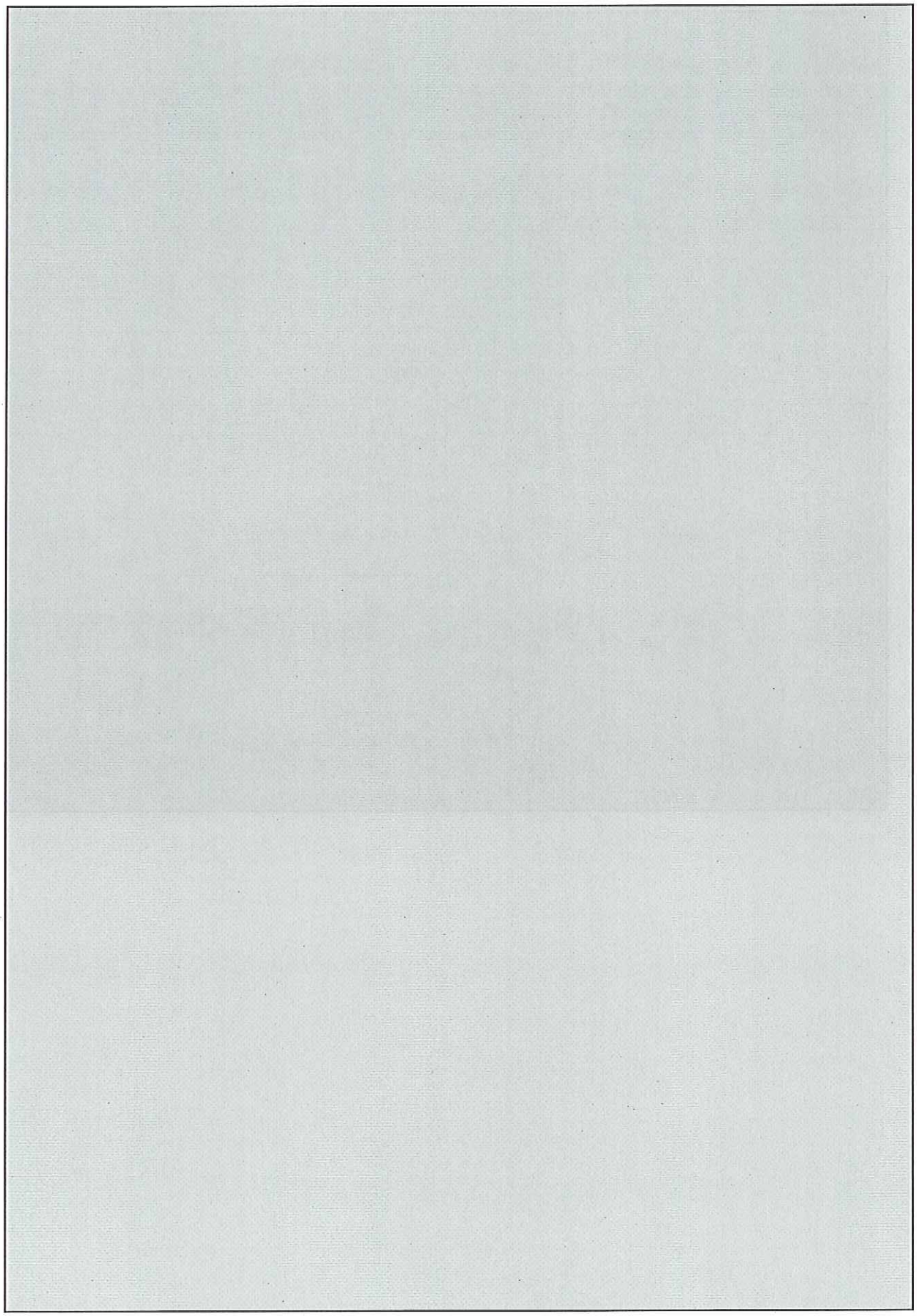
Network Planning	Criteria	Notes
Main Grid including Bulk Supply Transformation	10% PoE "Low", "Medium" and "High" forecasts	
Regional Grid including Zone Supply Transformation	50% PoE "Low", "Medium" and "High" forecasts	
Wind Generation Capacity Factor	5% of installed capacity coincident with summer 50% or 10% PoE area peak	
N-1	All circuits within normal line ratings prior to contingency All transformers within normal cyclic ratings prior to contingency All circuits within incremental line ratings following N-1 All transformers within emergency cyclic rating following N-1	Network switching (of 275/132/110kV transformers, 132kV and/or 110kV network) allowed to land within the post-contingent ratings Load transfers by the DNSP may be considered but must be pre-contingent Generation can be constrained to meet these objectives (within the limits of installed capacity), but the cumulative market impact needs to be considered

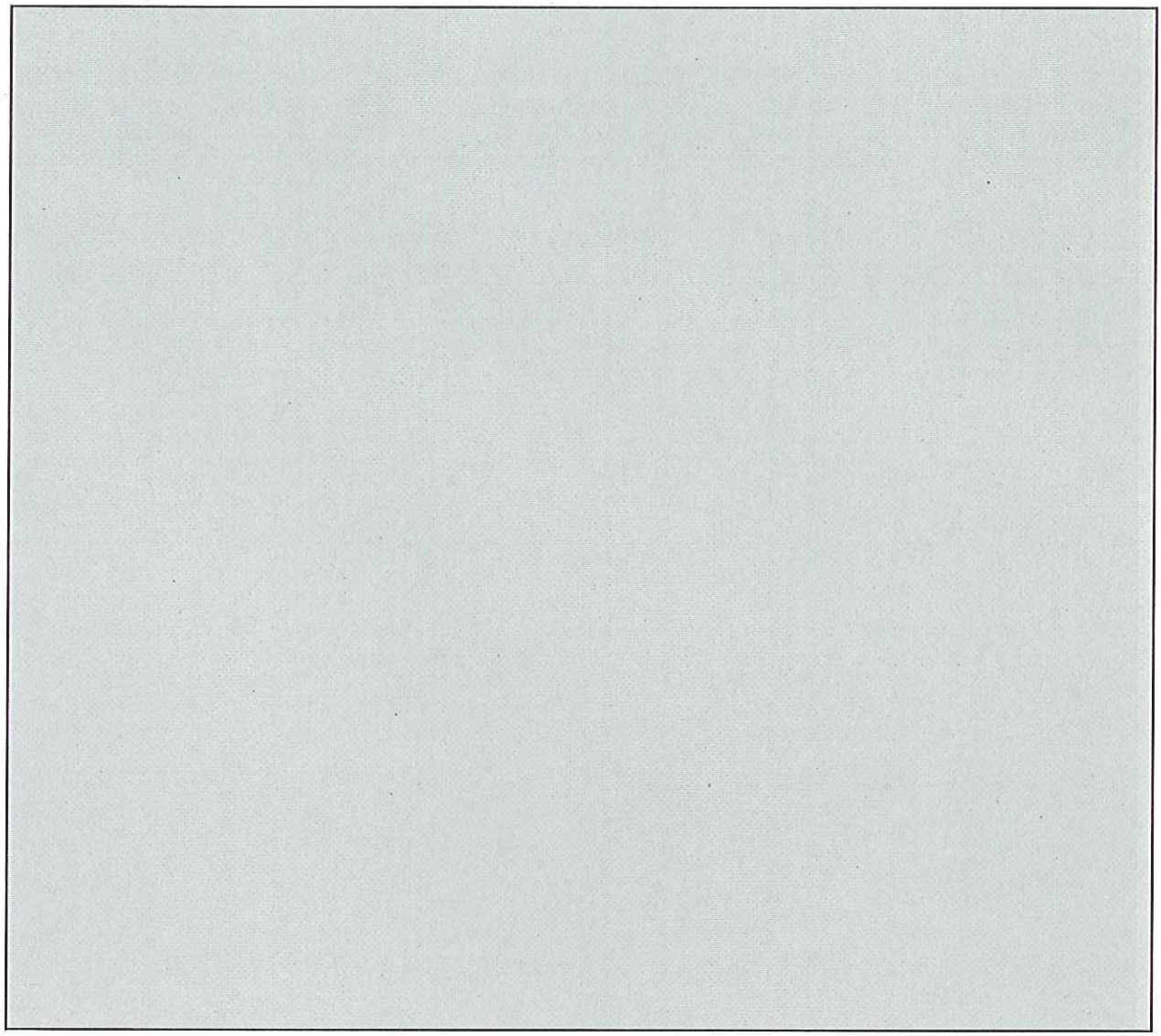


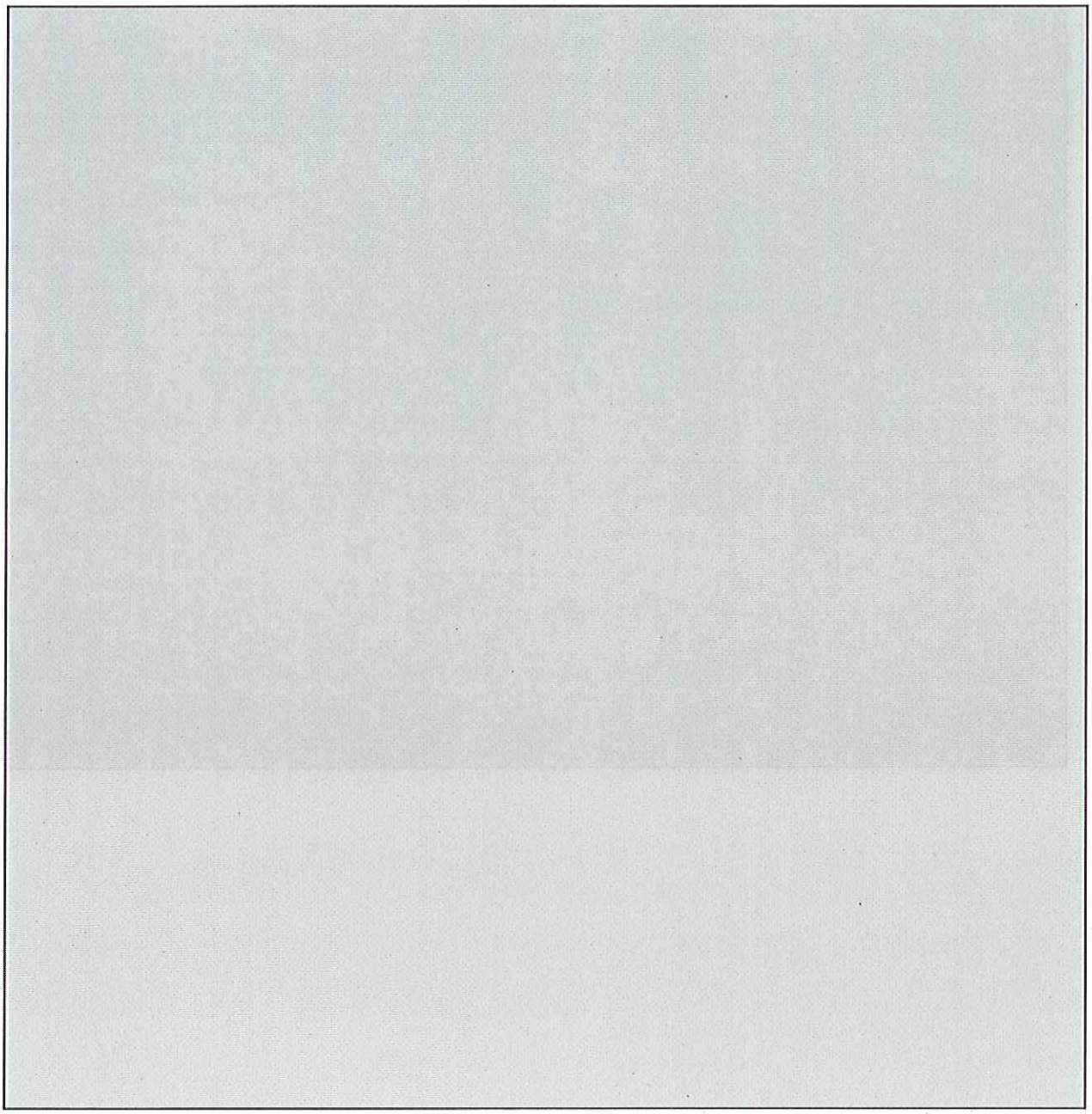


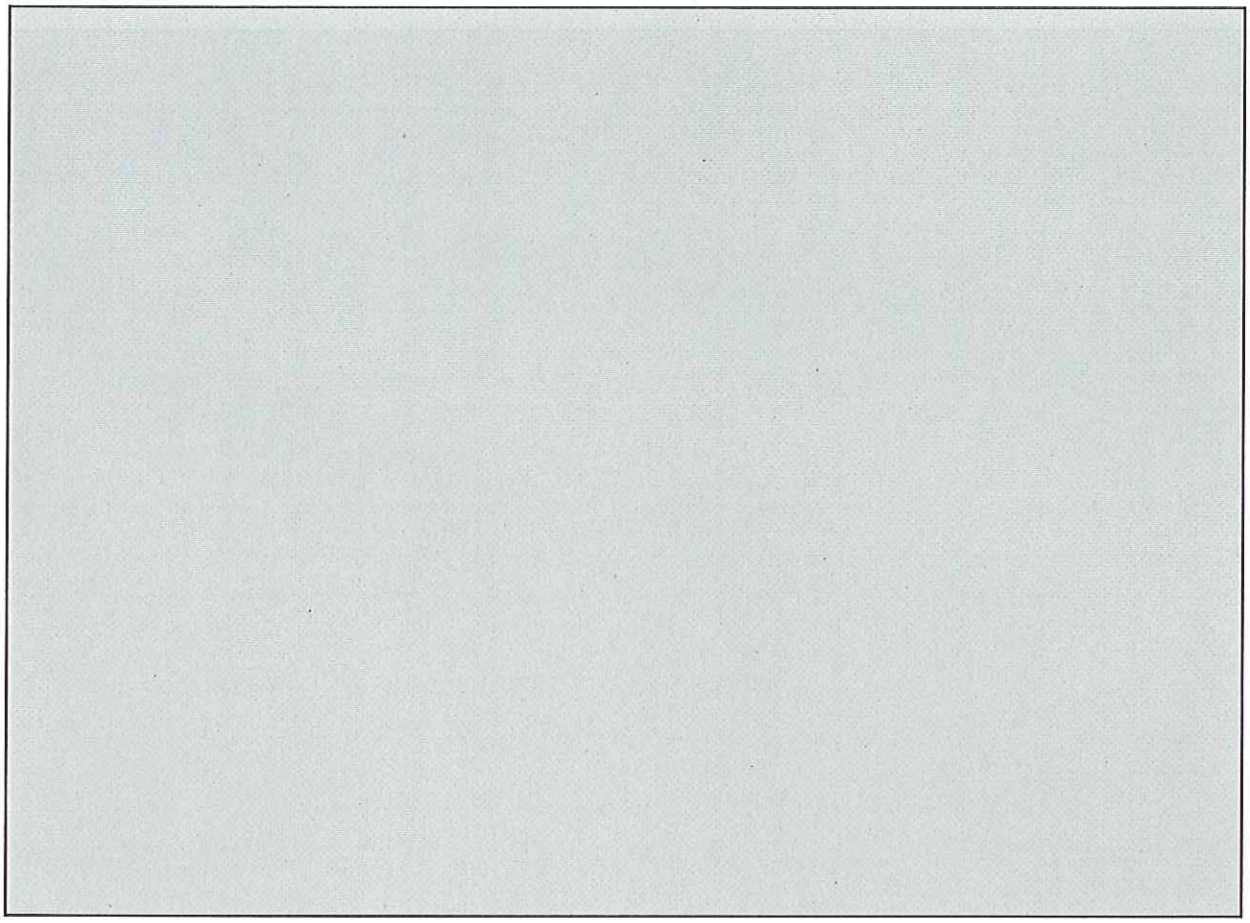


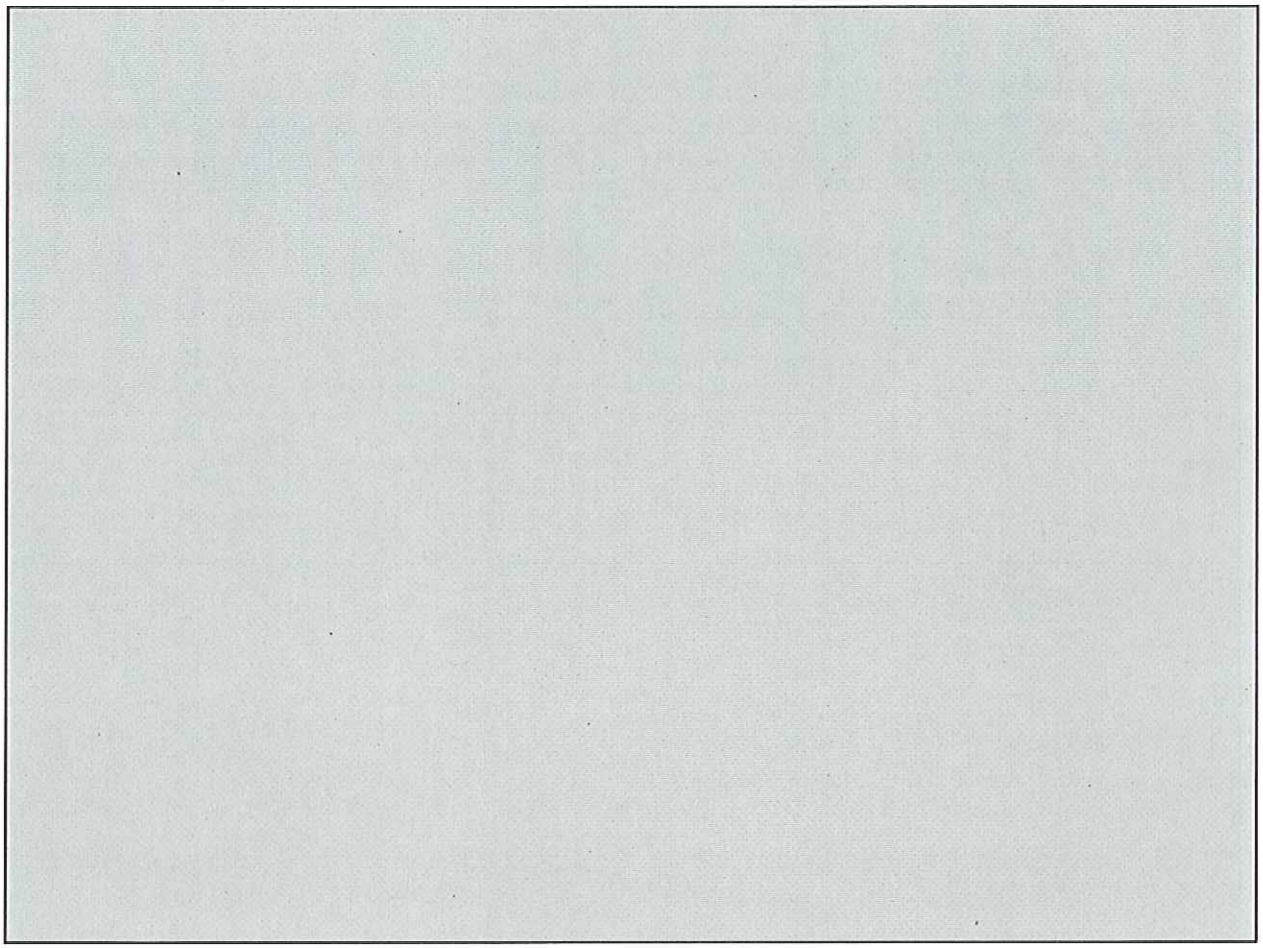


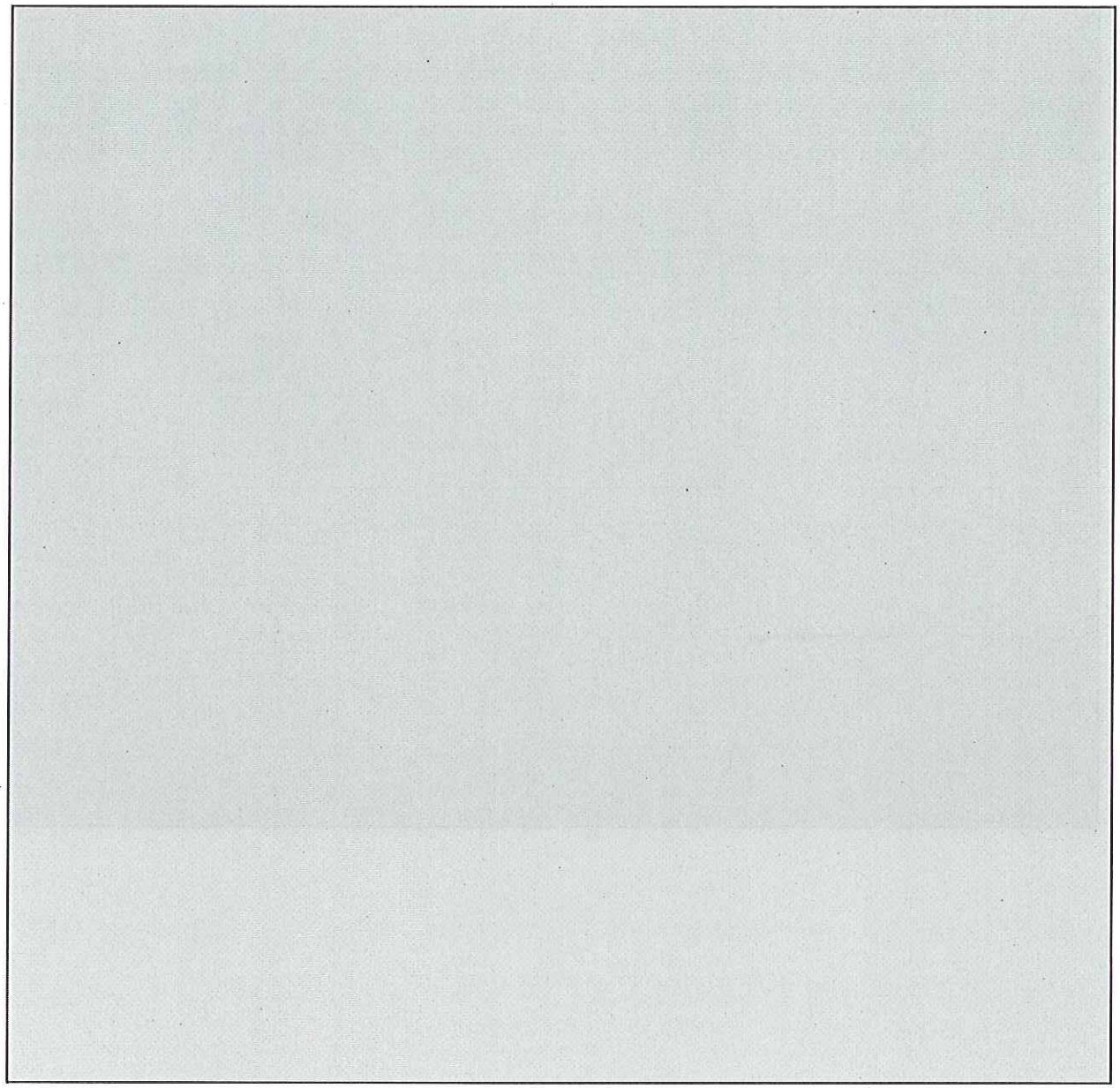










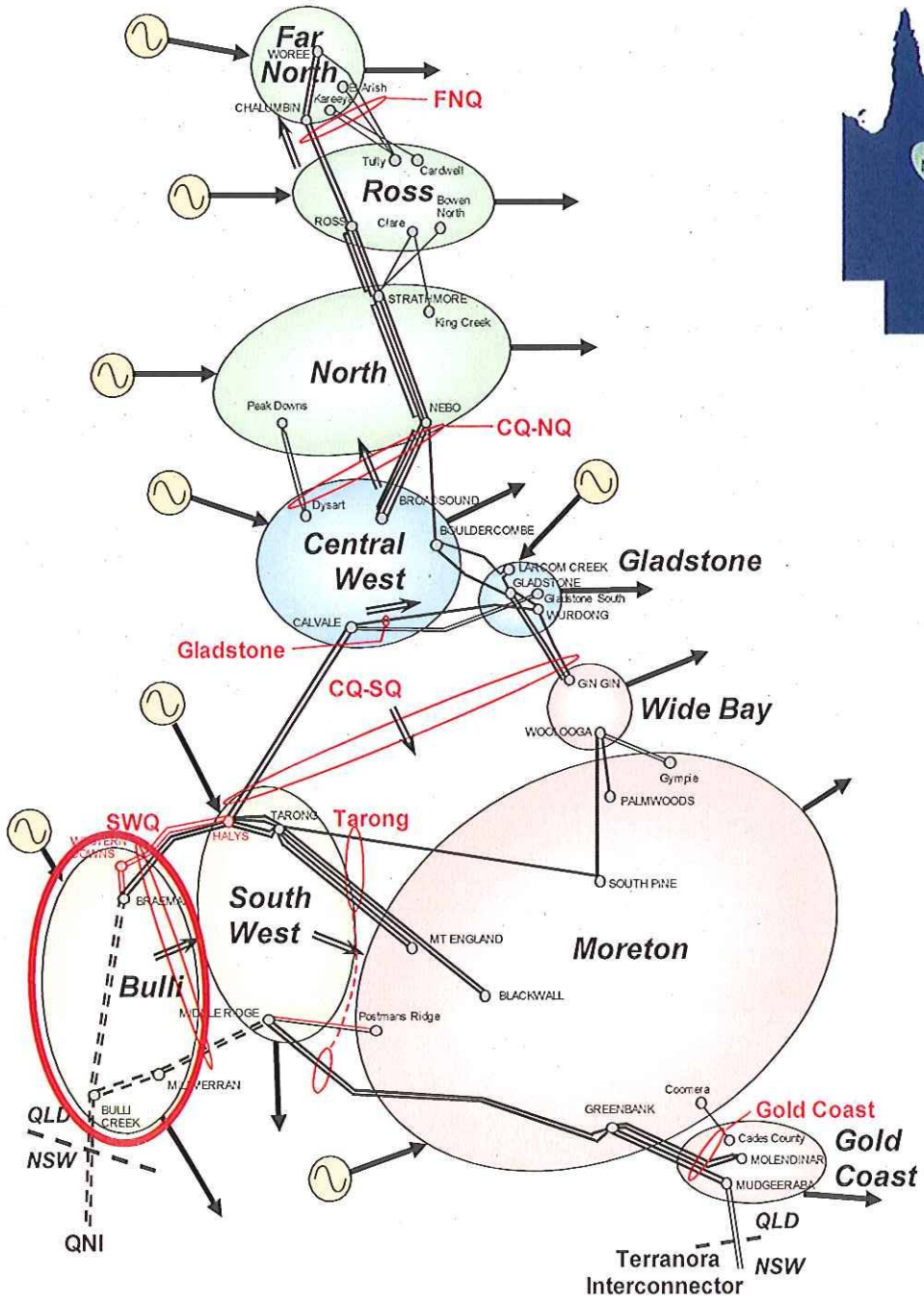


2010 GRID PLAN

VOLUME 2 SECTION 8

Network Development

Bulli Area



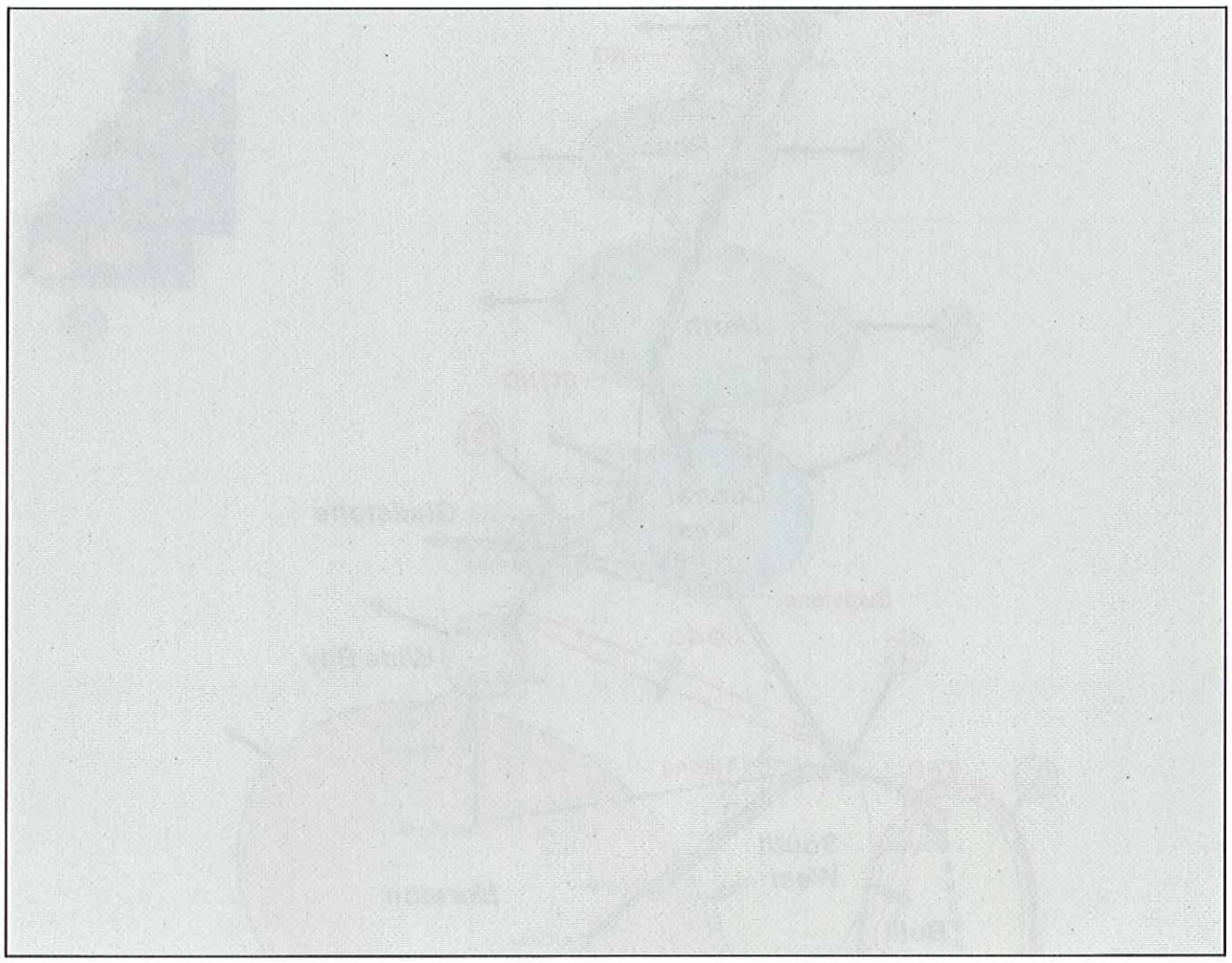
Bulli Area

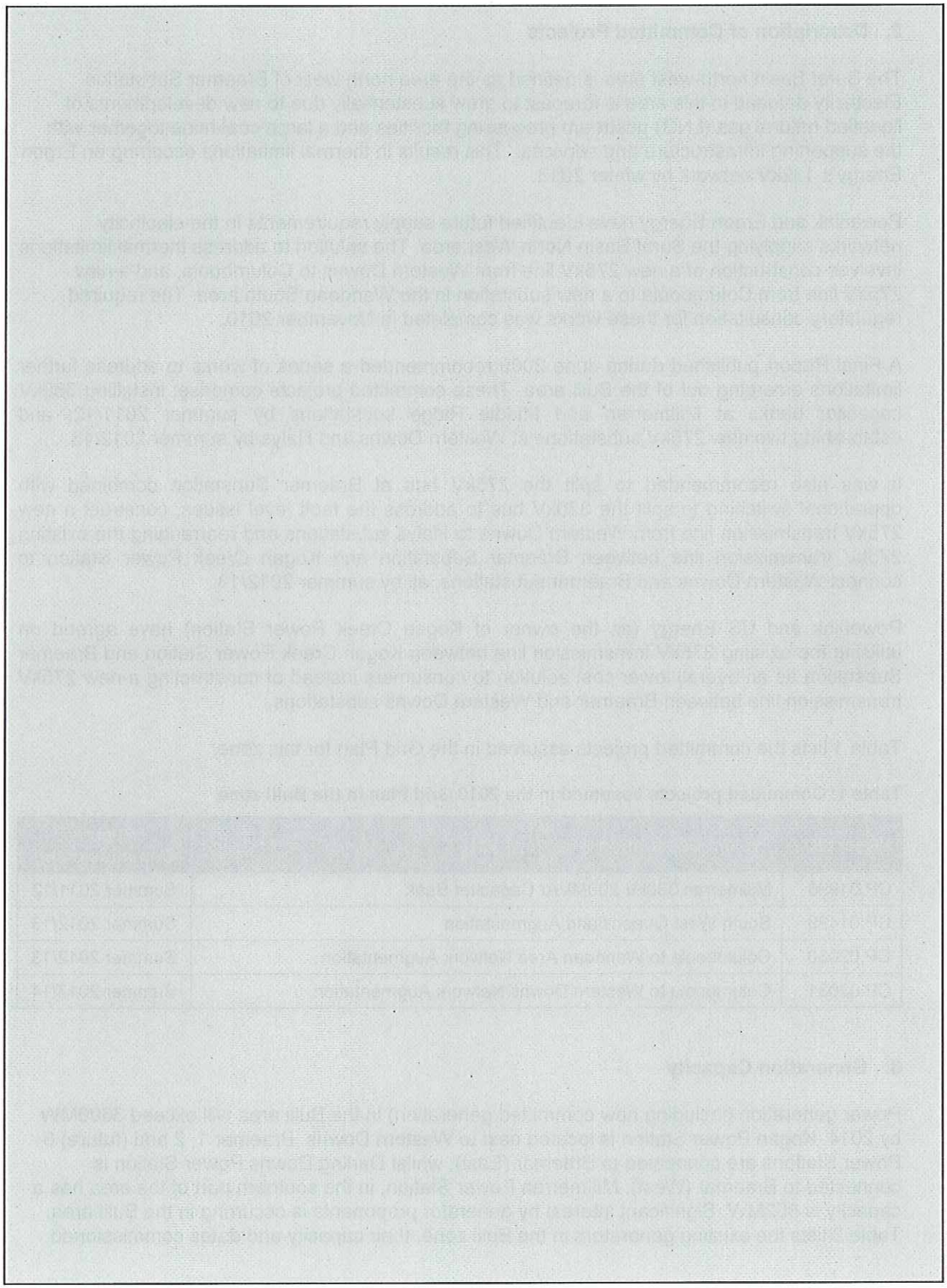
1. Network Description

Bulli is a net exporter of electricity. Electricity is predominantly exported via double circuit 275kV and 330kV lines from Braemar and Millmerran substations. Circuits to Tarong and Middle Ridge carry power generated in the Bulli area and in NSW via the Queensland to NSW Interconnector (QNI).

The QNI consists of high capacity 330kV and 275kV double circuit line constructed between Tarong and Armidale using twin Sulphur conductor. The interconnector initially incorporated Braemar Substation and switching stations at Bulli Creek and Dumaresq. It now facilitates the connection of new coal and gas fired generation from the black coal seams within the Surat Basin.

The electricity supply system in Bulli and SWQ is shown in Figure 1. Figure 2 shows a one line diagram representation of the existing transmission system.





2. Description of Committed Projects

The Surat Basin north-west area is defined as the area north west of Braemar Substation. Electricity demand in this area is forecast to grow substantially due to new developments of liquefied natural gas (LNG) upstream processing facilities and a large coal mine together with the supporting infrastructure and services. This results in thermal limitations occurring on Ergon Energy's 132kV network by winter 2013.

Powerlink and Ergon Energy have identified future supply requirements in the electricity networks supplying the Surat Basin North West area. The solution to address thermal limitations involves construction of a new 275kV line from Western Downs to Columboola, and a new 275kV line from Columboola to a new substation in the Wandoan South area. The required regulatory consultation for these works was completed in November 2010.

A Final Report published during June 2009 recommended a series of works to address further limitations emerging out of the Bulli area. These committed projects comprise: installing 330kV capacitor banks at Millmerran and Middle Ridge substations by summer 2011/12; and establishing two new 275kV substations at Western Downs and Halys by summer 2012/13.

It was also recommended to split the 275kV bus at Braemar Substation combined with operational switching to split the 330kV bus to address the fault level issues, construct a new 275kV transmission line from Western Downs to Halys substations and rearranging the existing 275kV transmission line between Braemar Substation and Kogan Creek Power Station to connect Western Downs and Braemar substations, all by summer 2012/13.

Powerlink and CS Energy (as the owner of Kogan Creek Power Station) have agreed on utilising the existing 275kV transmission line between Kogan Creek Power Station and Braemar Substation as an overall lower cost solution to consumers instead of constructing a new 275kV transmission line between Braemar and Western Downs substations.

Table 1 lists the committed projects assumed in the Grid Plan for this zone.

Table 1: Committed projects assumed in the 2010 Grid Plan in the Bulli zone

Project ID	Project Description	Expected Commissioning
CP.01996	Millmerran 330kV 200MVAr Capacitor Bank	Summer 2011/12
CP.01429	South West Queensland Augmentation	Summer 2012/13
CP.02030	Columboola to Wandoan Area Network Augmentation	Summer 2012/13
CP.02031	Columboola to Western Downs Network Augmentation	Summer 2013/14

3. Generation Capacity

Power generation (including new committed generation) in the Bulli area will exceed 3600MW by 2014. Kogan Power Station is located next to Western Downs. Braemar 1, 2 and (future) 3 Power Stations are connected to Braemar (East), whilst Darling Downs Power Station is connected to Braemar (West). Millmerran Power Station, in the southern part of the area has a capacity is 852MW. Significant interest by generator proponents is occurring in the Bulli area. Table 2 lists the existing generators in the Bulli zone, their capacity and dates commissioned.

Table 2: Existing generators in Bulli

Generator	Capacity (MW)	Commissioning Date
Millmerran	852	2002
Braemar	435	2006
Kogan Creek	724	2007
Braemar 2	462	2009
Darling Downs	605	2010

4. Generation Scenarios

Table 3 lists potential new entrants (in addition to existing plant) as identified by ROAM.

Table 3: ROAM new entrants in Bulli

Generator	Capacity (MW)	Assumed Point of Connection	Cumulative Probability of Proceeding by 2021/22
Braemar 3 OCGT	300	Braemar East 275kV	100%
Braemar 4 OCGT	300	Braemar East 275kV	100%
Darling Downs 2 OCGT	600	Braemar West 275kV	100%
Bulli OCGT	450	Braemar East 275kV	79%
Coopers Gap 1 Wind	300	Western Downs – Halys 275kV	94%
New Entrant 1 CCGT	500	Western Downs 275kV	78%
New Entrant 2 CCGT	500	Western Downs 275kV	70%
New Entrant 2 OCGT	300	Western Downs 275kV	60%
New Entrant 3 OCGT	300	Western Downs 275kV	86%
Kogan Creek OCGT	250	Western Downs 275kV	84%
Braemar 2 OCGT	600	Western Downs 275kV	91%
Coopers Gap 2 Wind	140	Western Downs – Halys 275kV	11%
New Entrant 5 OCGT	300	Western Downs 275kV	18%
New Entrant 7 OCGT	300	Western Downs 275kV	11%
New Entrant 4 CCGT	500	Western Downs 275kV	11%
New Entrant 5 CCGT	500	Western Downs 275kV	11%
New Entrant 7 CCGT	500	Western Downs 275kV	11%

5. Description of Transmission Limitations

Main Grid

The Bulli zone is already a large exporter of electricity. With potential large scale coal seam gas (CSG) generation projects this is likely to increase significantly. ROAM has identified this in their generation scenarios and planted significant new generation within the Bulli zone across all of the generation scenarios (Table 3). This new generation will be required to be exported beyond the Bulli zone to meet mandated reliability of supply obligations to the rest of the Queensland

Region. As a result, the capability and adequacy of the transmission network connecting Bulli to the SWQ zone is essential in delivering a reliable electricity supply to the Queensland Region.

Maximum power transfer across the Bulli to SWQ grid section is limited by transmission plant thermal capacity, the ability to maintain stable voltage levels or to maintain transient stability following a critical contingency.

For thermal limitations, the critical contingency is an outage of a 330kV circuit (and associated 330/275kV transformer) between Millmerran and Middle Ridge or an outage of a 275kV circuit between Braemar East and Halys substations or between Western Downs and Halys substations.

The thermal power transfer capability out of the Bulli zone is sensitive to the distribution of generation dispatched within the Bulli and South West zones. Generation at the southern end of the Bulli zone (Millmerran and northerly flow on QNI) increases the loading on the southern corridor between Millmerran and Middle Ridge. Generation at the northern end (Braemar/Western Downs) results in proportionally higher flows on the northern corridor (Braemar to Halys and Western Downs to Halys circuits).

When assessing the transmission adequacy of this grid section, generation is dispatched to maximise the available transmission capability.

For voltage stability, the critical contingencies are again an outage of one of the 275kV or 330kV circuits that make up this grid section. Voltage instability results from the exhaustion of reactive power reserves in Southern Queensland.

Following a credible contingency there may be insufficient generation beyond the Bulli zone to allow AEMO to return the power system to a secure state while maintaining a reliable supply to all customers. These limitations mean that a portion of the available generation capacity within the Bulli zone cannot be dispatched, resulting in a supply deficit. This is a violation of Powerlink's mandated reliability of supply obligations.

In light of a number of market developments, including mooted generation investments, the expanded renewable energy target, CPRS, and the recent revision of the Regulatory Test, Powerlink and TransGrid have agreed to undertake the further investigations to evaluate the economic viability (and optimal timing) of potential upgrades to Queensland/New South Wales Interconnector (QNI), based on the principles and methodology of the Regulatory Investment Test for Transmission (RIT-T). A contingent project is recommended to address the potential QNI upgrade for the purposes of Powerlink's Revenue Proposal.

AEMO's 2010 National Transmission Network Development Plan introduced a potential significant interconnector, it is prudent to recommend that this project be included as a contingent project for the purposes of Powerlink's Revenue Proposal.

Regional Grid

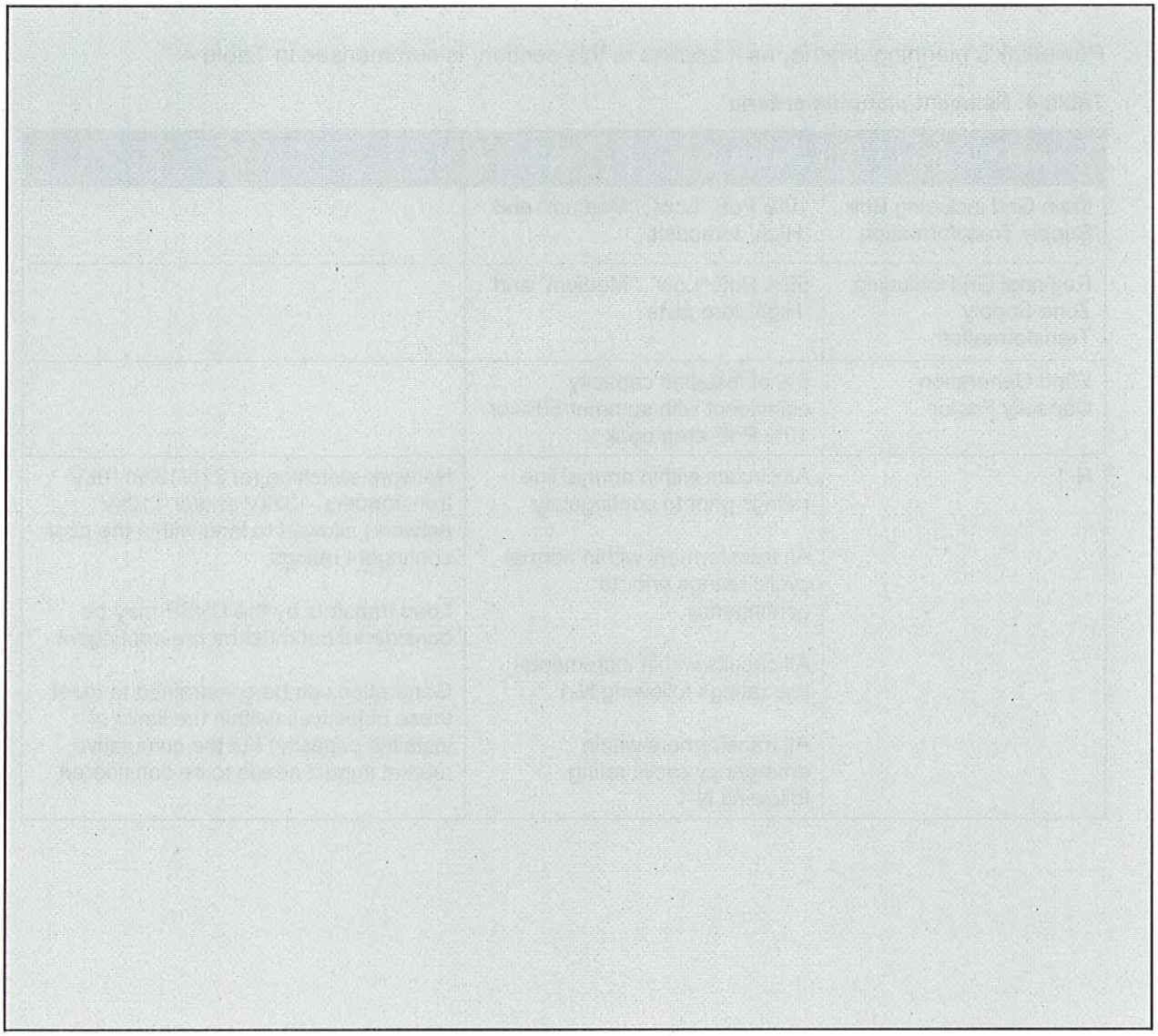
Load growth in the Surat Basin north-west area is not expected to trigger any further regional grid augmentation projects in the regulatory period 2013-17 due to committed projects providing sufficient capacity. On the Ergon sub-transmission system the identified limitations are to be addressed by projects within the sub-transmission system.

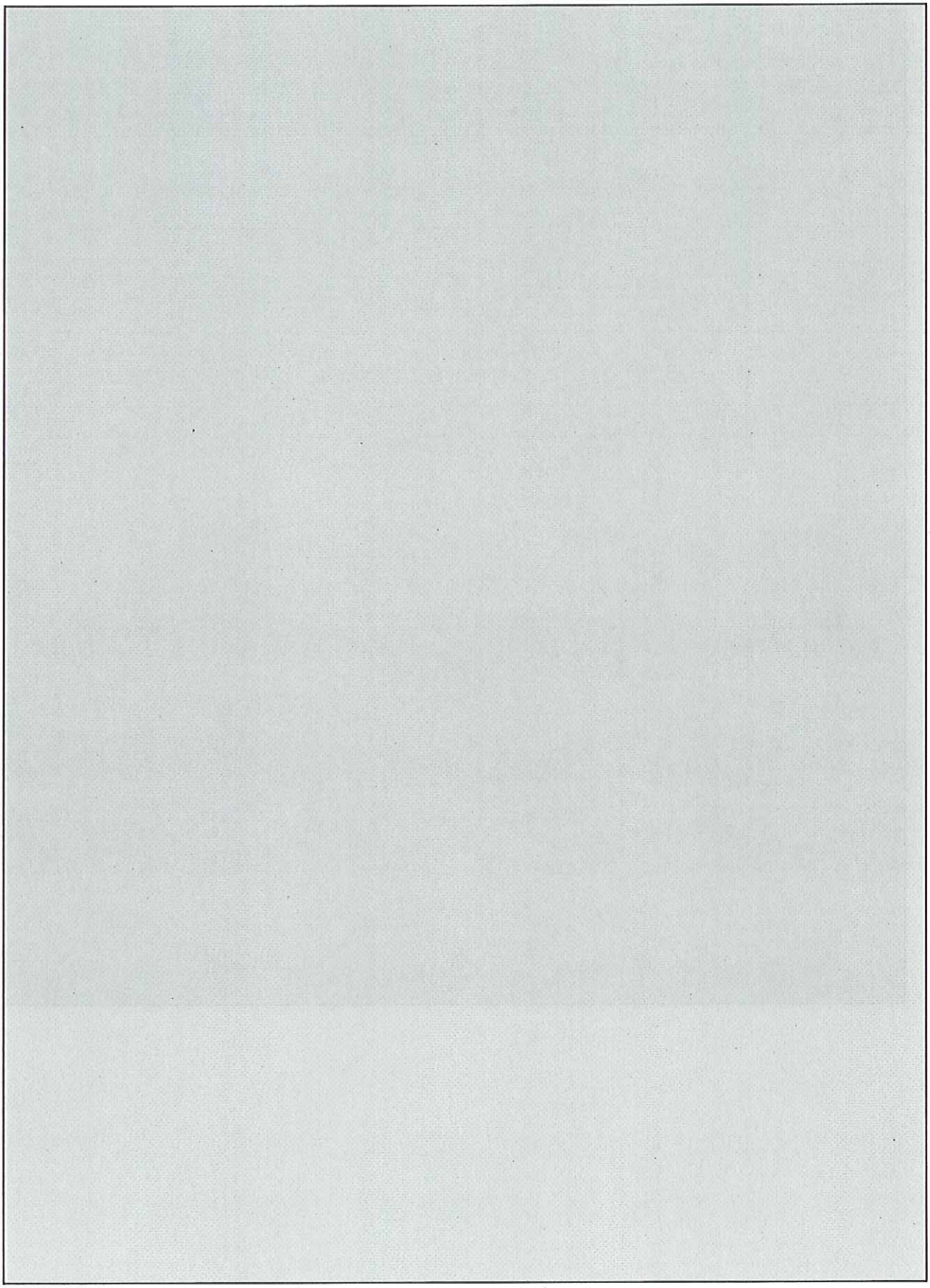
6. Relevant Planning Criteria

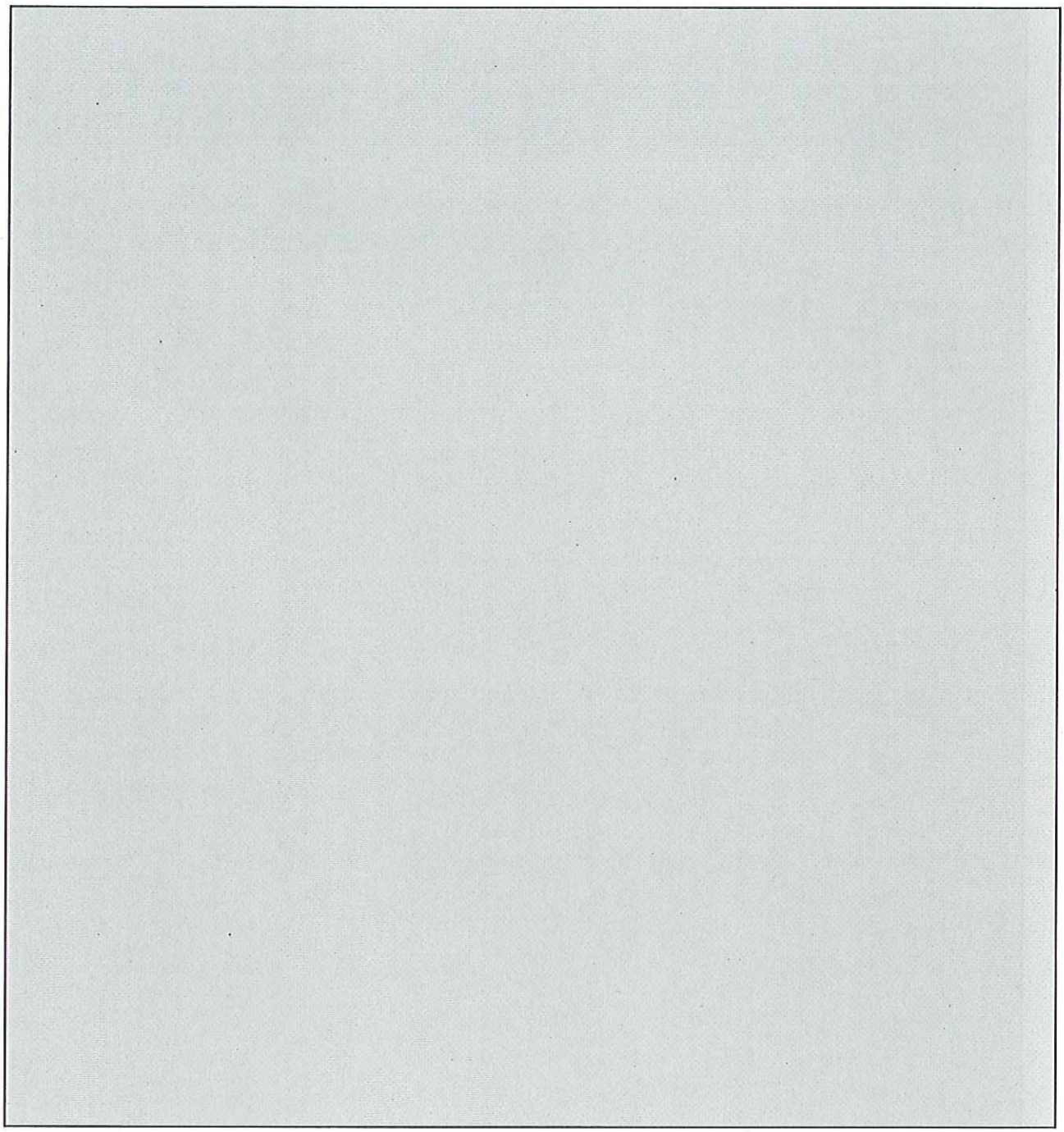
Powerlink's planning criteria, as it applies to this section, is summarised in Table 4.

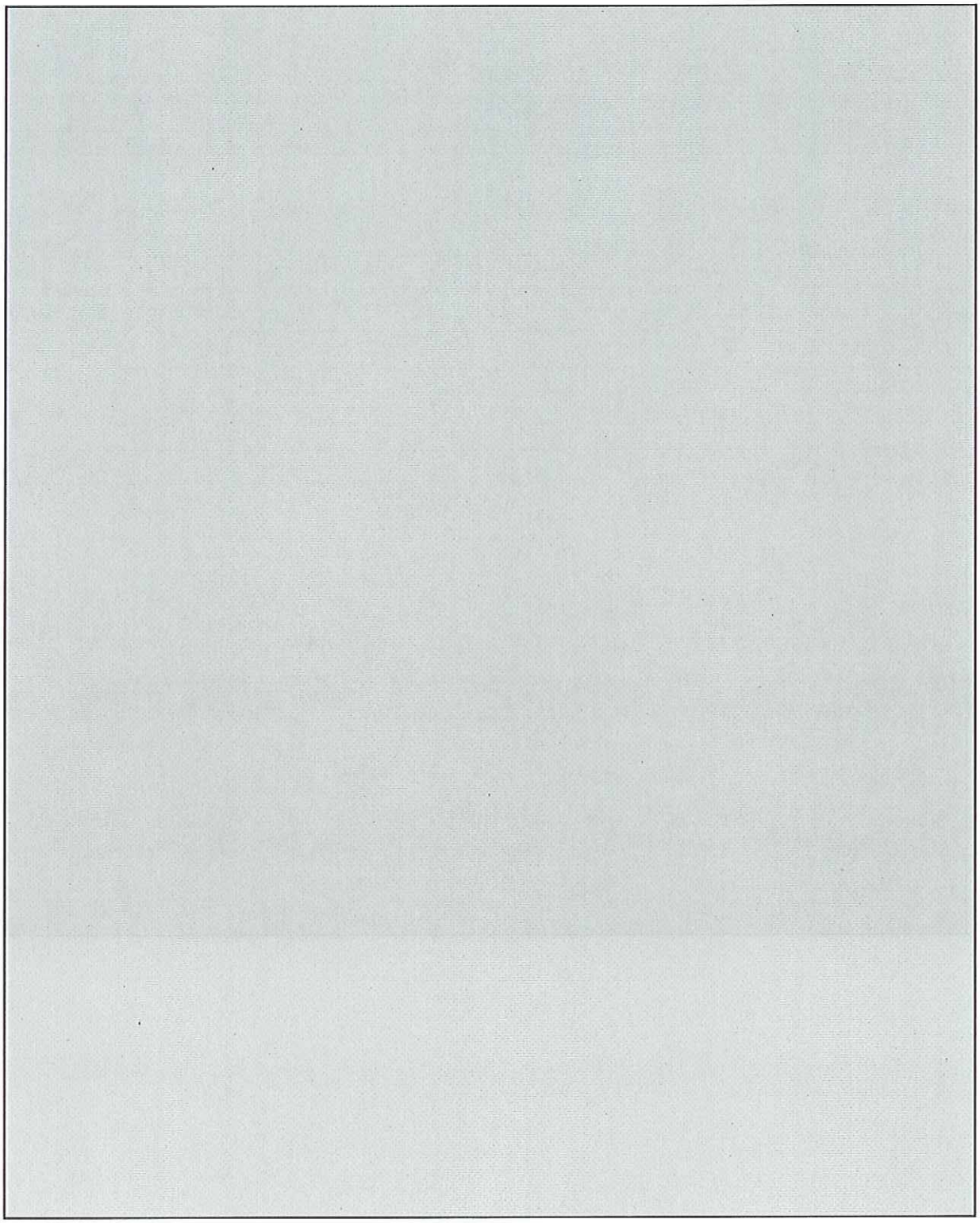
Table 4: Relevant planning criteria

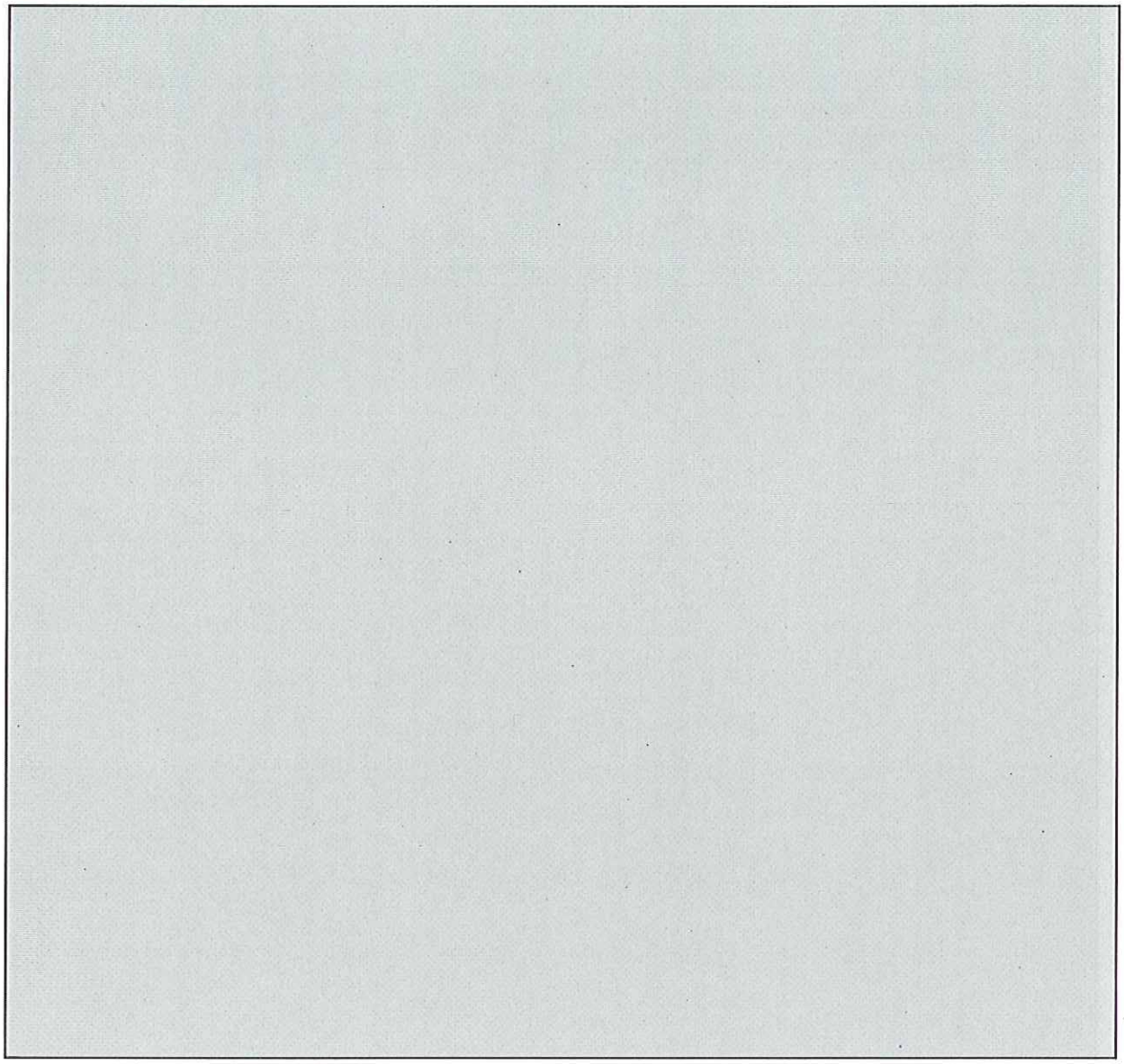
Network Planning	Criteria	Notes
Main Grid including Bulk Supply Transformation	10% PoE "Low", "Medium" and "High" forecasts	
Regional Grid including Zone Supply Transformation	50% PoE "Low", "Medium" and "High" forecasts	
Wind Generation Capacity Factor	5% of installed capacity coincident with summer 50% or 10% PoE area peak	
N-1	All circuits within normal line ratings prior to contingency All transformers within normal cyclic ratings prior to contingency All circuits within incremental line ratings following N-1 All transformers within emergency cyclic rating following N-1	Network switching (of 275/132/110kV transformers, 132kV and/or 110kV network) allowed to land within the post-contingent ratings Load transfers by the DNSP may be considered but must be pre-contingent Generation can be constrained to meet these objectives (within the limits of installed capacity) but the cumulative market impact needs to be considered

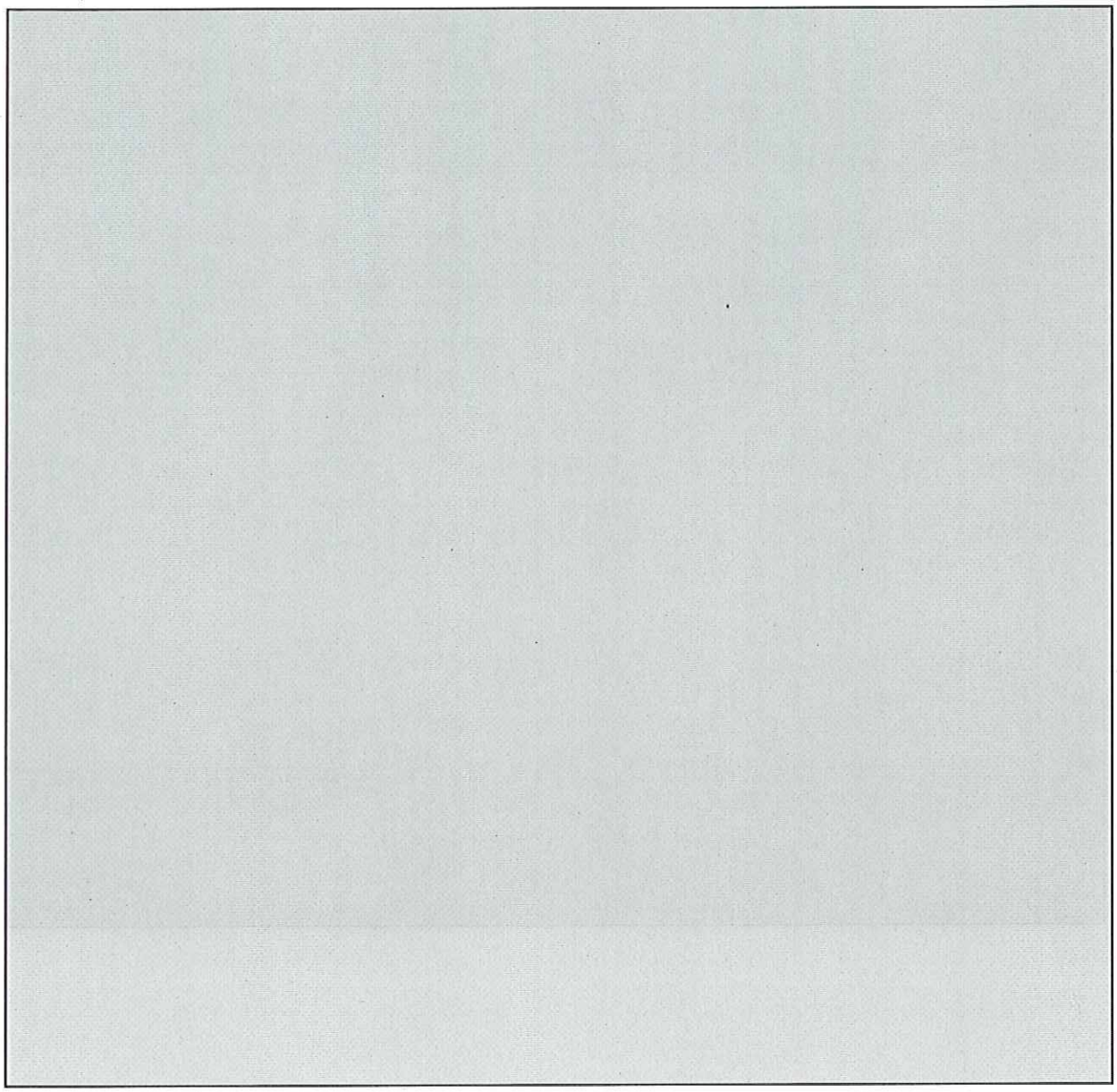


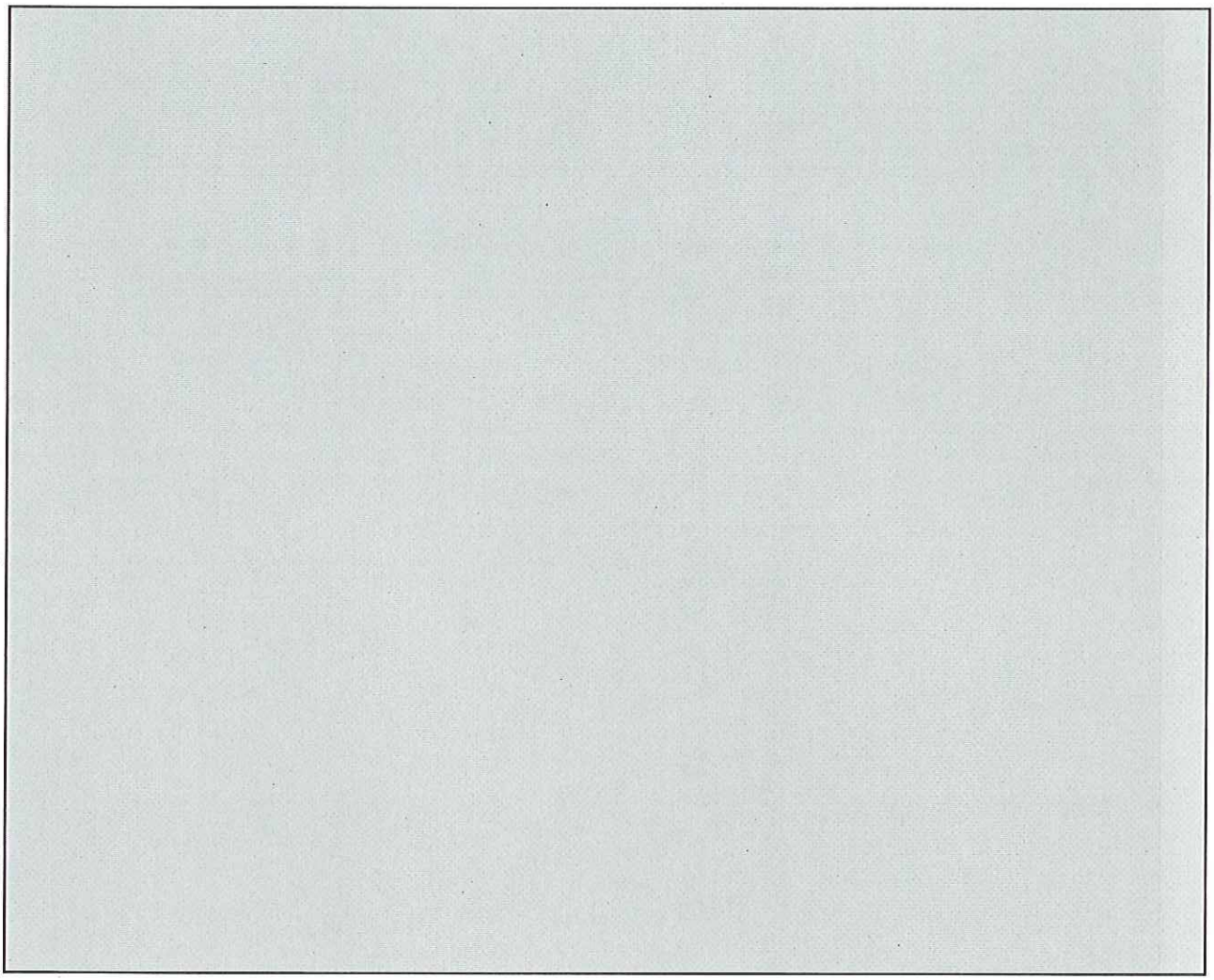


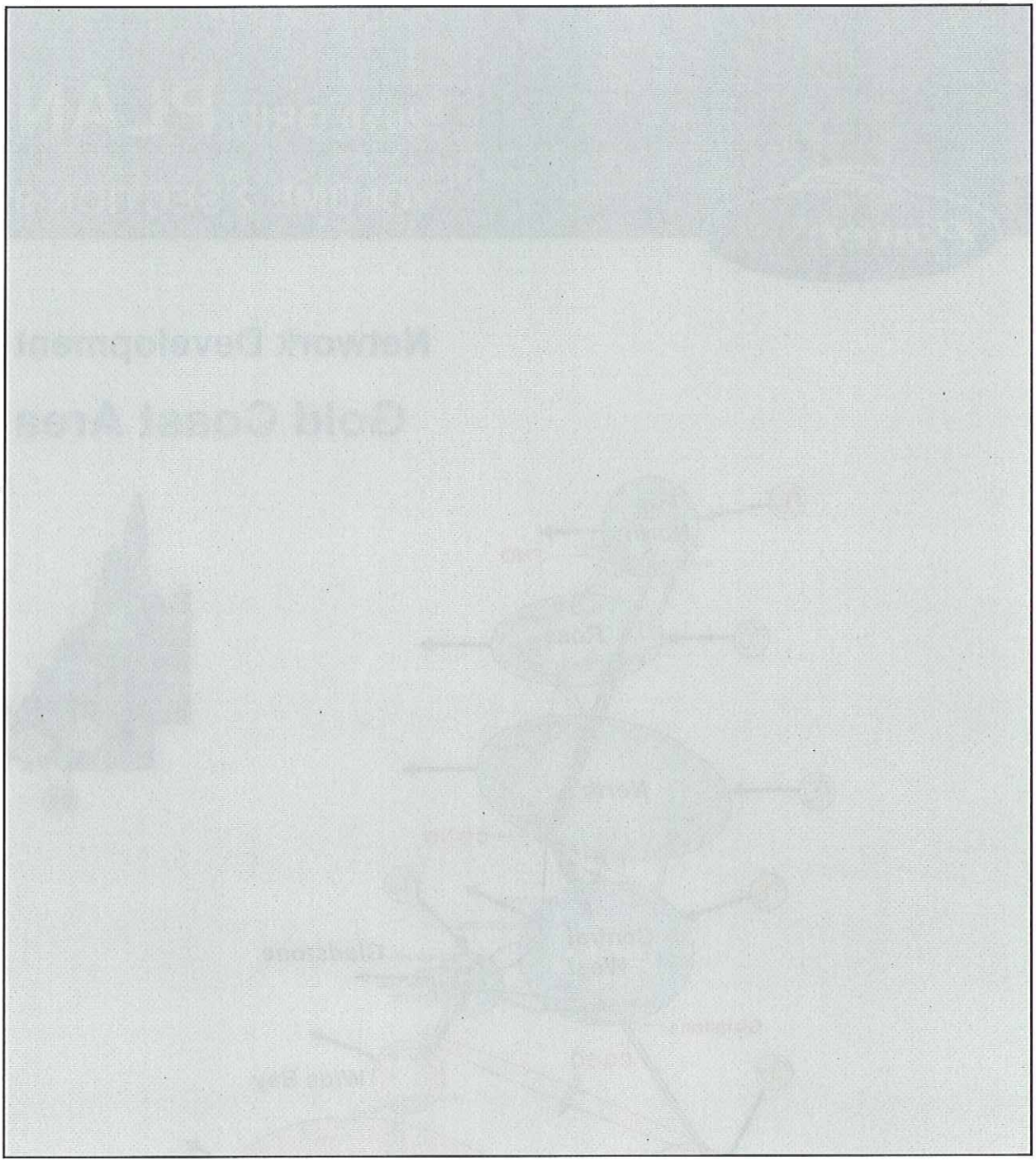










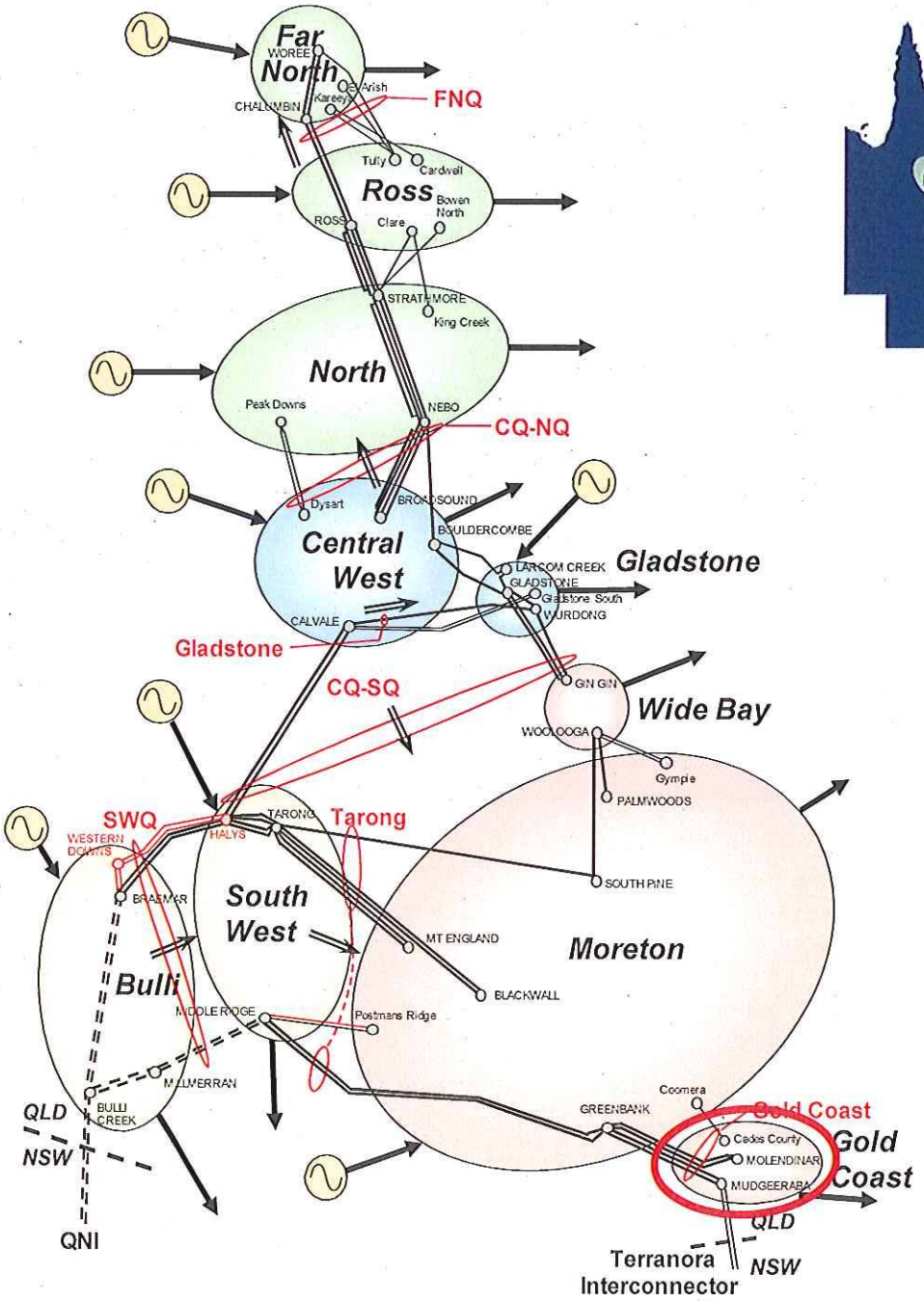


2010 GRID PLAN

VOLUME 2 SECTION 9

Network Development

Gold Coast Area



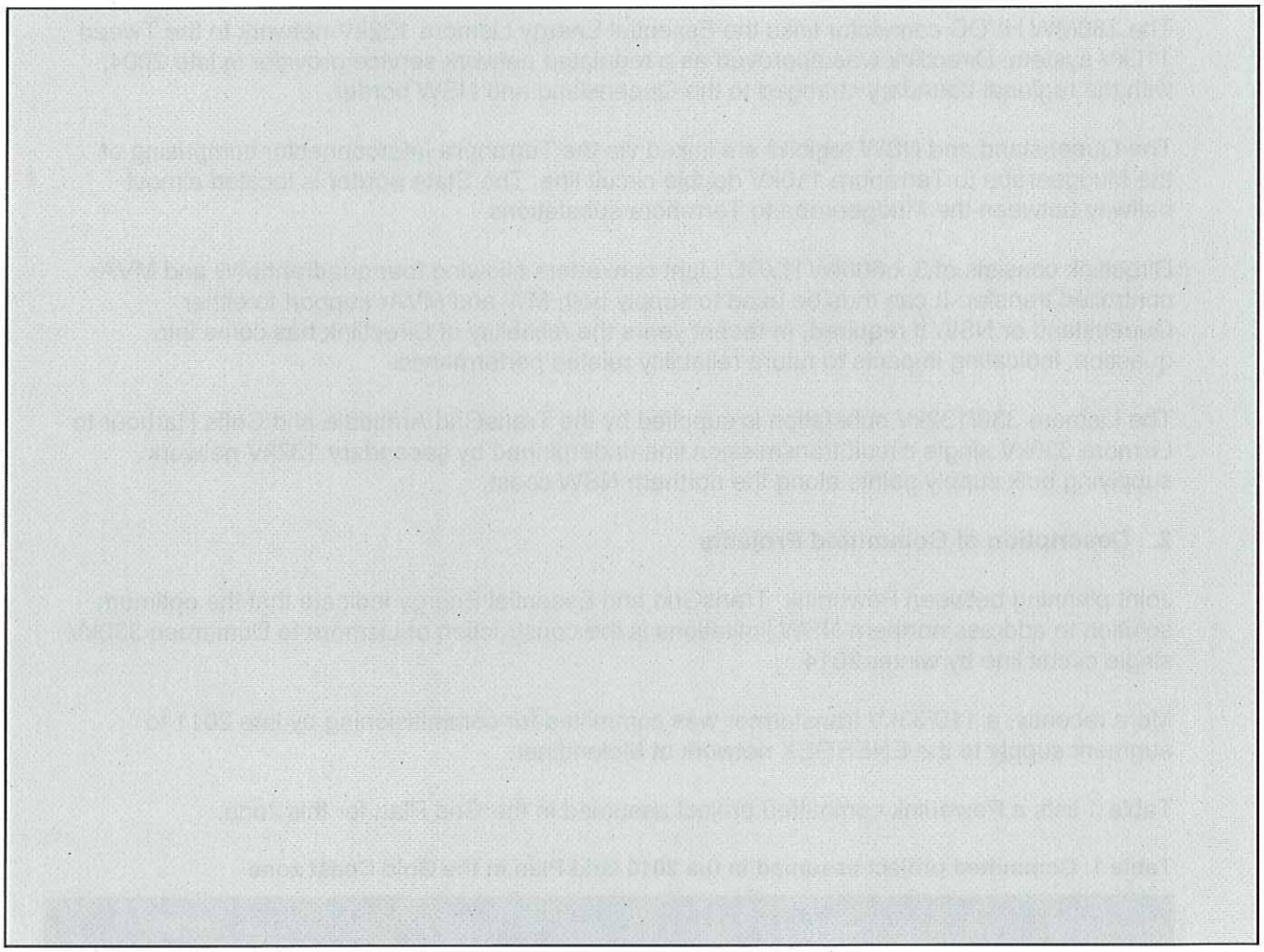
Gold Coast Area

1. Network Description

The Gold Coast zone is a net importer of electricity. The Gold Coast and Tweed area is defined as south of Coomera and includes the Tweed Shire within northern NSW. The area incorporates major commercial, tourism, business and residential areas.

Import of electricity is predominantly via the 275kV network from within SEQ and from the 110kV connection with NSW via Terranora Interconnector.

The electricity supply system in Gold Coast is shown in Figure 1. Figure 2 shows a one line representation of the existing transmission system.



The main transmission system to the Gold Coast consists of the Greenbank to Molendinar and Greenbank to Mudgeeraba 275kV transmission lines.

The Molendinar and Mudgeeraba 275/110kV substations are the major injection points into the area. Molendinar Substation is located within the northern end of the zone, and Mudgeeraba Substation is located towards the southern end.

Mudgeeraba Substation was established in the 1970s, and is supplied from Greenbank Substation by two 275kV single circuit transmission lines each constructed using single Martin conductor. The substation was supplied from Swanbank prior to the establishment of Greenbank Substation.

The Molendinar Substation is supplied from Greenbank Substation by a 275kV double circuit transmission line constructed using twin Phosphorus conductor. There is currently no 275kV bus at Molendinar, and the two 275/110kV transformers are supplied transformer ended from each circuit. The first transformer was commissioned in 2003 supplied as a tee from one of the Swanbank to Mudgeeraba 275kV circuits.

The transmission system is also underpinned by the ENERGEX 110kV sub-transmission network which provides additional supply from Loganlea to Beenleigh, Coomera and Cades County substations.

The ENERGEX 110kV sub-transmission system from Molendinar to Mudgeeraba links the coastal bulk supply points at Southport, Surfers Paradise and Broadbeach. An inland 110kV network supplies Robina and Nerang substations.

The 180MW HVDC connector links the Essential Energy Lismore 132kV network to the Tweed 110kV system. Directlink was approved as a regulated network service provider in late 2004, with the regional boundary changed to the Queensland and NSW border.

The Queensland and NSW regions are linked via the Terranora Interconnector comprising of the Mudgeeraba to Terranora 110kV double circuit line. The State border is located almost halfway between the Mudgeeraba to Terranora substations.

Directlink consists of 3 x 60MW HVDC Light converters allowing four quadrant MW and MVAr controlled transfer. It can thus be used to supply both MW and MVAr support to either Queensland or NSW if required. In recent years the reliability of Directlink has come into question, indicating impacts to future reliability related performance.

The Lismore 330/132kV substation is supplied by the TransGrid Armidale and Coffs Harbour to Lismore 330kV single circuit transmission line underpinned by secondary 132kV network supplying bulk supply points along the northern NSW coast.

2. Description of Committed Projects

Joint planning between Powerlink, TransGrid and Essential Energy indicate that the optimum solution to address northern NSW limitations is the construction of Lismore to Dumaresq 330kV single circuit line by winter 2014.

More recently, a 110/33kV transformer was committed for commissioning by late 2011 to augment supply to the ENERGEX network at Molendinar.

Table 1 lists a Powerlink committed project assumed in the Grid Plan for this zone.

Table 1: Committed project assumed in the 2010 Grid Plan in the Gold Coast zone

Project ID	Project Description	Expected Commissioning
CP.01719	Molendinar 3rd 110/33kV 100MVA Transformer	Summer 2011/12

3. Generation Capacity

There are no generators connected to the transmission grid in the Gold Coast area. Furthermore, ROAM has not identified any new entrants in the Gold Coast area.

4. Description of Transmission Limitations

Main Grid

Maximum power transfer to the Gold Coast is set by voltage stability associated with the loss of Swanbank E generator west of Brisbane, an outage of a Greenbank to Molendinar 275kV circuit (and associated 275/110kV transformer), or an outage of a Greenbank to Mudgeeraba 275kV circuit.

The variables which have significant effect on transfer capability are: the number of Swanbank generating units online; the loading of Terranora Interconnector; the capacitive compensation levels within SEQ; and the ratio of the Brisbane to Gold Coast load.

Voltage limits are higher when Swanbank E is online. Reducing southerly flow on Terranora Interconnector reduces transfer capability, but increases the overall amount of supportable Gold Coast load. This is because reduction in transfer capability is more than offset by reduction in power transfers resulting from the reduction in southerly flow on Terranora Interconnector.

Due to ongoing load growth, supply to the Gold Coast area may be limited by thermal capacity of transmission plant following critical contingencies. The network limitation relates to thermal overload of a 275/110kV transformer at Molendinar Substation following an outage of a parallel transformer. This limitation is forecast to emerge in 2015/16 and 2019/20 for the high and medium economic growth scenarios respectively.

A future thermal network limitation also emerges on a Greenbank to Mudgeeraba 275kV circuit following an outage of the parallel circuit. This limitation is forecast to occur beyond 2020 without action to augment supply. Replacing an existing Greenbank to Mudgeeraba 275kV circuit with a 275kV double circuit transmission line would address this limitation. Powerlink has included a project to facilitate the permits and approvals required to undertake these works on the existing easement.

A new easement (or easement widening) adjacent to the existing Greenbank to Mudgeeraba circuits is not able to be obtained. Therefore, this circuit must be rebuilt on the existing alignment. To ensure reliable supply, construction would need to occur during the winter and shoulder months over a two-year period.

Investigations indicate that based on existing and committed capacity of the ENERGEX 110kV network between Molendinar and Mudgeeraba, the outages to implement solutions to address the thermal limitation between Greenbank and Mudgeeraba may only be feasible until 2015. However, joint planning with ENERGEX has identified that it is more economic to augmentation and replace (condition based) plant within the ENERGEX 110kV network to defer the rebuild of the 275kV circuits to beyond 2020.

Regional Grid

Studies indicate growing demand on the ENERGEX sub-transmission network will necessitate augmentation at 33kV and 110kV. Emerging limits will require additional connecting bays at Mudgeeraba.

The critical Regional Grid contingencies include:

- 110kV sub-transmission circuits between Mudgeeraba and Molendinar; and
- 110kV sub-transmission circuits between Molendinar and Loganlea;

5. Relevant Planning Criteria

Powerlink's planning criteria, as it applies to this section, is summarised in **Table 2**.

Table 2: Relevant planning criteria

Network Planning	Criteria	Notes
Main Grid including Bulk Supply Transformation	10% PoE "Low", "Medium" and "High" forecasts	
Regional Grid including Zone Supply Transformation	50% PoE "Low", "Medium" and "High" forecasts	
Availability of Capacitor Banks	Discrete unavailability of an individual capacitor bank may be considered	
N-1	All circuits within normal line ratings prior to contingency All transformers within normal cyclic ratings prior to contingency All circuits within incremental line ratings following N-1 All transformers within emergency cyclic rating following N-1	Network switching (of 275/132/110kV transformers, 132kV and/or 110kV network) allowed to land within the post-contingent ratings Load transfers by the DNSP may be considered but must be pre-contingent