

From: [REDACTED]
Sent: Wednesday, 19 February 2014 2:30 PM
To: [REDACTED]
Cc: [REDACTED]
Subject: UV Index Verification [SEC=UNCLASSIFIED]

Hi [REDACTED],

In preparation for tomorrow's UV group meeting I have attached a summary of the recent UV verification project for discussion.

Could you please forward this to all relevant attendees.

Regards,

[REDACTED] | Weather and Ocean Services Branch



Australian Government
Bureau of Meteorology

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UV Index Verification Summary

Background

The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) (through [REDACTED]) contacted the Australian Bureau of Meteorology (BoM) early in January 2014 with concerns that the Bureau's forecast UV index levels seemed anomalously high compared with that shown on the ARPANSA website. This followed some feedback from the general public asking about the differences in the two forecasts.

In response to this concern the Weather Services section undertook a short assessment of the UV service. This document describes a brief assessment of the Bureau's UV forecast accuracy over January, 2014. It compares forecast accuracies between the BoM, [REDACTED] as compared with real time observed UV index levels around Australia.



Results and discussion

[REDACTED] Figure 1 presents the average prediction error for each agency when probable cloud days are discounted from the dataset. The automated detection of cloud days was deemed to be 71% accurate for the six day validation period (23rd to 31st) and reduced overall error by 0.62. The BoM has the highest error nationwide with an average over-prediction of 1.8 UV Index levels [REDACTED]. The BoM does not have any site with an average under-prediction suggesting a need to review the source data and current model.

[REDACTED]
BoM's 23%.

Table 1 provides the average errors for each site in conjunction with longitude, latitude and the number of discarded cloud days. It appears that there may be residual cloud days within the dataset as the worst performing cities (Brisbane and Darwin) also have the highest count of detected cloud days. This is a predictable result due to a monsoon and storm season peak around January for Darwin and Brisbane respectively. There appears to be no connection between latitude and longitude and average errors.

Table 1 - Average error for forecasted UV-index values for January, 2014. Red (blue) cells indicate over-predictions (under-predictions) and are graded to white indicating the most accurate values. Longitude, latitude and the number of cloud days for each site are included for reference.

Average Error (discounting probable cloud days)					
Long	Lat	City	BoM		Cloud days
		Australia	1.8		77
145.1	37.7	Melbourne	2.3		0
116.0	32.0	Perth	0.2		1
149.1	35.3	Canberra	2.2		1
138.6	34.9	Adelaide	2.2		4
133.9	23.7	Alice Springs	1.5		5
147.3	43.0	Kingston	1.1		5
151.7	32.9	Newcastle	3.0		6
146.8	19.3	Townsville	1.4		7
151.1	34.0	Sydney	1.4		10
153.0	27.5	Brisbane	2.7		13
130.9	12.4	Darwin	3.7		25
		Total days (n):	258		

Conclusions

It is clear that the Bureau's UV Index predictions are higher than that observed at the ARPANSA sites:



18 February 2014

Author:

Reviewed by:

Weather Services Branch, Bureau of Meteorology

IRRELEVANT INFORMATION REMOVED FROM THIS DOCUMENT s22.

SunSmart UV Alert Working Group Minutes

Thursday 20 February 2014 2:00pm - 3:00 pm EST

Attendees:

Apologies:

The Meeting opened at 2:00 pm.

1. Review of previous notes and remaining actions

Number	Action	By whom	Comments
2.2	[REDACTED]		
2.3			
4.1			
6.2			
7.3			
7.4			

[REDACTED]

[Redacted]

[Redacted]

[Redacted] (Bureau of Meteorology) submitted a 3 page document entitled UV Index Verification Summary.docx to the UV Alert Group. This document looked at the difference between predictions and measurements of UV Index for Melbourne, Perth, Canberra, Adelaide, Alice Springs, Kingston, Townsville, Sydney, Brisbane and Darwin made by ARPANSA, BOM and NIWA. The conclusions were :

It is clear that the Bureau's UV Index predictions [Redacted] are higher than that observed at the ARPANSA sites [Redacted]

[Redacted]

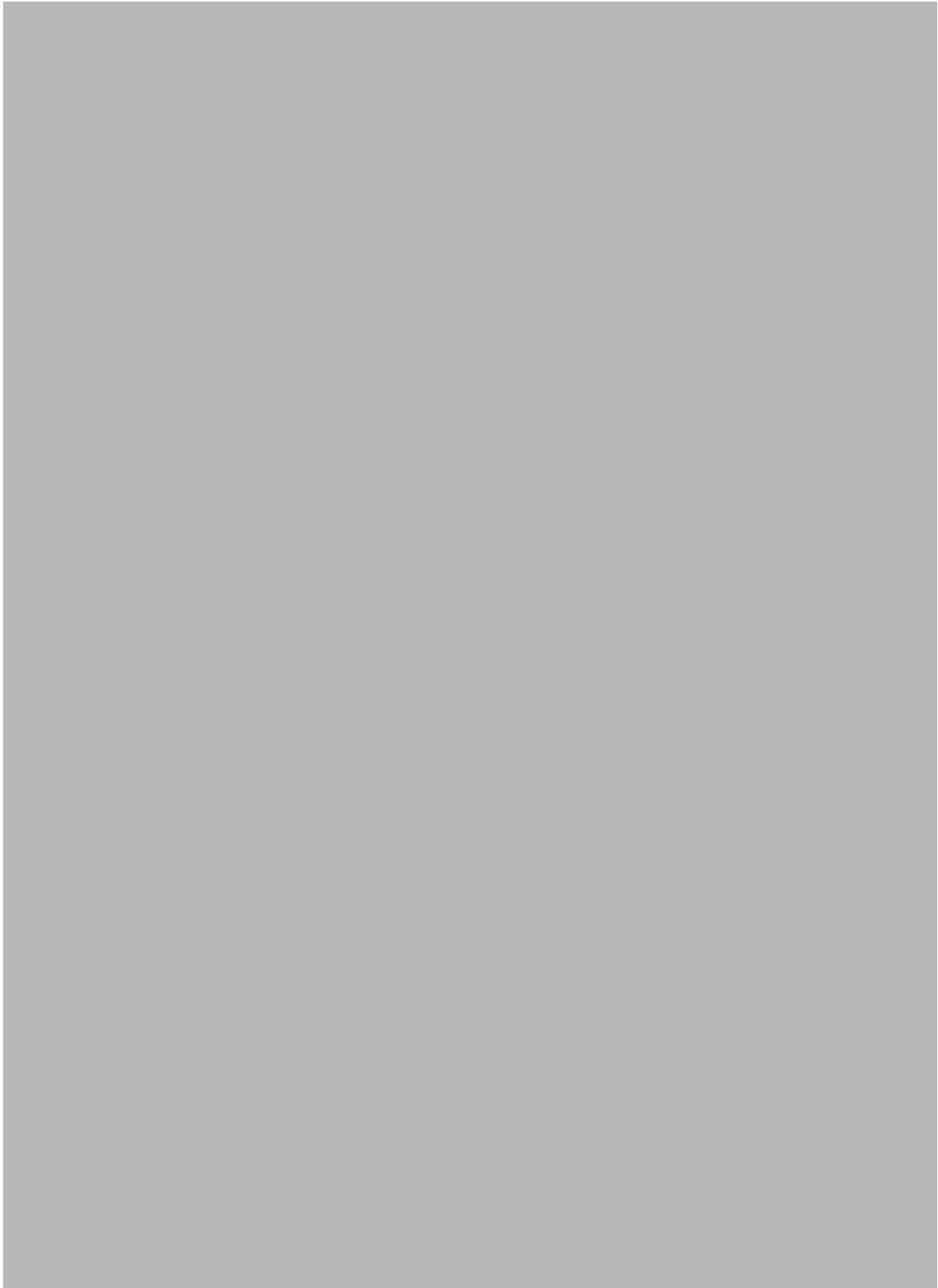
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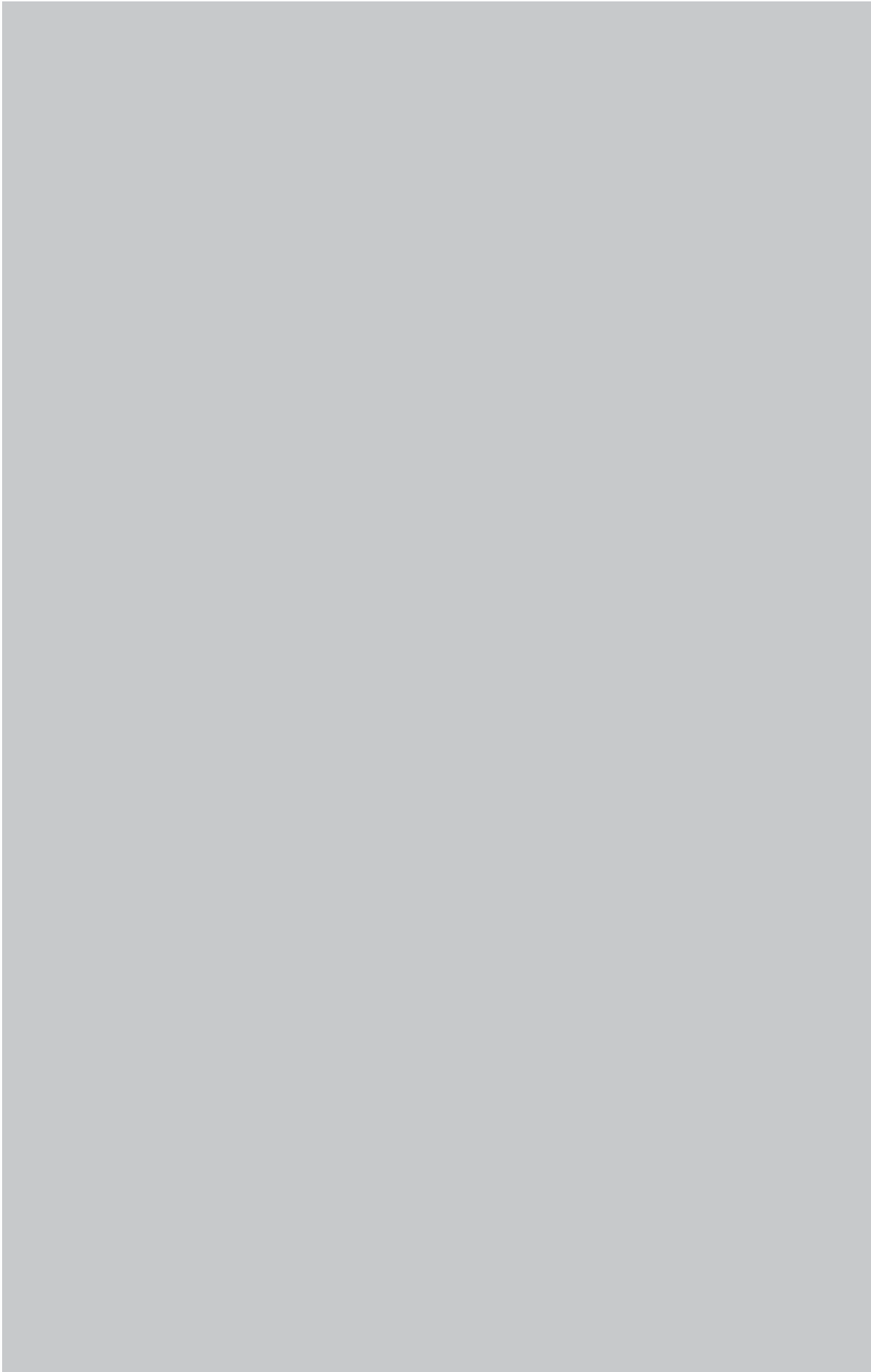
MINUTES
SA Marine Weather Consultative Meeting
Meeting No. 27

Thursday 22 May 2014 between 10.00 am and midday
Bureau of Meteorology, 25 College Rd. Kent Town

Meeting Contact: 

AGENDA





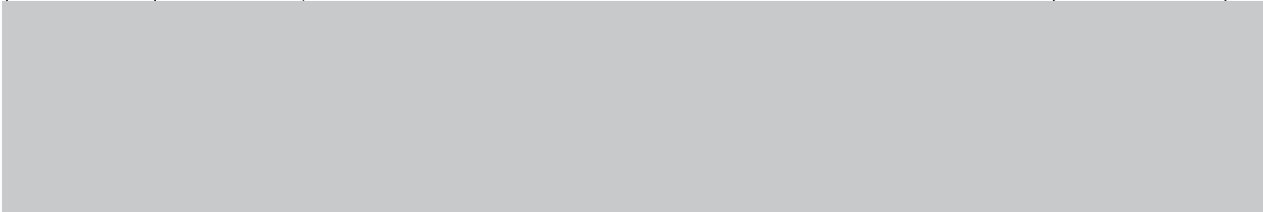


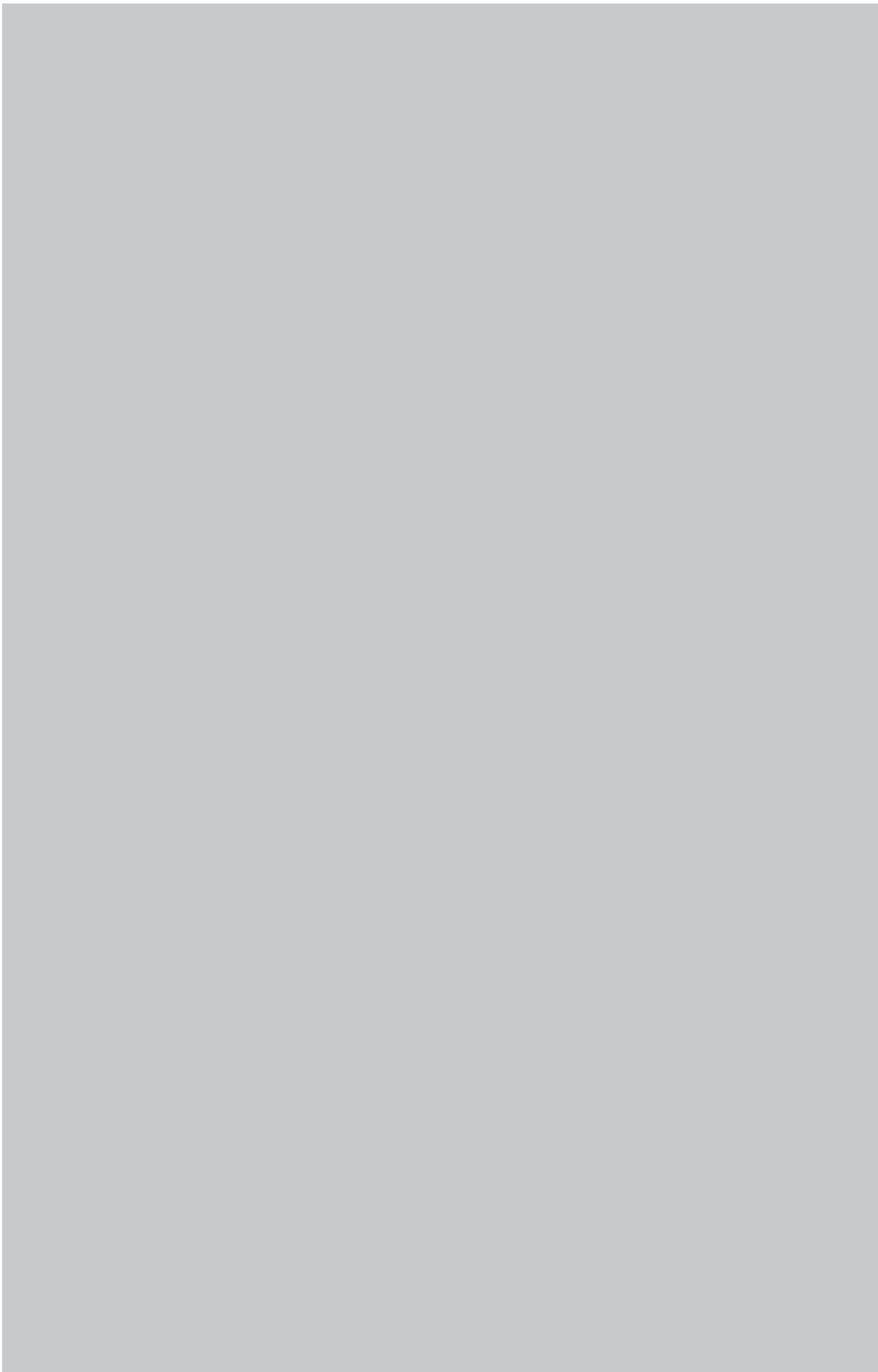
26.7 Verification of Coastal Waters (Black Pole) Forecast;

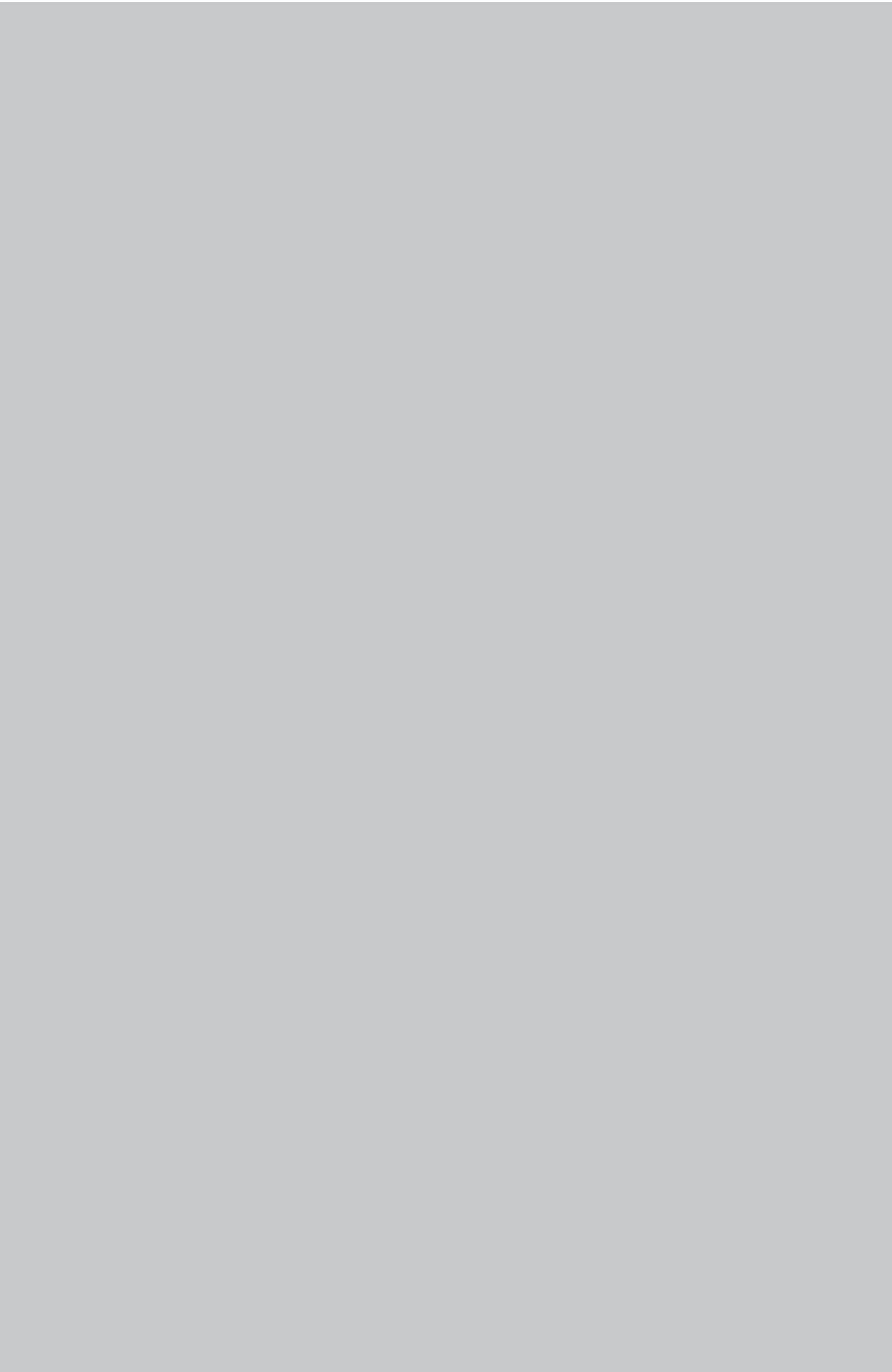
Analysis of official forecasts versus observed conditions at Black Pole. The verification data continues to support a slowly improving trend in terms of direction and speed accuracy. Since the introduction of Forecast Explorer in April 2012 there has been a marked improvement in speed bias. At this point the method of verification changed from interpreting the text forecast to verifying from the location specific data. Verification is within 5 knots of forecast.

For outer harbor below 15 knots 75%, above 15kt 90%, above 25kt 97%

±30 degrees direction below 15kts 50%, above 15kts 70%

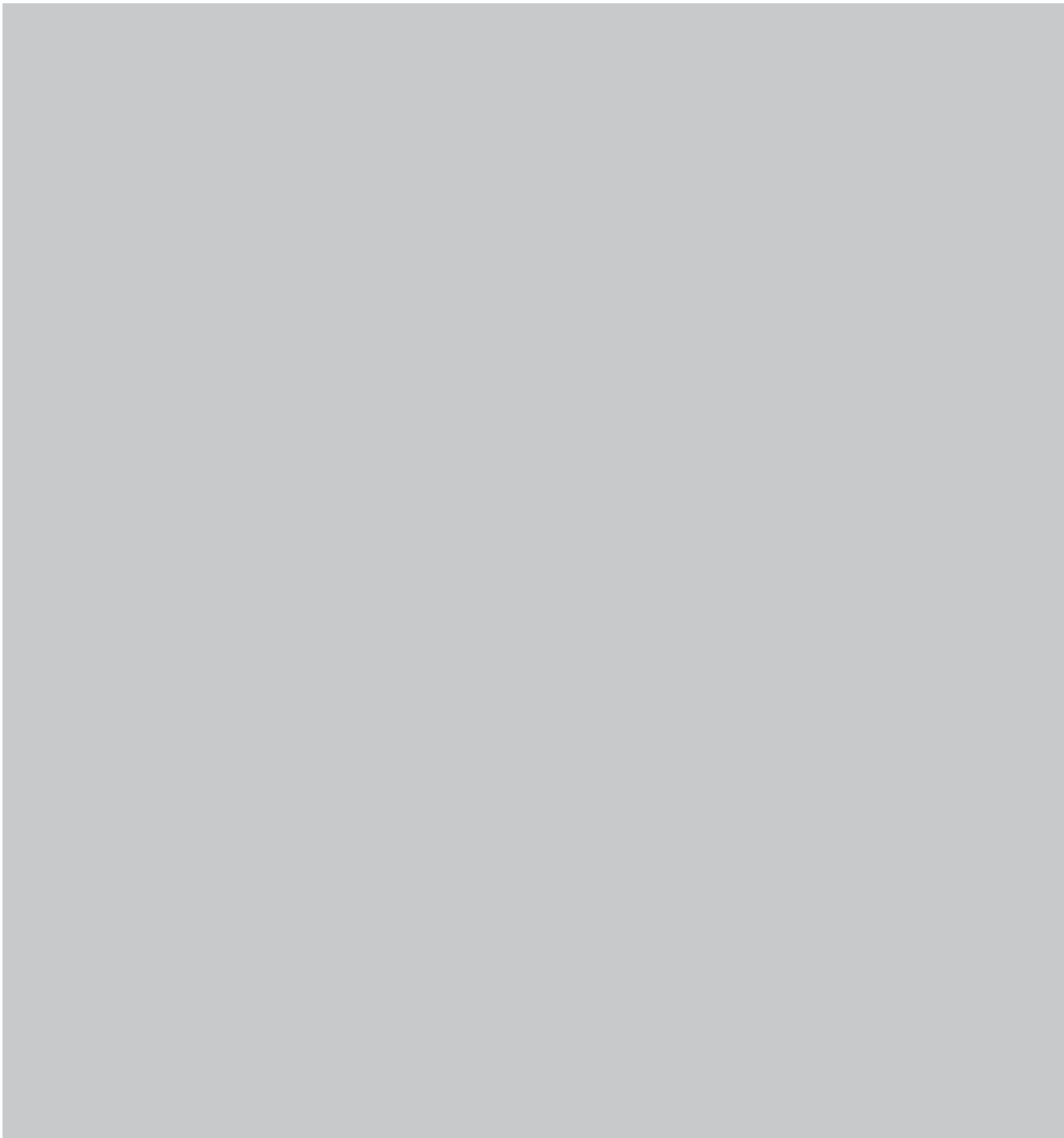






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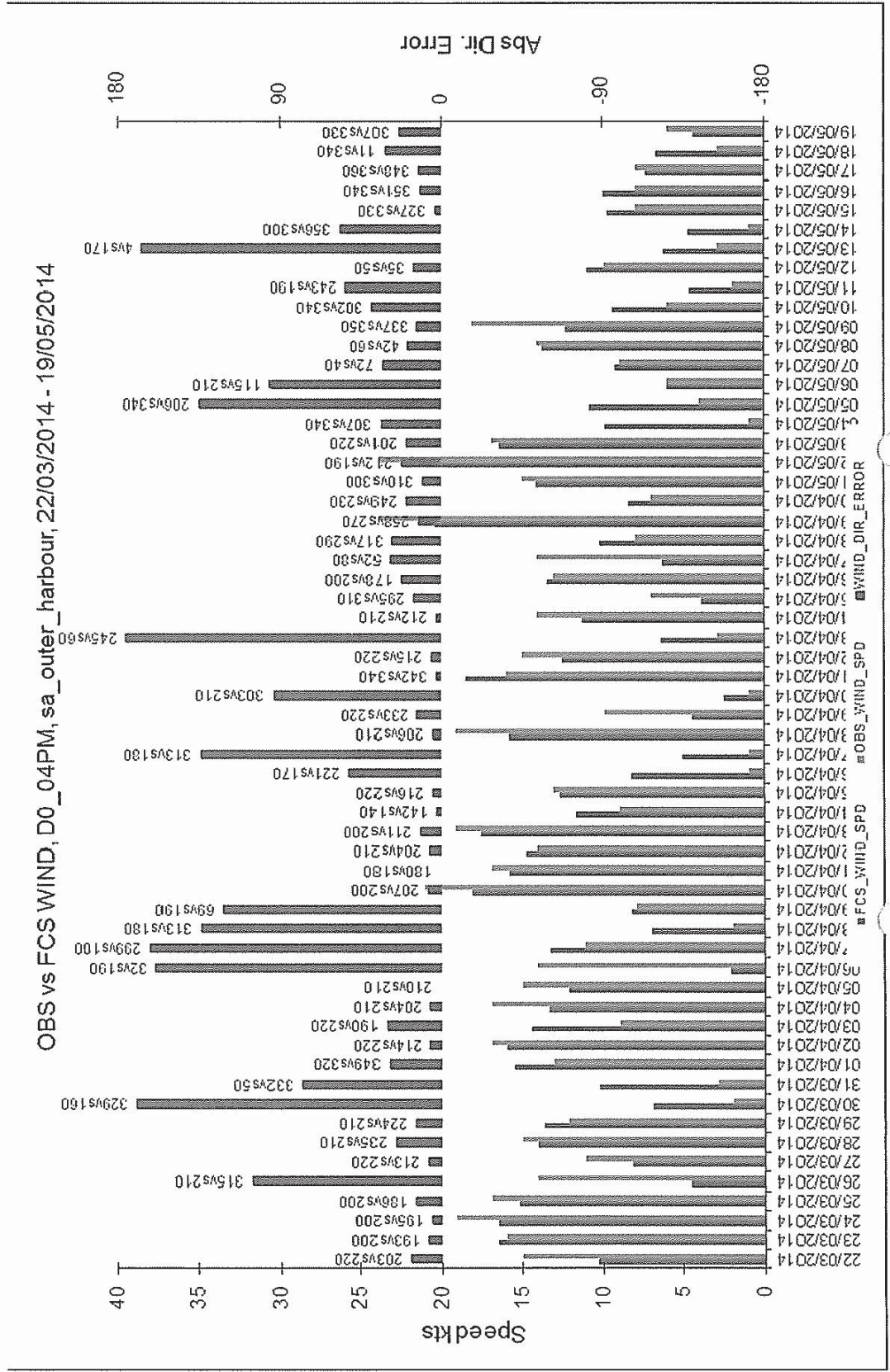
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Review of wind verification statistics reported by the Bureau

SA MCC, 22 May 2014

Day by day wind verification



Direction statistics - breakdown

For winds below 15 knots

- Percentage within 30 degrees = 50%

For winds above 15 knots

- Percentage within 30 degrees = 70%



Speed statistics - breakdown

For winds below 15 knots

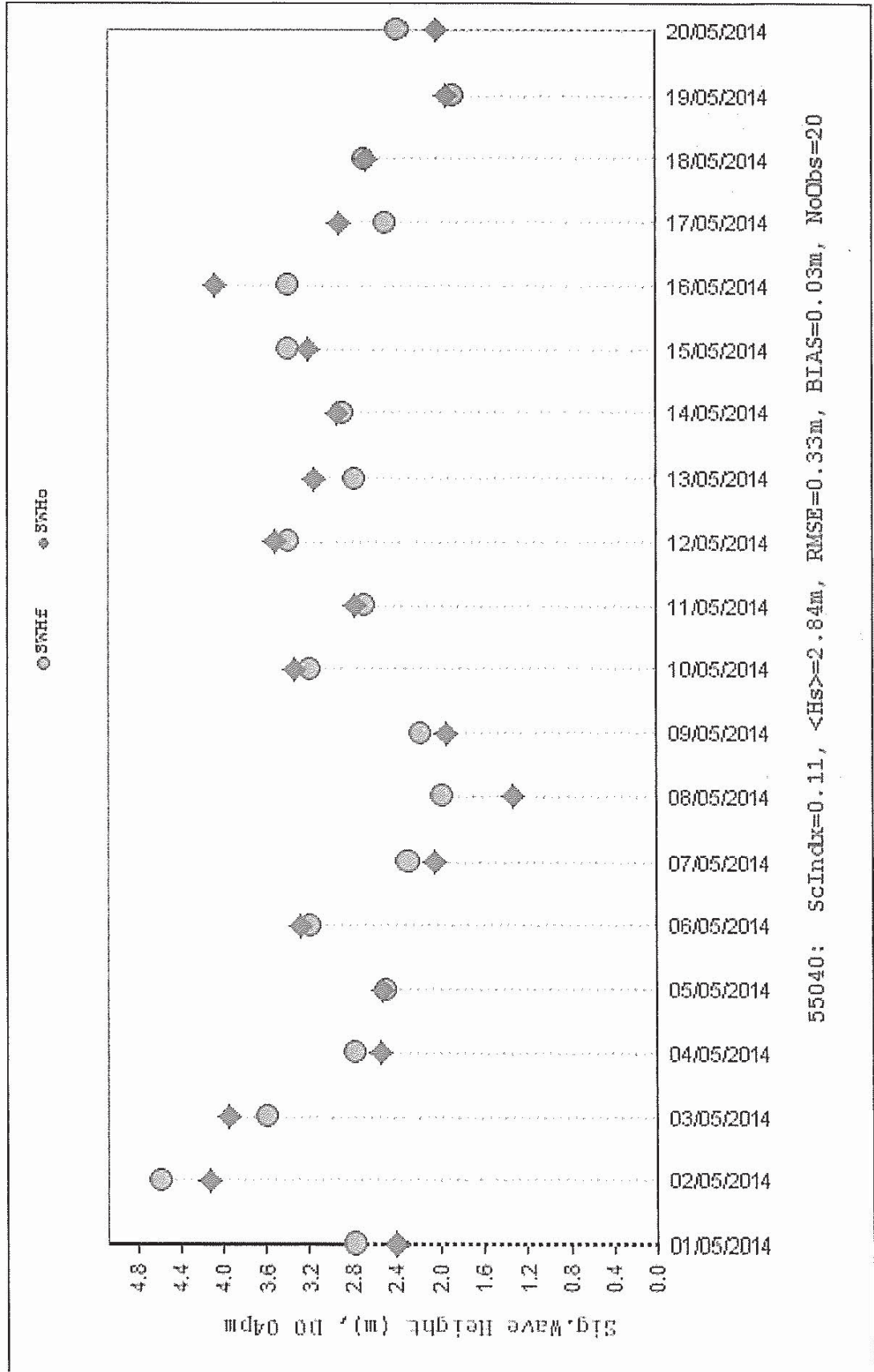
- Percentage within 5 knots = 75%

For winds above 15 knots

- Percentage within 5 knots = 90%

For winds above 25 knots = 97%

Recent wave verification - Adelaide



IRRELEVANT INFORMATION

A short summary of Wave OCF performance, 2012 to 2013

REMOVED FROM THIS DOCUMENT - s22.

Background

A once off verification of the wave OCF system using data between 2012 and 2013 was conducted to enable forecasters to assess the value of wave OCF within the forecast process. 24 locations around Australia were used to verify the OCF model and its input components: Auswave-A, Auswave-G, Auswave-R, ECMWF, JMA, UKMO, and NOAA. The following provides an insight into some of the key findings for initial review by forecasters. A comprehensive suite of statistics has been calculated and is available on request.

Executive Summary

OCF root mean square errors at 24 hour lead times varied between 27cm and 45cm around Australia, with higher errors along the East Coast than the West Coast.

There was a positive bias of 2 to 7cm across all sites. Biases were generally highest in the west.

On average small waves (1.5m and below) are forecast within half of a metre 92% of the time, while waves greater than 1.5m are forecast within 75cm 94% of the time.

For waves over 3 metres, Wave OCF achieved a reliability percentage of 87% for forecasts within 0.75m, which is 8% higher than Auswave-R.

OCF performance around the country

Table 1 provides an overall summary of the OCF performance at each site for day 1 wave height forecasts against various metrics.

Table 1 - Stats for OCF wave height forecasts at 24 hour lead times. Populations (n) provided where available. Ordered clockwise around the coast from Mackay.

	Site	RMSE (m)	Bias (m)	% within 0.5m when obs <= 1.5m	% within 0.75m when obs > 1.5m	% within ±15% of obs
QLD	Mackay Wave-rider Buoy	0.29	+0.02	97% (590)	87% (79)	65% (n=669)
	Mooloolaba Wave Rider Buoy	0.27	+0.03	98% (498)	95% (186)	81% (n=684)
	North Moreton Wave Rider Buoy	0.29	+0.04	96% (598)	89% (76)	73% (n=674)
	Brisbane Wave-rider Buoy	0.38	+0.04	88% (321)	93% (358)	81% (n=679)
NSW	Tweed Heads Wave Rider Buoy	0.32	+0.05	95% (570)	93% (135)	81% (n=705)
	Byron Bay Wave Rider Buoy	0.35	+0.04	95% (354)	93% (302)	83% (n=656)
	Coffs Harbour Wave Rider Buoy	0.36	+0.04	94% (350)	93% (210)	82% (n=560)

	Site	RMSE (m)	Bias (m)	% within 0.5m when obs ≤ 1.5m	% within 0.75m when obs > 1.5m	% within ±15% of obs
NSW	Crowdy Head Wave Rider Buoy	0.34	+0.04	95% (327)	92% (205)	84% (n=532)
	Sydney Wave Rider Buoy	0.35	+0.03	94% (391)	94% (274)	84% (n=665)
	Port Kembla Wave Rider Buoy	0.36	+0.05	95% (280)	90% (173)	81% (n=453)
	Batemans Bay Wave Rider Buoy	0.35	+0.05	95% (460)	91% (197)	78% (n=657)
	Eden Wave Rider Buoy	0.39	+0.05	85% (313)	95% (226)	78% (n=539)
VIC	Kingfish B Oil Rig	0.38	+0.08	93% (393)	90% (97)	71% (n=490)
	Port Campbell Wave Rider Buoy	0.40	+0.05	86% (71)	94% (351)	91% (n=422)
	Cape Bridgewater Wave Rider Buoy	0.45	+0.07	86% (50)	90% (308)	91% (n=358)
	Strahan (Cape Sorell) Wave Rider Buoy	0.39	+0.05	85% (66)	94% (646)	94% (n=712)
TAS	Cape du Couedic Wave Rider Buoy	0.40	+0.06	84% (79)	93% (583)	91% (n=662)
SA	Esperance Wave-rider Buoy	0.31	+0.04	96% (229)	96% (291)	87% (n=520)
WA	Albany Wave-rider Buoy	0.42	+0.05	89% (19)	93% (537)	96% (n=556)
	Cape Naturaliste Wave-rider Buoy	0.32	+0.05	93% (59)	98% (561)	96% (n=620)
	Rottneest Island Wave-rider Buoy	0.34	+0.06	92% (190)	96% (434)	92% (n=624)
	Jurien Wave-rider Buoy	0.29	+0.07	96% (106)	99% (382)	93% (n=488)
	Exmouth Wave-rider Buoy	0.28	+0.06	96% (76)	100% (14)	86% (n=90)
	North Rankin Platform	0.27	+0.03	98% (327)	96% (183)	90% (n=510)

Reliability of OCF forecasts

Reliability metrics were calculated using the following user-centric thresholds:

- Wave height forecasts within 0.5 metres of observed waves 1.5 metres and below; and
- Wave height forecasts within 0.75 metres of observed waves above 1.5 metres.

The reliability of wave height forecasts is also included in Table 2 and shows a 4% improvement from the Auswave-R model to the OCF at 24 hour lead times.

Table 2 - Overall wave height forecast reliability.

Wave height (forecast within 0.5m of obs)		
	OCF	Auswave-R
24 hour	90% (n=13525)	86% (n=13587)
72 hour	84% (n=13461)	82% (n=13589)

The reliability improvement is even greater for waves over 3 metres. At 24 hour lead times the OCF is 8% more reliable than Auswave-R while at a 72 hour lead it is 10% more reliable (Table 3). It is likely that OCF reliability will continue to improve with the recent introduction of the EC model during the last three months on 2013.

Table 3 - Reliability statistics for observed waves greater than 3m forecast within 0.75m. Period of study indicated in parentheses.

Wave height (forecast within 0.75m for obs > 3m)			
	OCF (24 months)	Auswave-R (24 months)	EC (3 months)
24 hour	87% (n=1673)	79% (n=1676)	88% (n=189)
72 hour	78% (n=1673)	68% (n=1676)	84% (n=189)

Wave height metrics are displayed spatially in Figure 1. Blue colours indicate higher accuracies while reds indicate lower. It is apparent that forecast challenges exist primarily along the East Coast likely due to complex wave generating systems such as East Coast Lows.

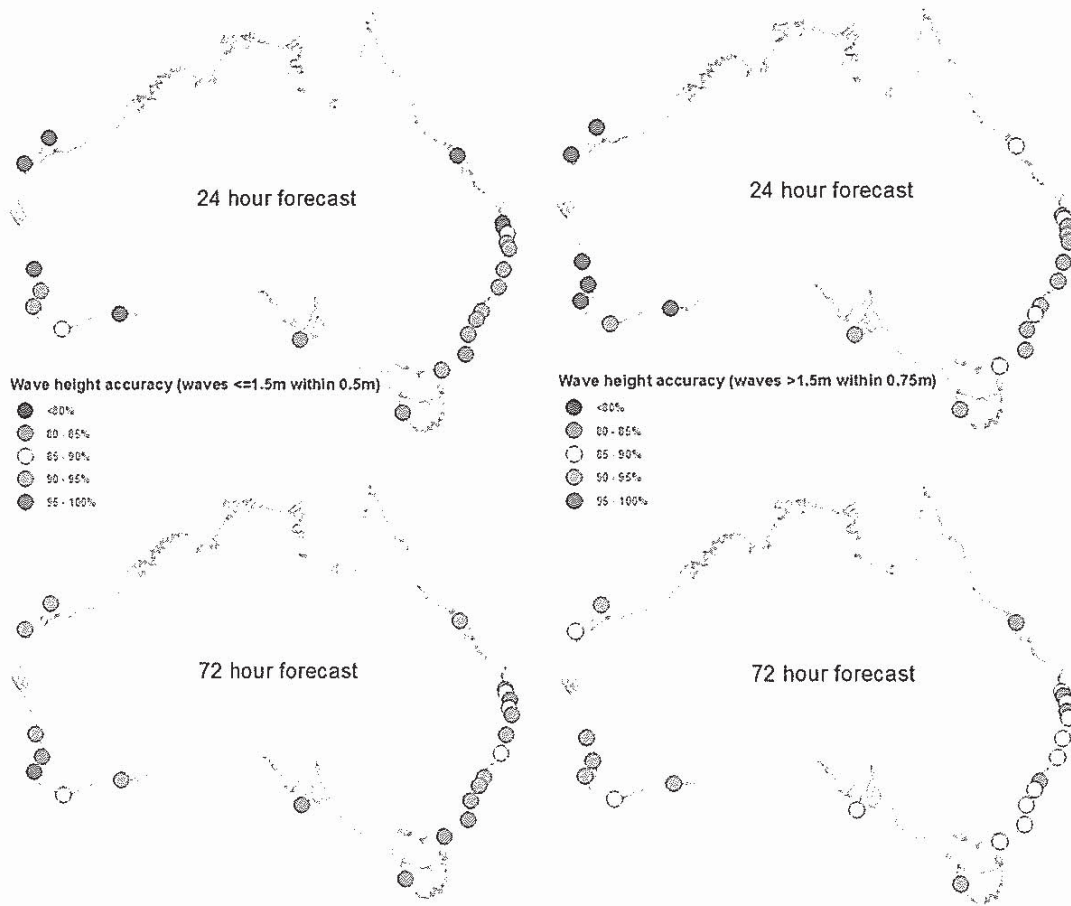


Figure 1 - Wave height OCF performance metrics: waves 1.5m and below forecast within 0.5m (left); waves above 1.5m forecast within 0.75m (right).

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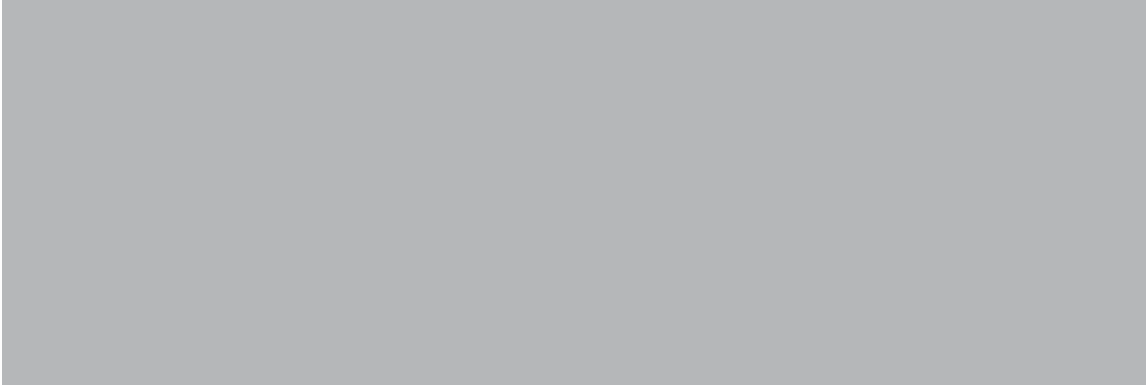
Bureau of Meteorology

Usage and Satisfaction

Summer 2013

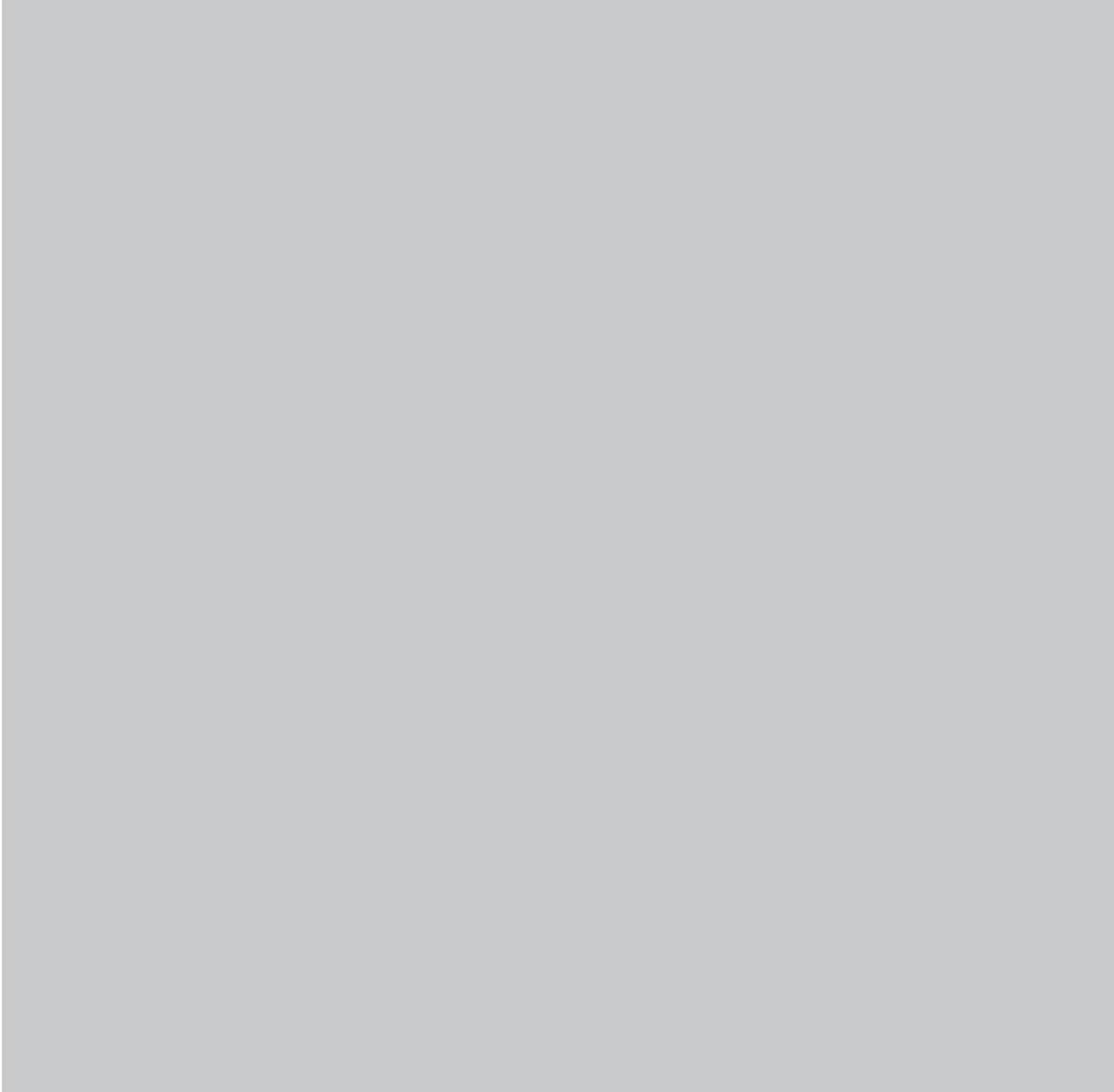
December 2013

Report Contents

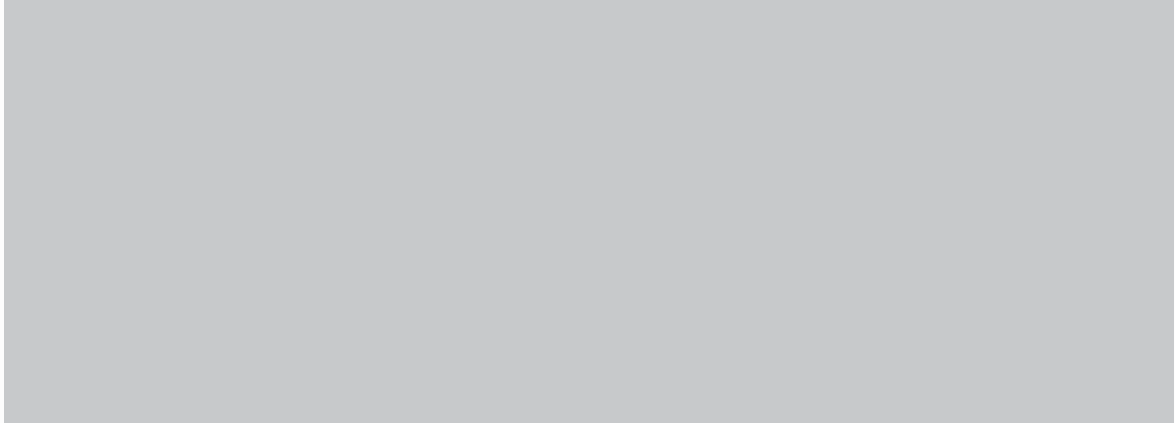
1. Executive Briefing	1
2. Survey Results	5
[Redacted]	5
[Redacted]	6
	
2.3. Satisfaction with Weather Information	16
[Redacted]	17
Coastal Users Summary	18
Farmers Summary	19
[Redacted]	20
[Redacted]	22
Timeliness KPI in detail	24
Accuracy KPI in detail	26
[Redacted]	28



1. Executive Briefing



In particular, farmers' rating of accuracy dropped from 77% to 71%, [REDACTED] It is not possible to determine from this data alone whether this reflects a perceived or actual decline in performance in that time, or a more seasonal variation. Only further monitoring across seasons would allow this to be explored and understood in more detail.



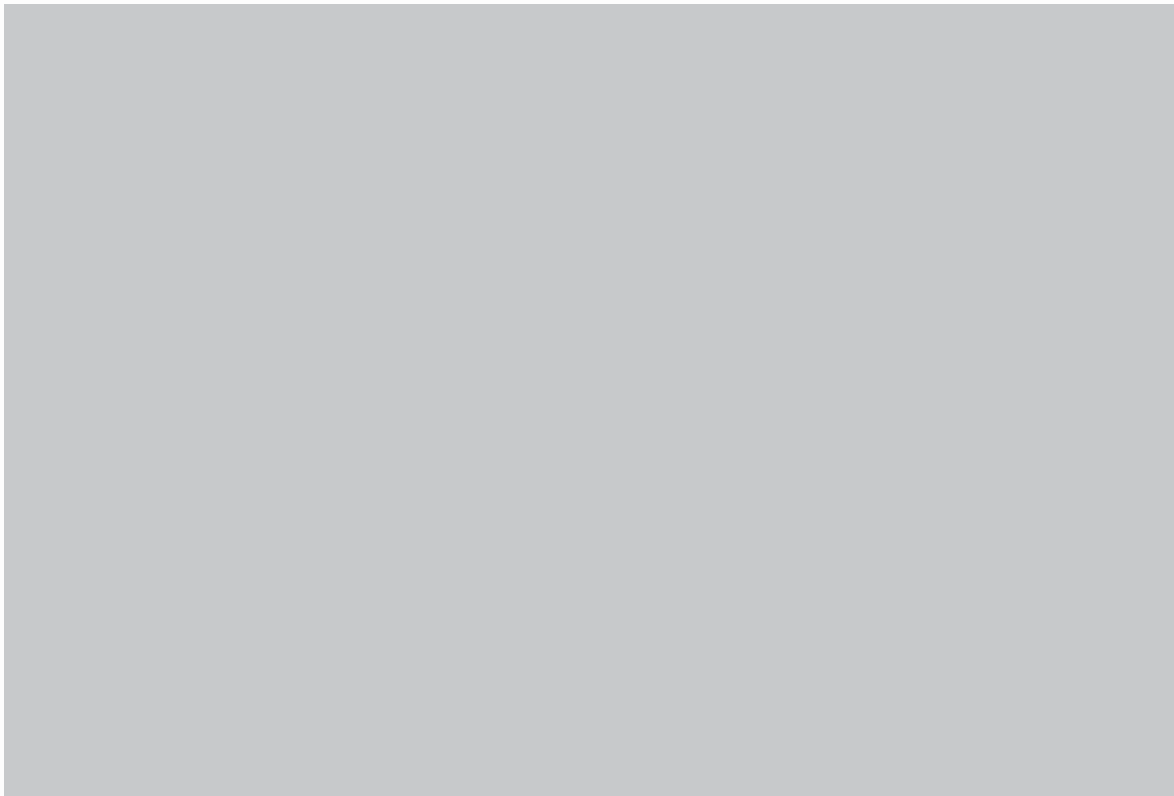
KPI Dashboard Summer 2013	General Population	Coastal Users subset	Farmers
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
Timeliness	89%	91%	86%
Accuracy	84%	85%	71%↓

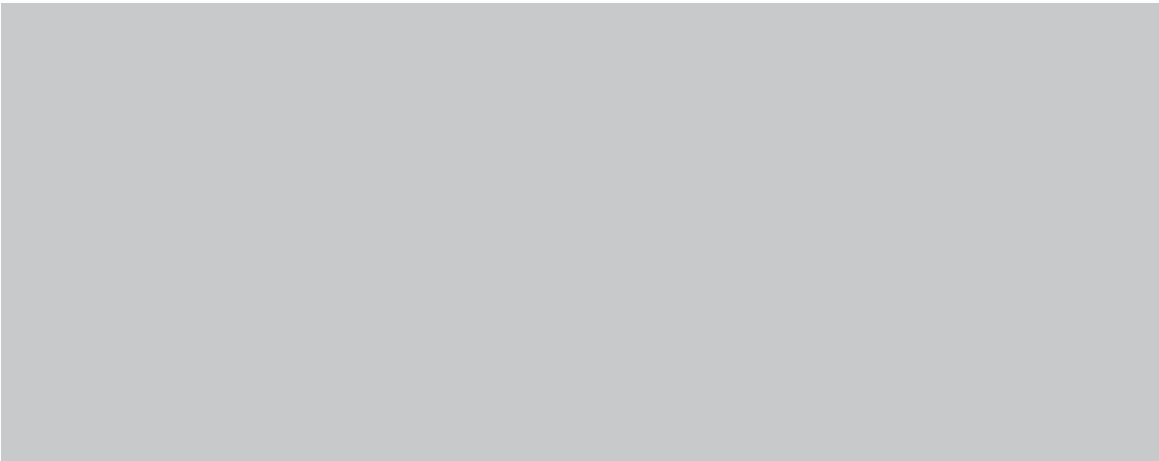


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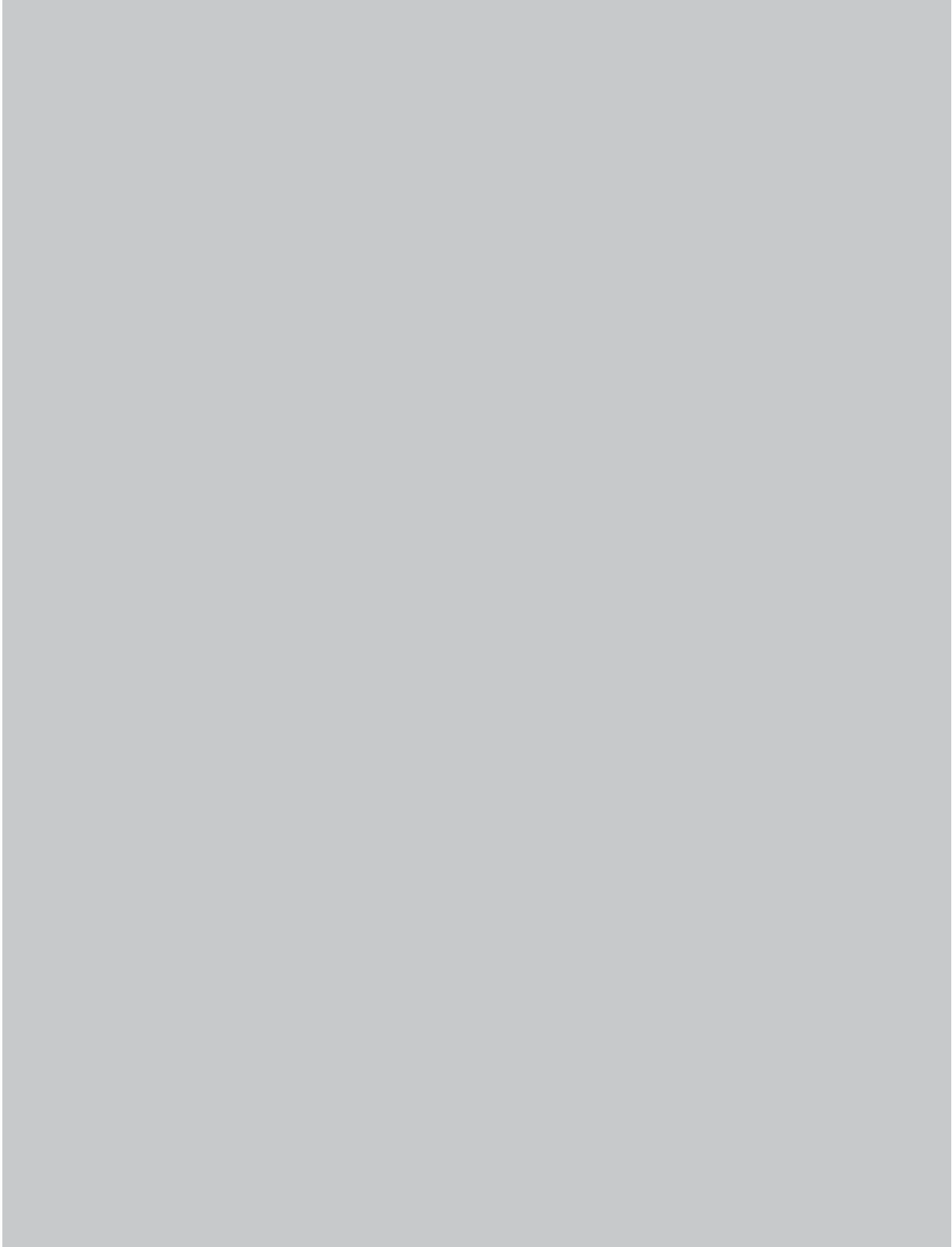
Urban / Metropolitan	Summer '08	Summer '09	Summer '10	Summer '11	Winter '13	Summer '13
Timeliness (Always / Usually)	90%	96%	95%	98%	89%	90%
Accuracy (Always / Usually)	75%	82%	82%	85%	83%	86%

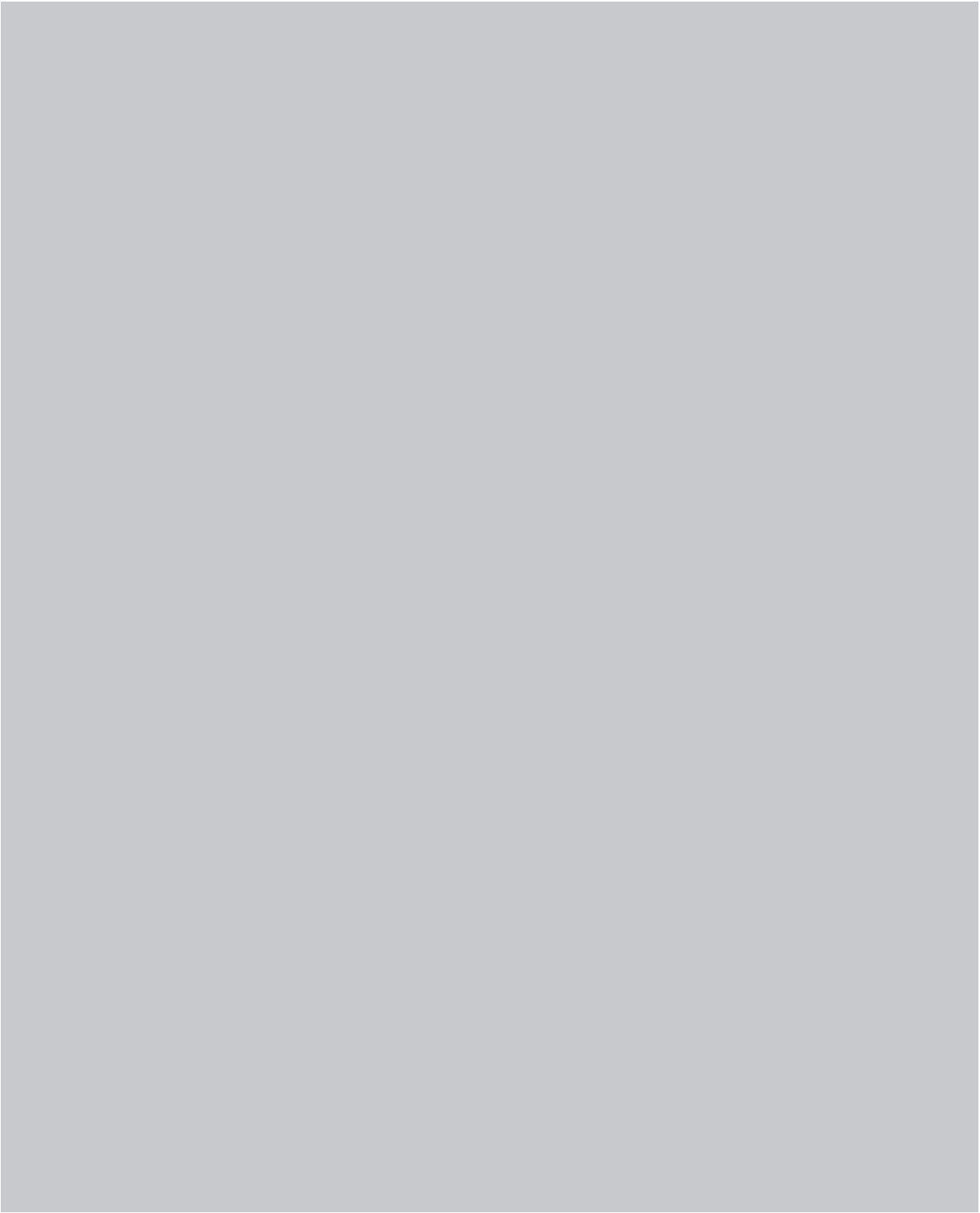


Regional	Summer '08	Summer '09	Summer '10	Summer '11	Winter '13	Summer '13
Timeliness (Always / Usually)	95%	92%	95%	94%	90%	88%
Accuracy (Always / Usually)	71%	79%	85%	89%	84%	80%



2. Survey Results



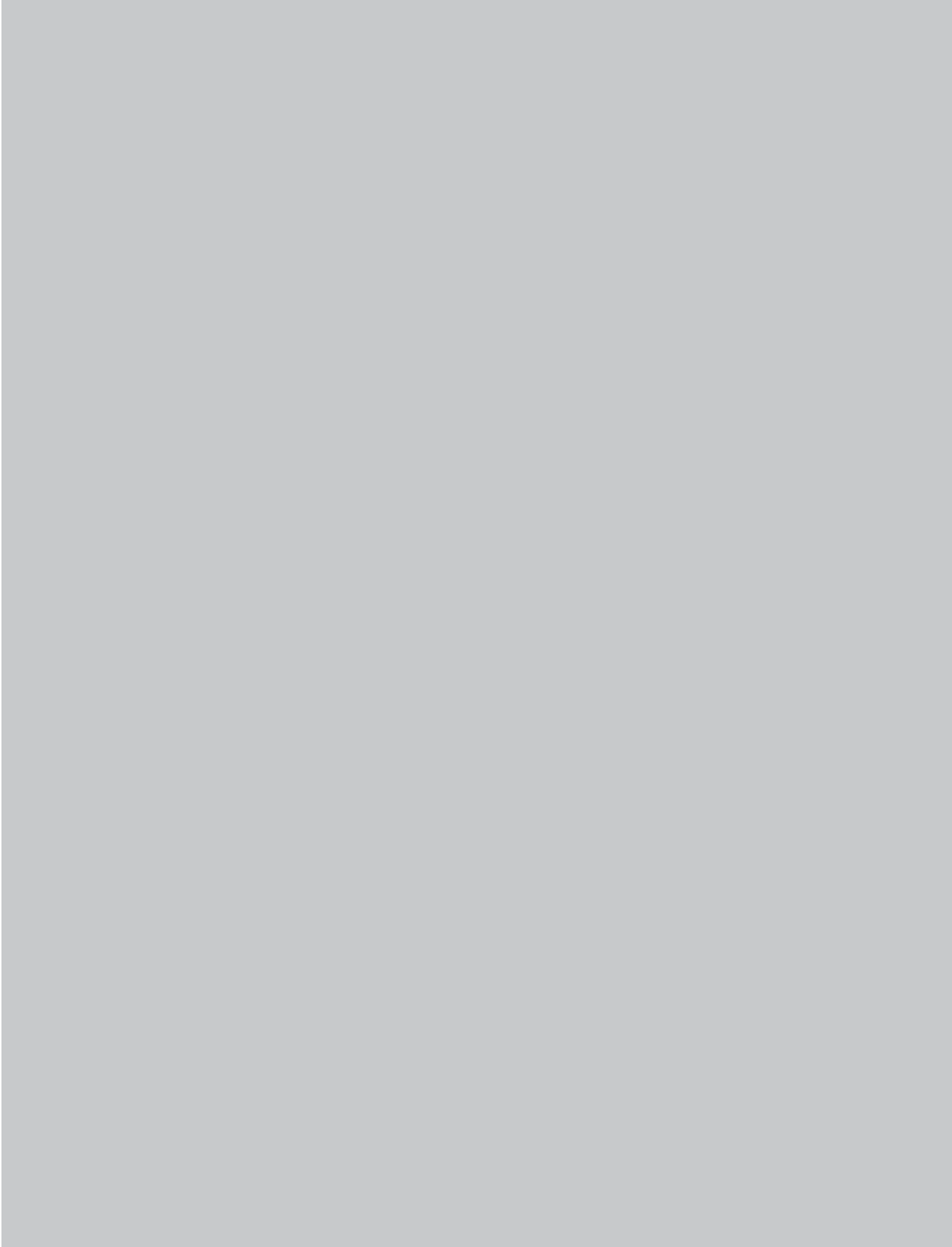


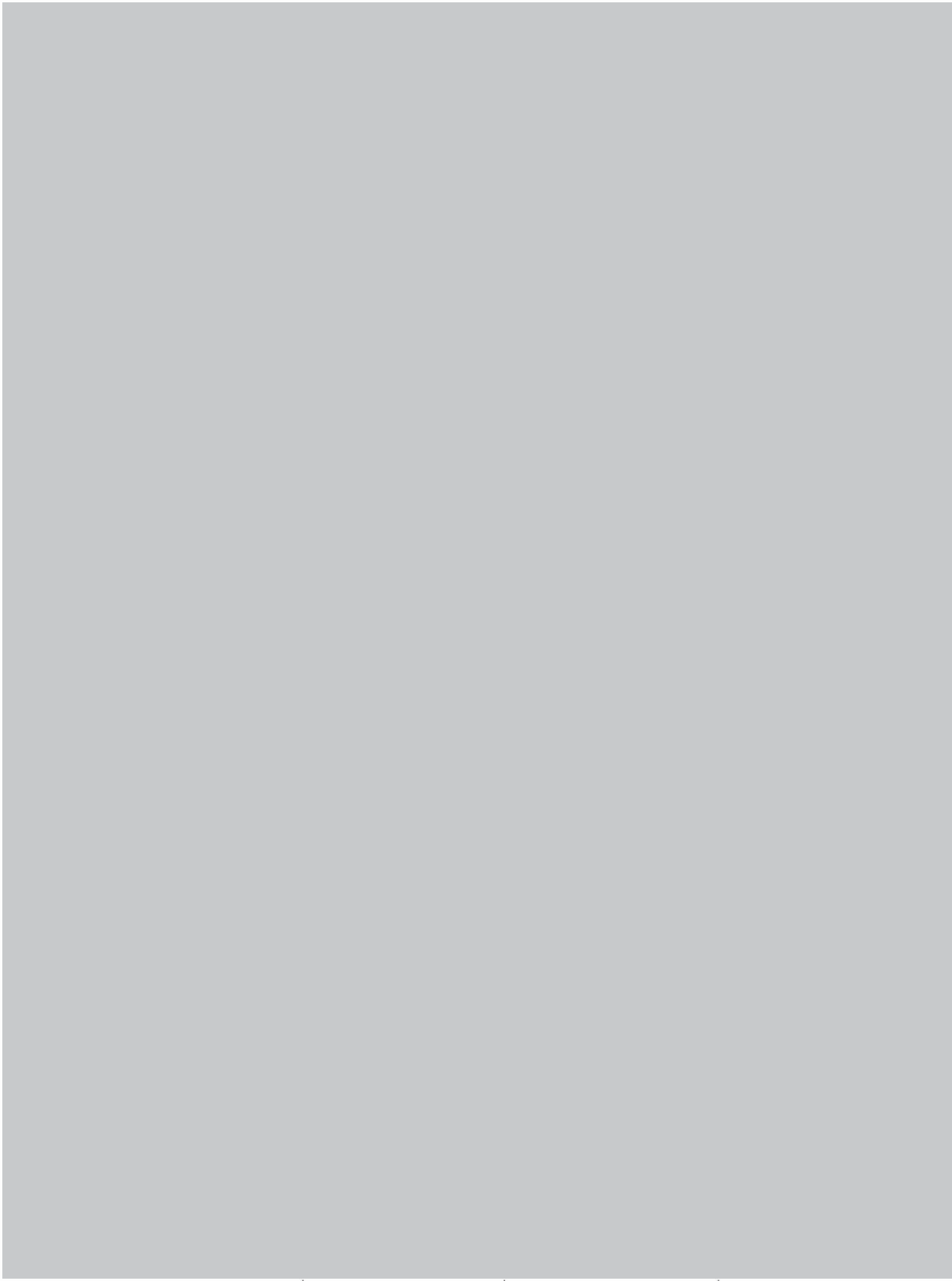


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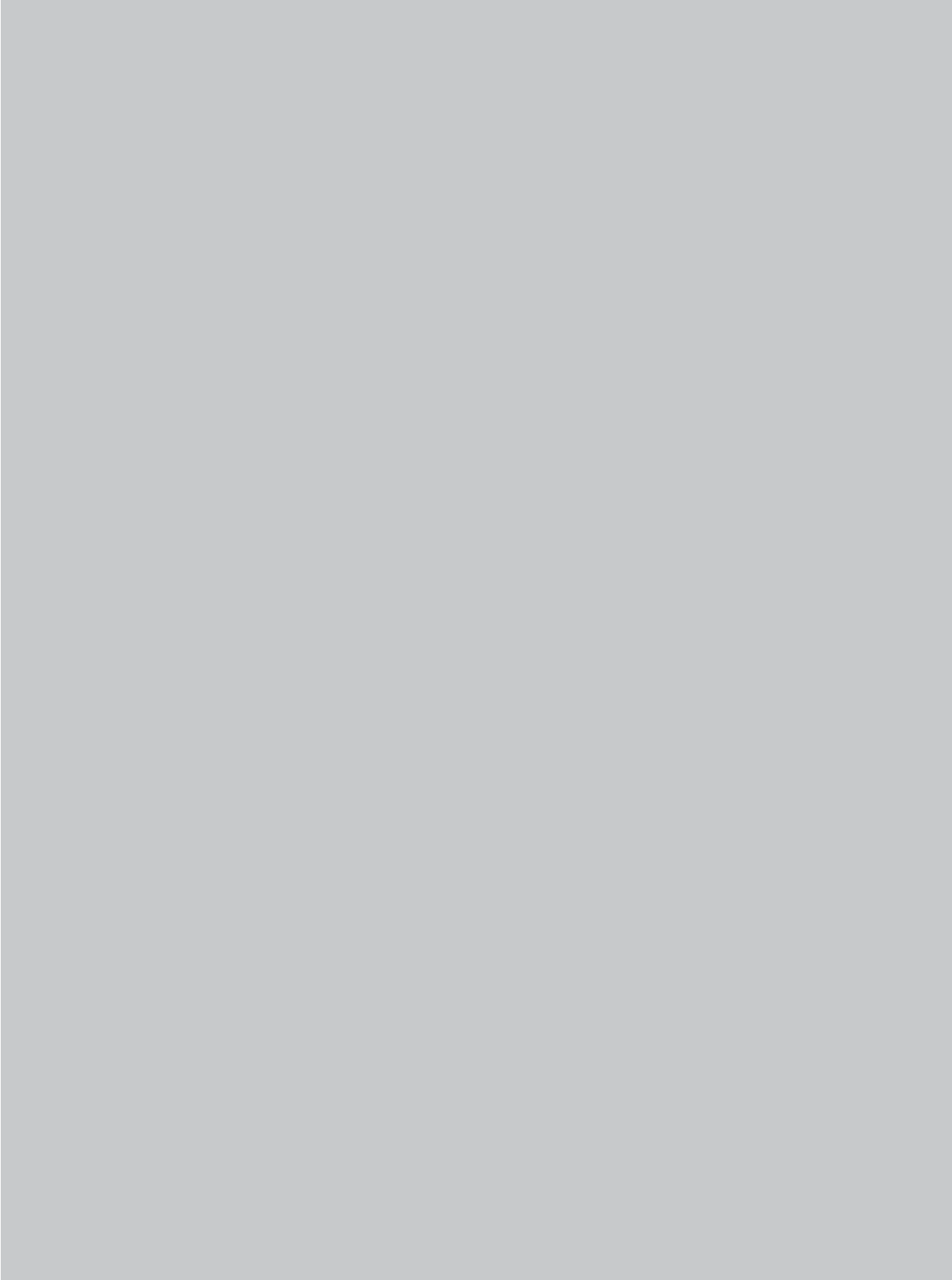


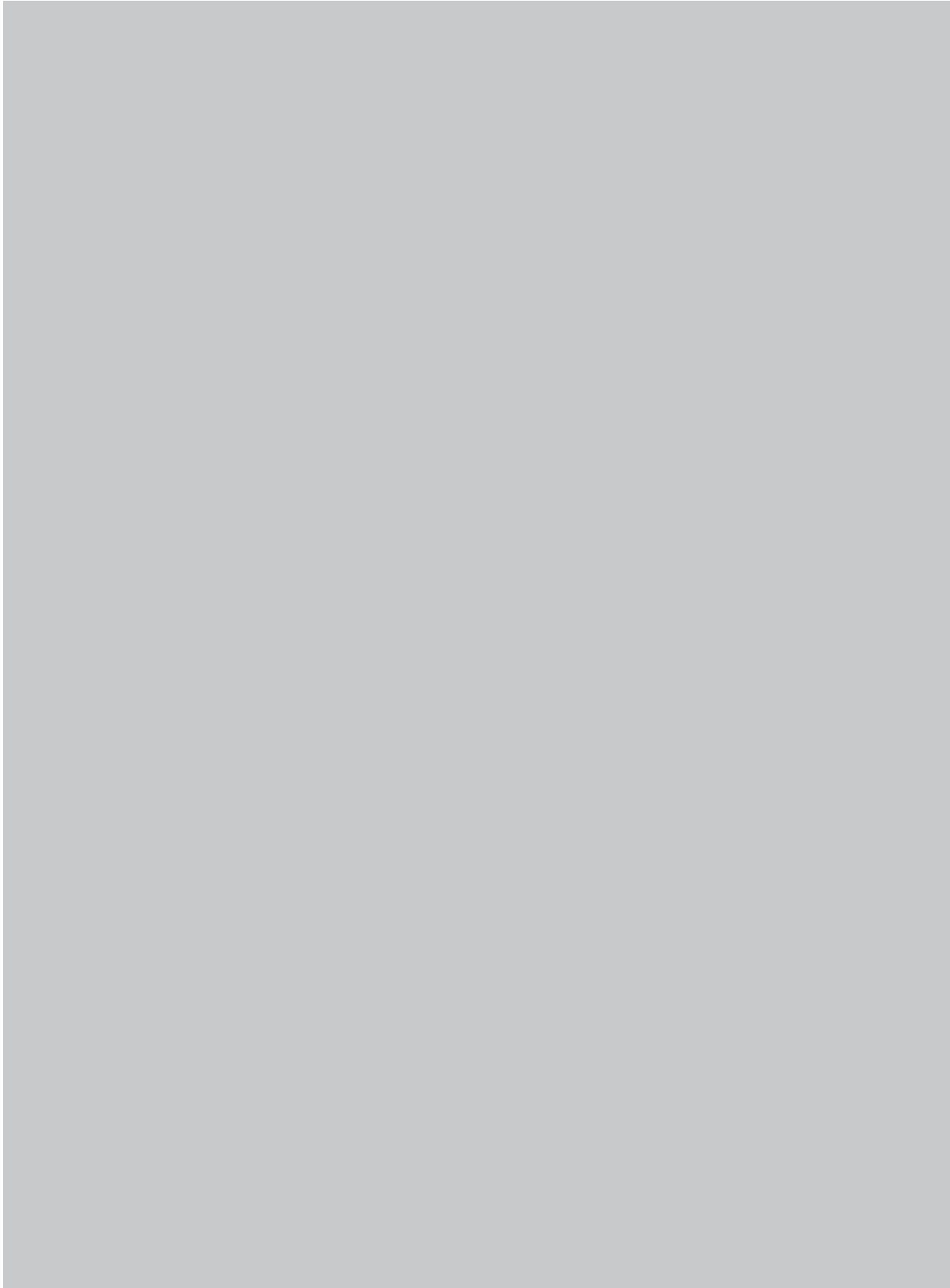
















2.3. Satisfaction with Weather Information



In particular, farmers' rating of accuracy dropped from 77% to 71%, [REDACTED] It is not possible to determine from this data alone whether this reflects a perceived or actual decline in performance in that time, or a more seasonal variation. Only further monitoring across seasons would allow this to be explored and understood in more detail.



General Population Summary



General Population Summary		Available In time At least usually	Accurate enough At least usually
[Redacted]	Winter '13	[Redacted]	[Redacted]
	Summer '13		
BOM website	Winter '13	98%	91%
	Summer '13	98%	95%
[Redacted]	[Redacted]	[Redacted]	[Redacted]

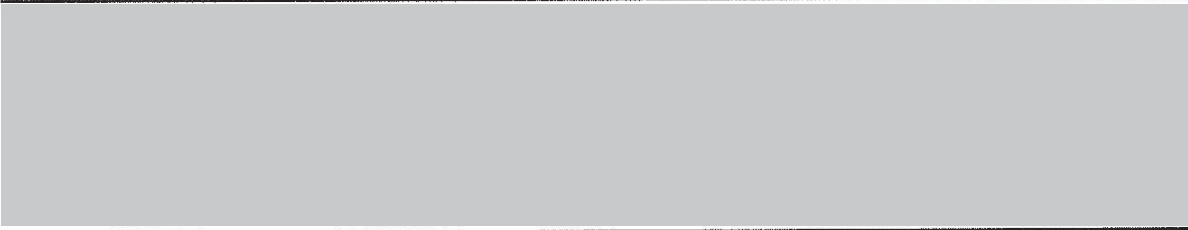
* CAUTION: SMALL SAMPLE SIZES (LESS THAN 100)



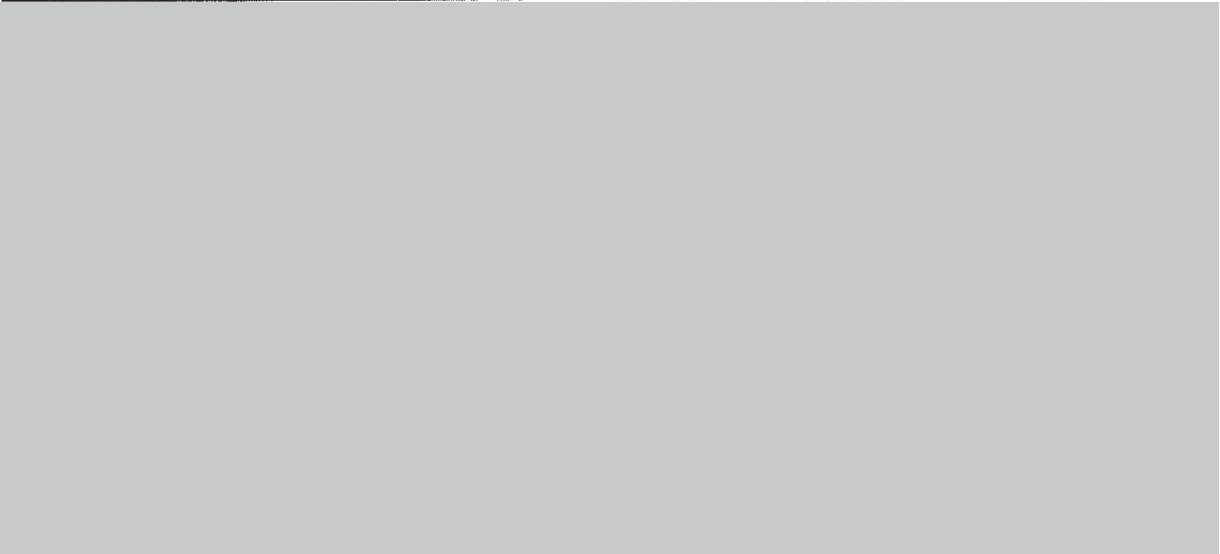
Coastal Users Summary



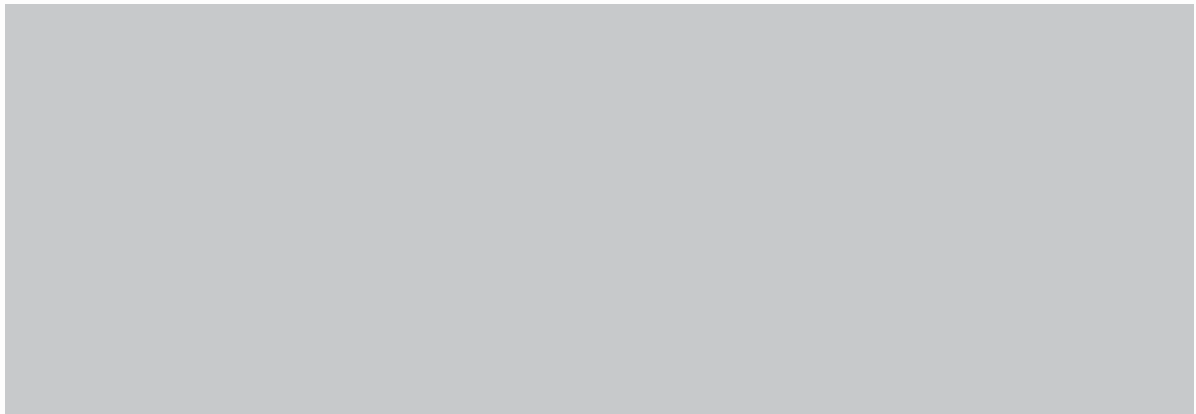
Coastal Users Summary	Available in time <i>At least usually</i>	Accurate enough <i>At least usually</i>
	91%	85%



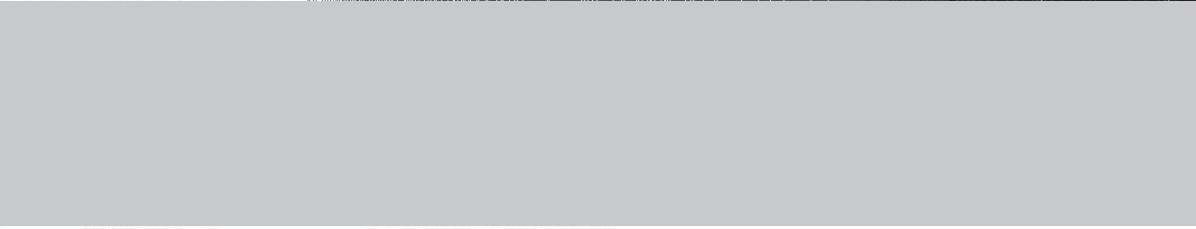
BOM website	Winter '13^	96%	93%
	Summer '13	99%	97%



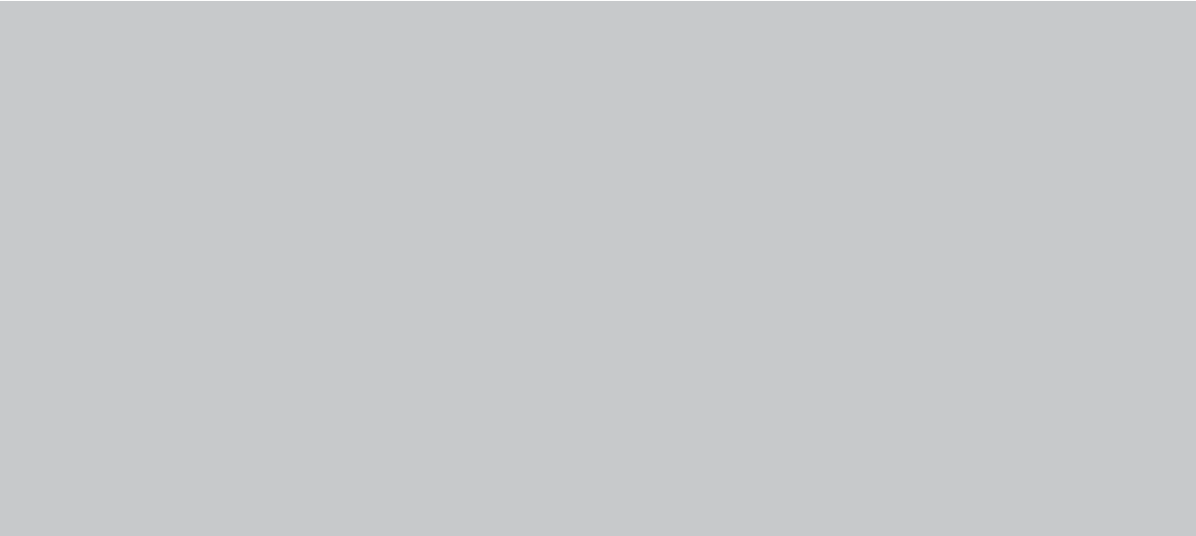
Farmers Summary

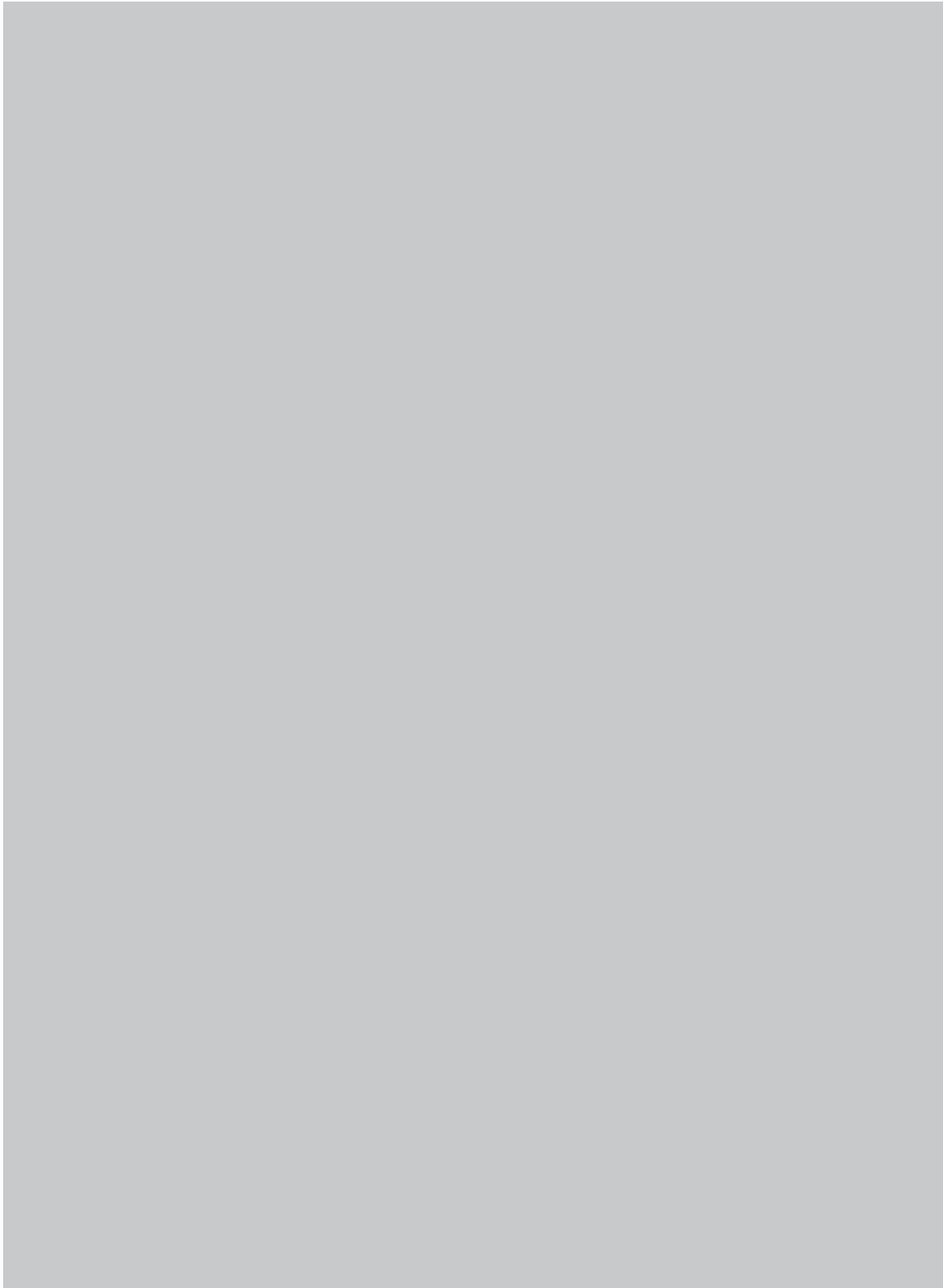


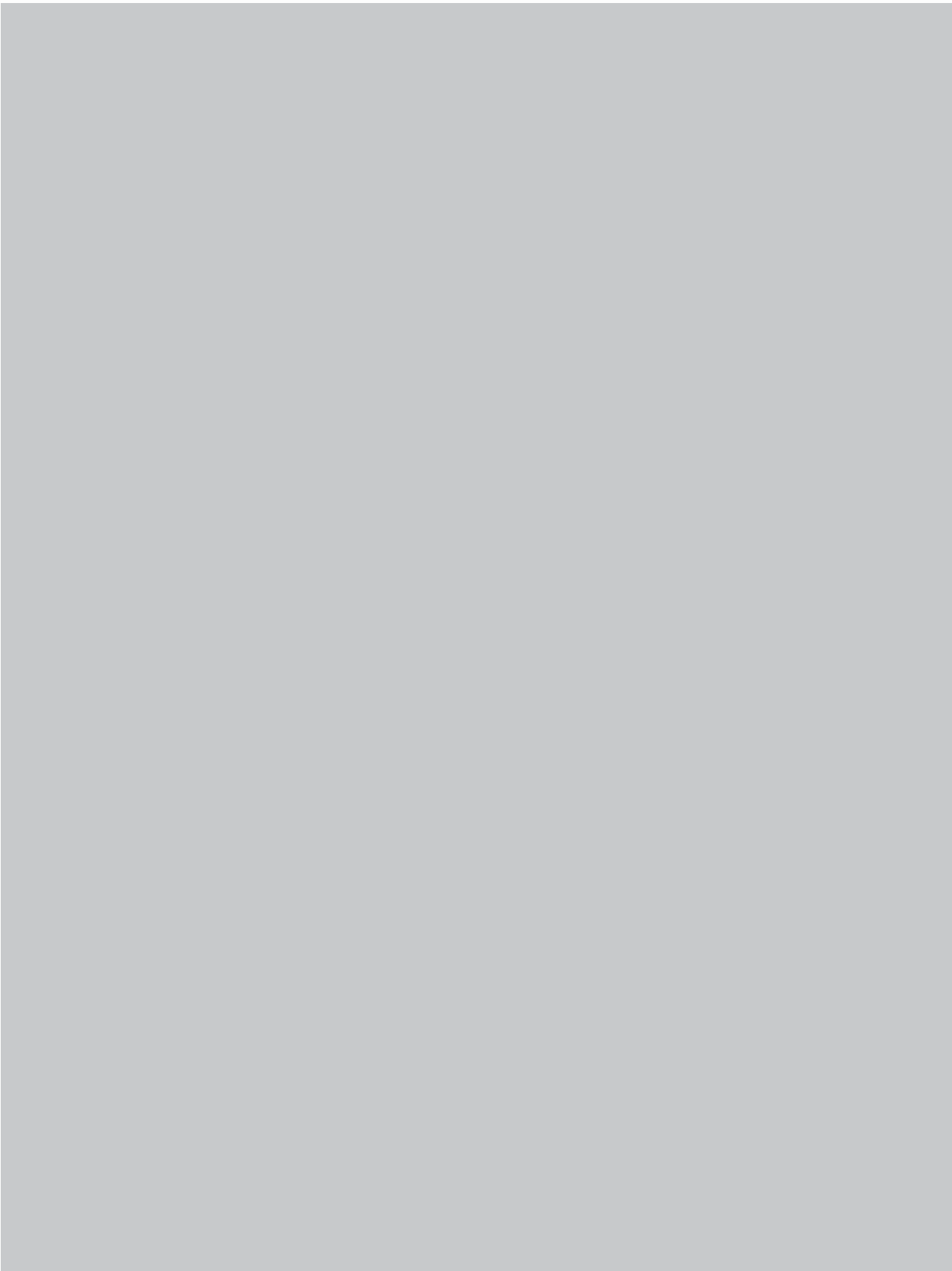
Farmers Summary		Available in time	Accurate enough
		At least usually	At least usually
		88%	77%
		86%	71%

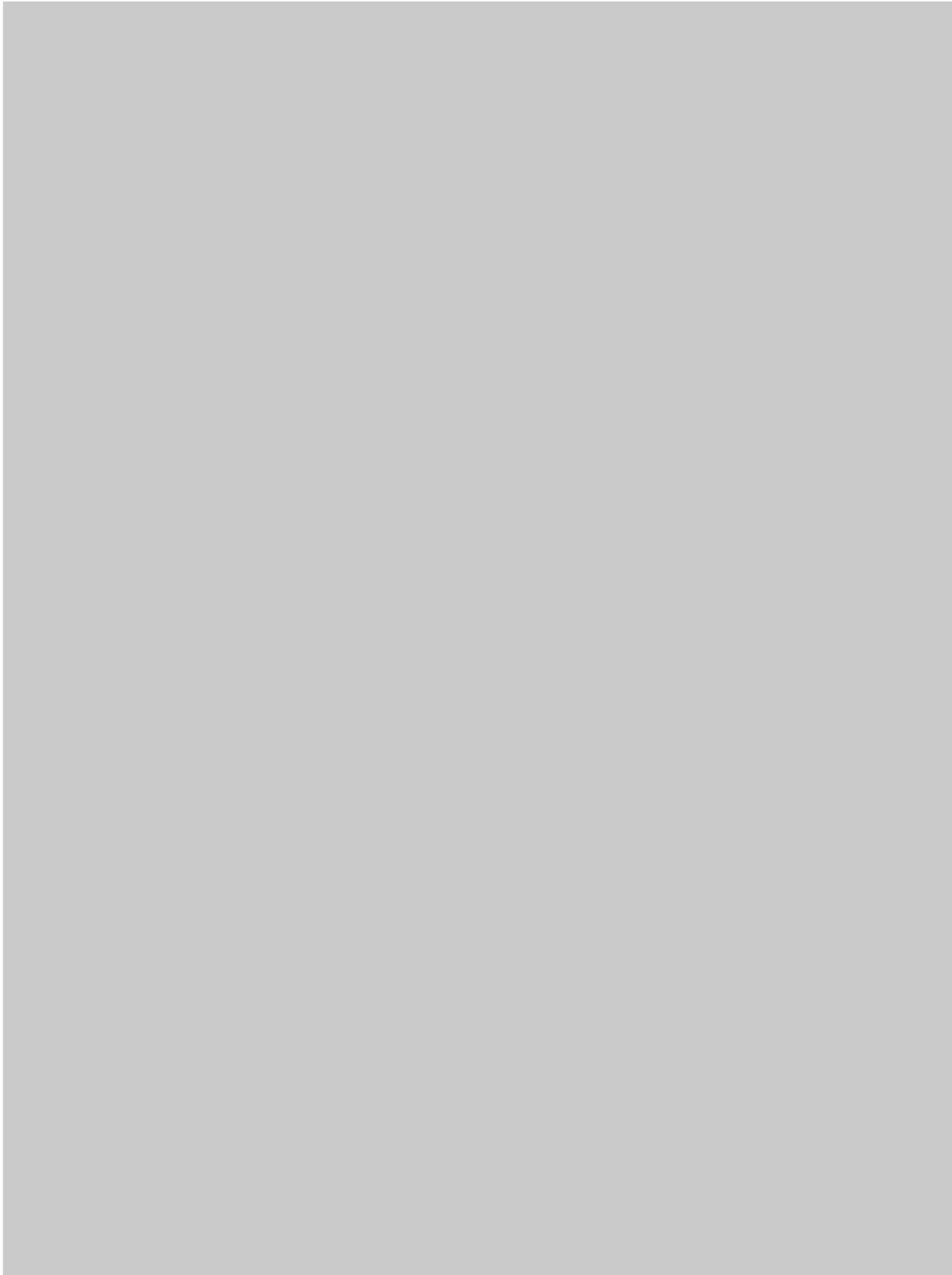


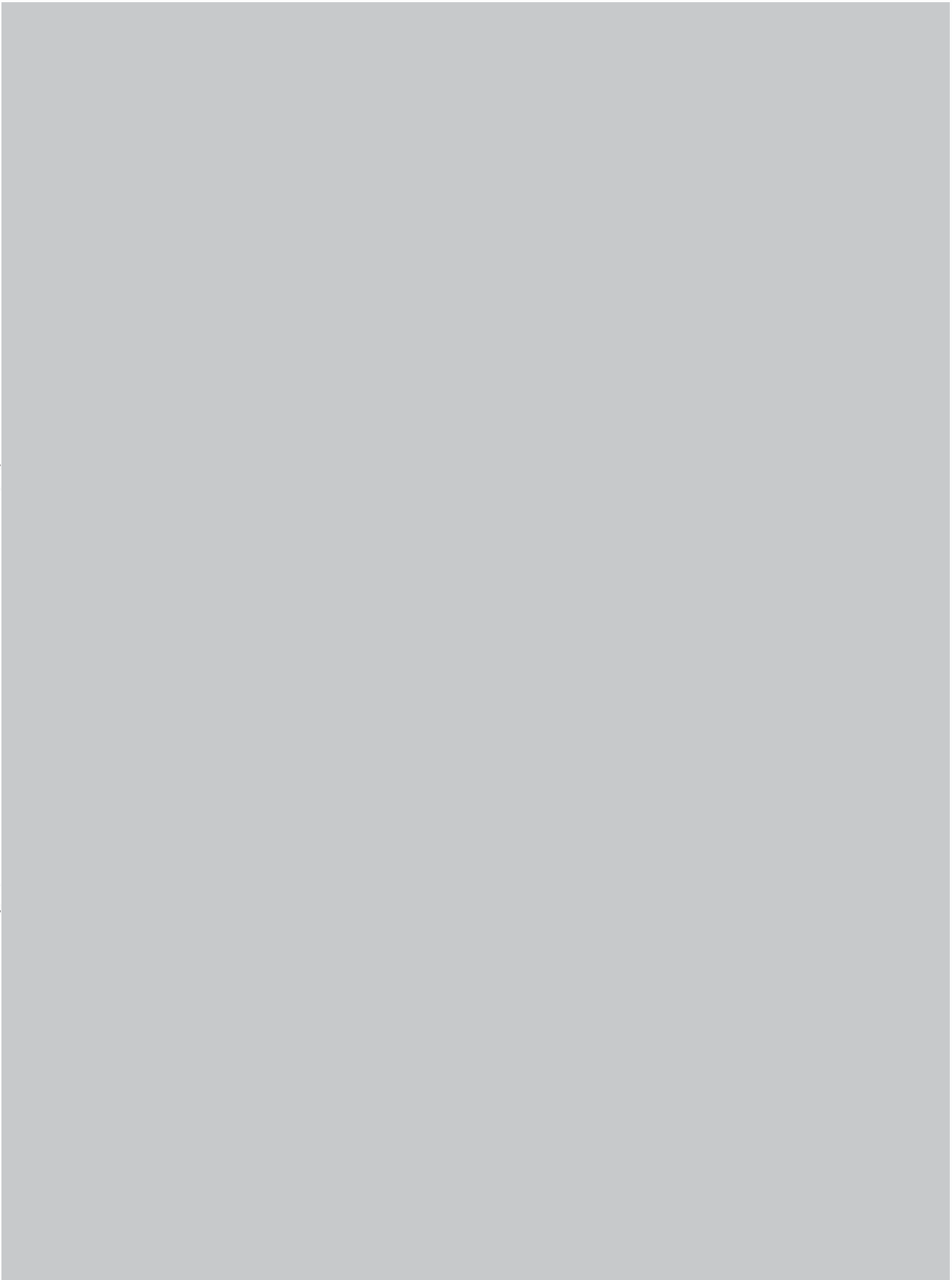
BOM website	Winter '13		96%	86%
		Summer '13		91%



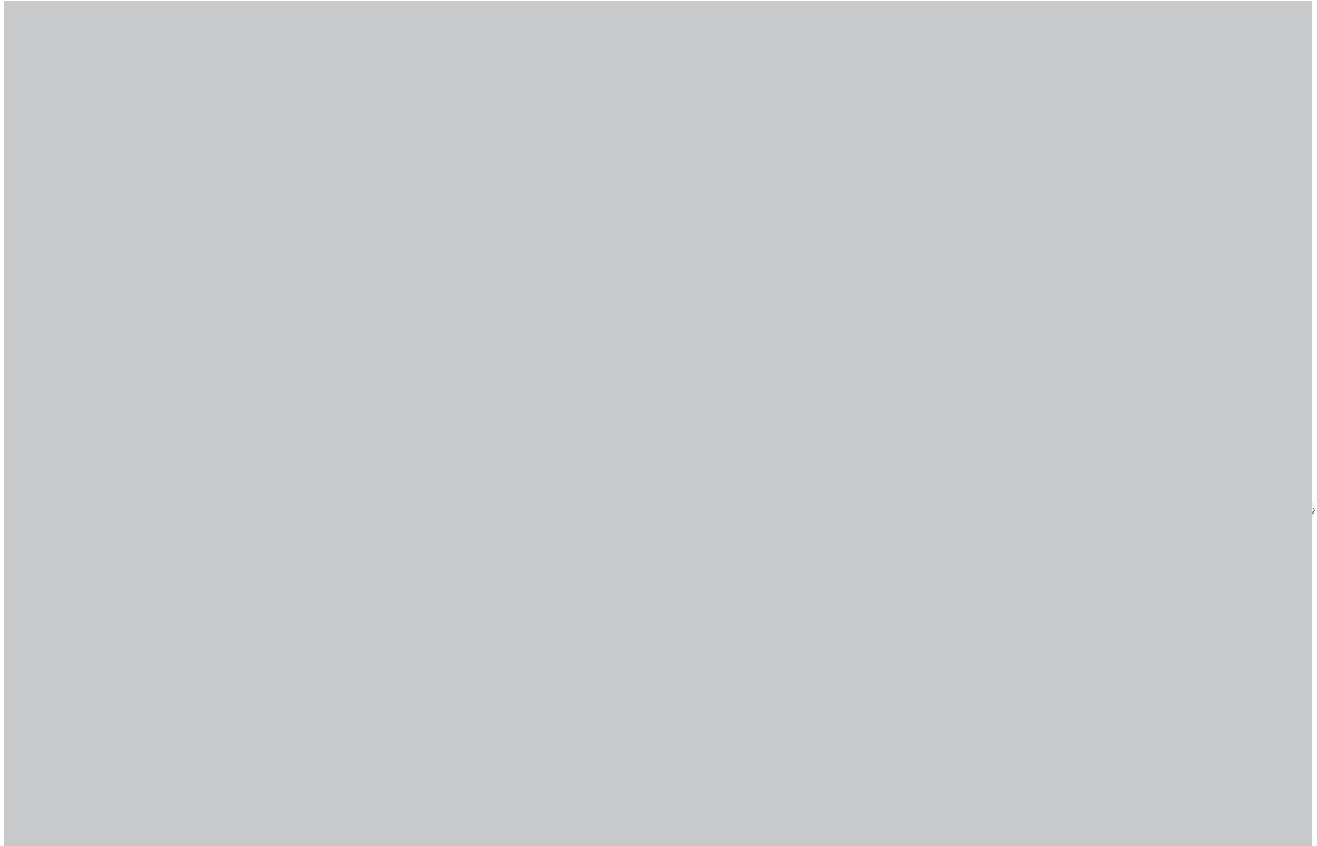








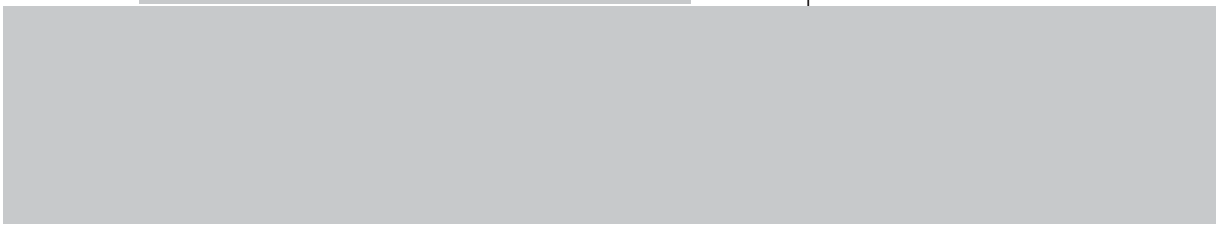
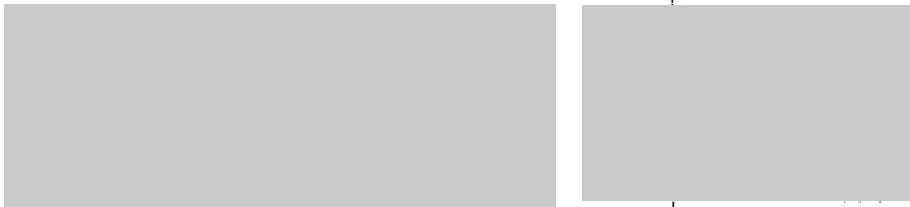
Timeliness KPI in detail



General Population Timeliness	Winter '13	Summer '13
	At least usually timely 89%	At least usually timely 89%



BOM website	98%	98%
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Coastal Users Timeliness	Winter '13^		Summer '13	
	At least usually timely		At least usually timely	
[Redacted]	91%	[Redacted]	91%	
BOM website	96%	[Redacted]	99%	

[Redacted]

[Redacted]

Farmers Timeliness	Winter '13		Summer '13	
	At least usually timely		At least usually timely	
[Redacted]	88%	[Redacted]	86%	
BOM website	96%	[Redacted]	91%	

[Redacted]

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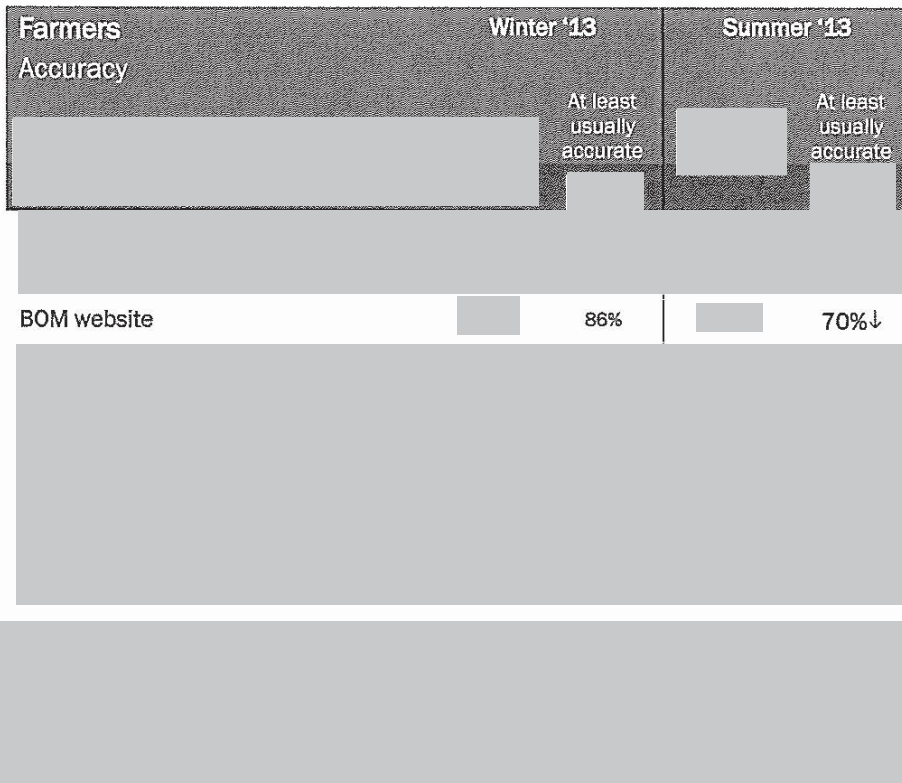
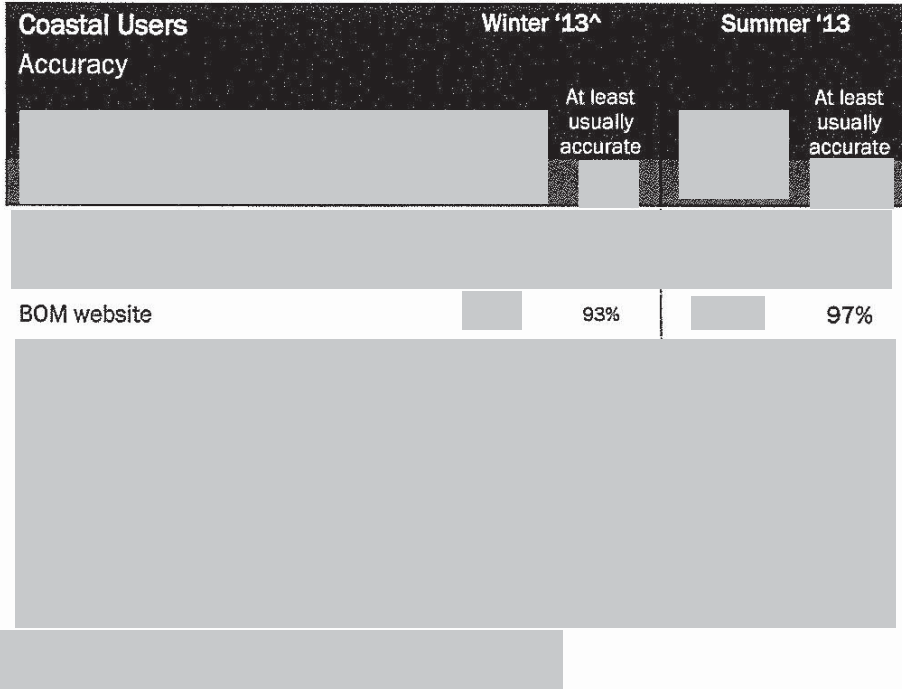
Accuracy KPI in detail

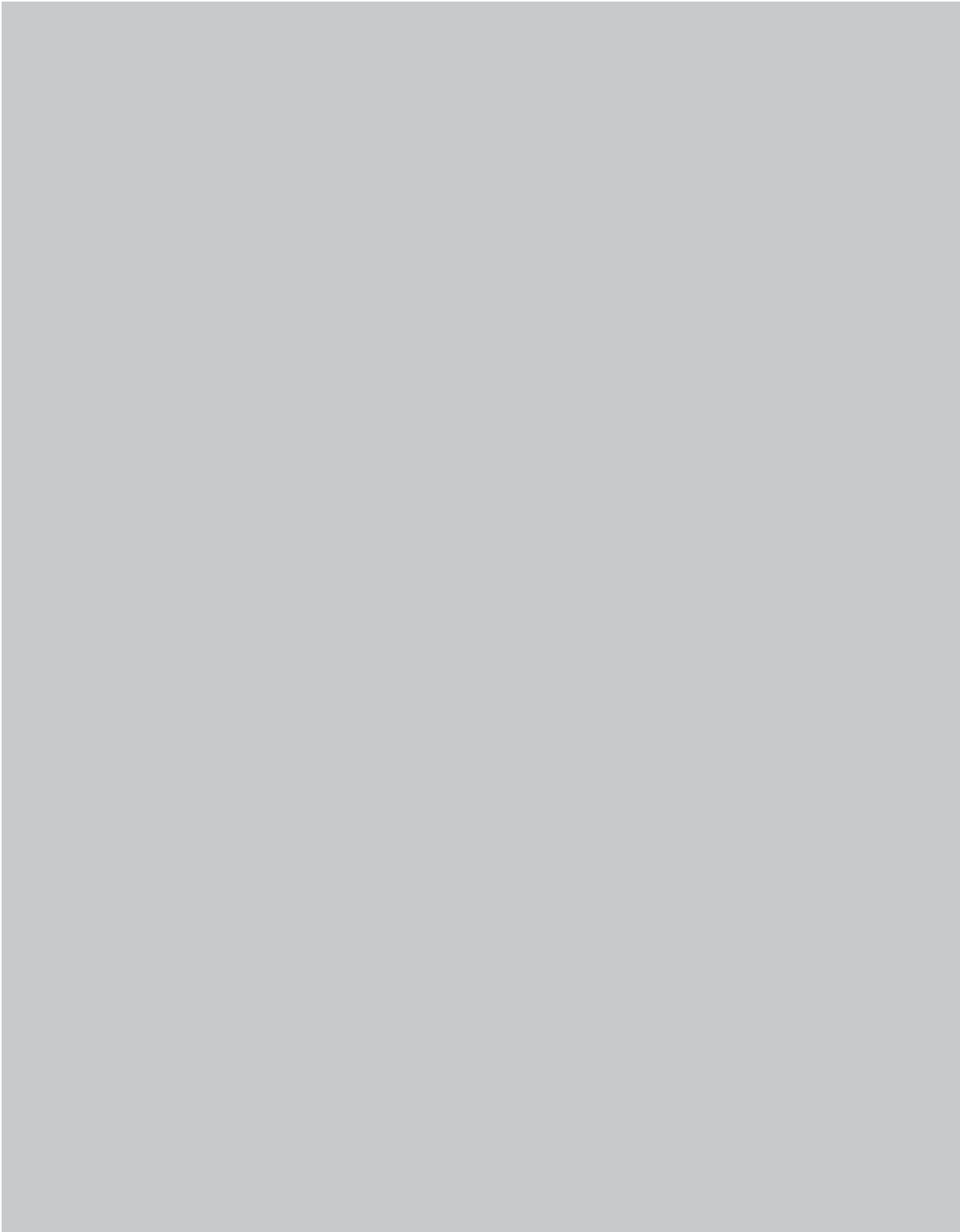


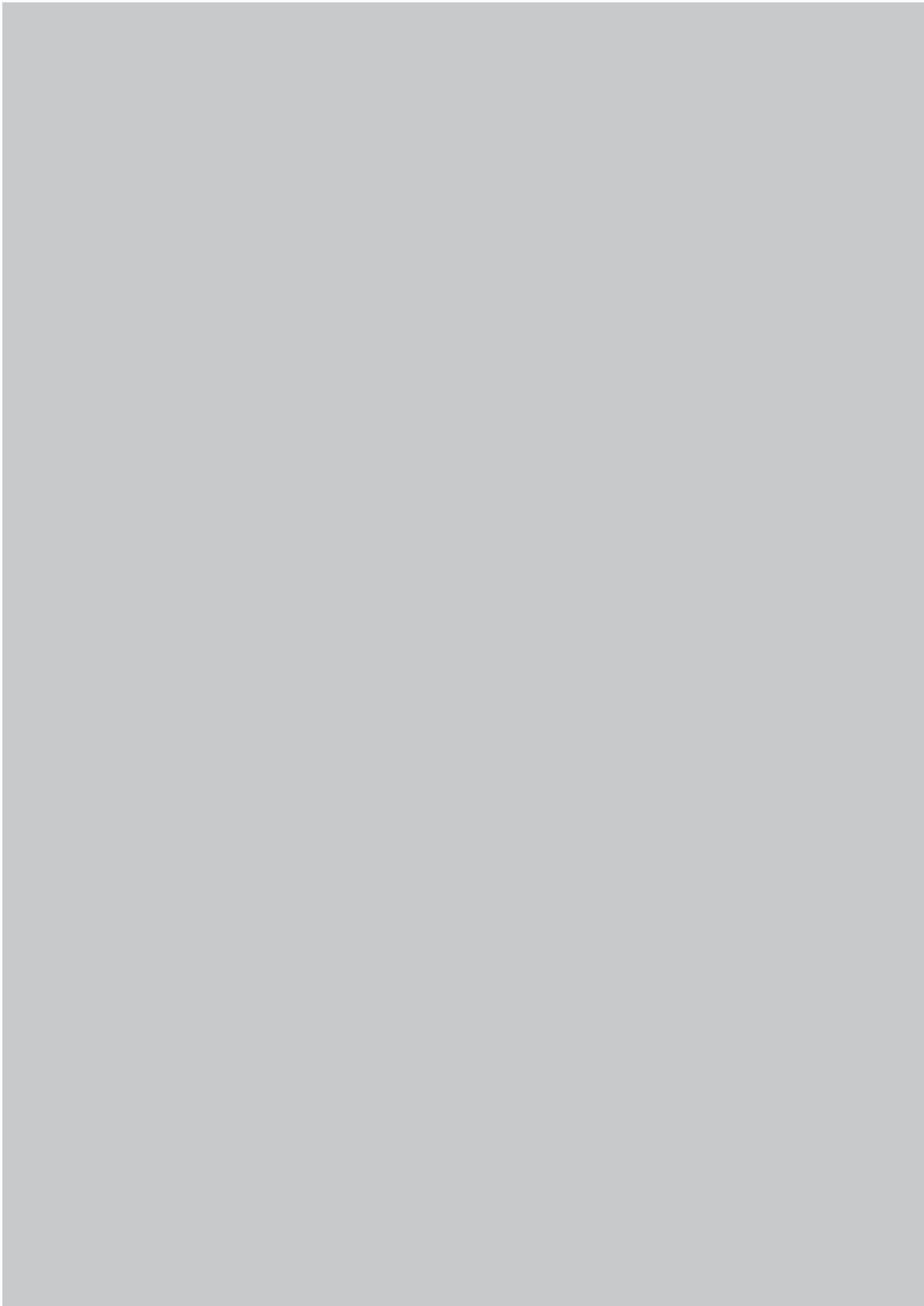
The following tables break down the responses for each of the individual channels:

General Population Accuracy	Winter '13		Summer '13	
		At least usually accurate		At least usually accurate
[Redacted]	[Redacted]	[Redacted]	[Redacted]	[Redacted]
BOM website	[Redacted]	91%	[Redacted]	95%
[Redacted]	[Redacted]	[Redacted]	[Redacted]	[Redacted]





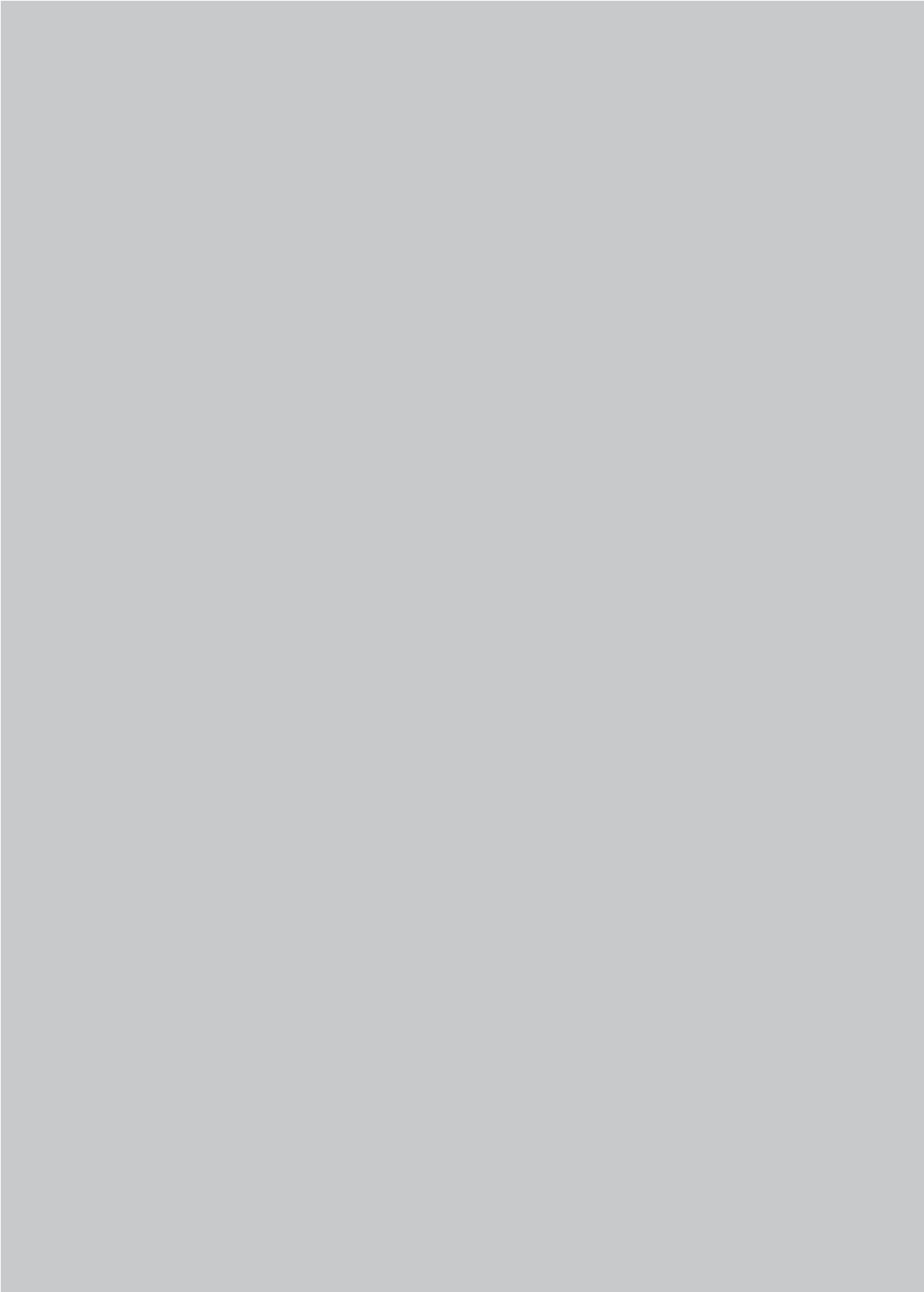




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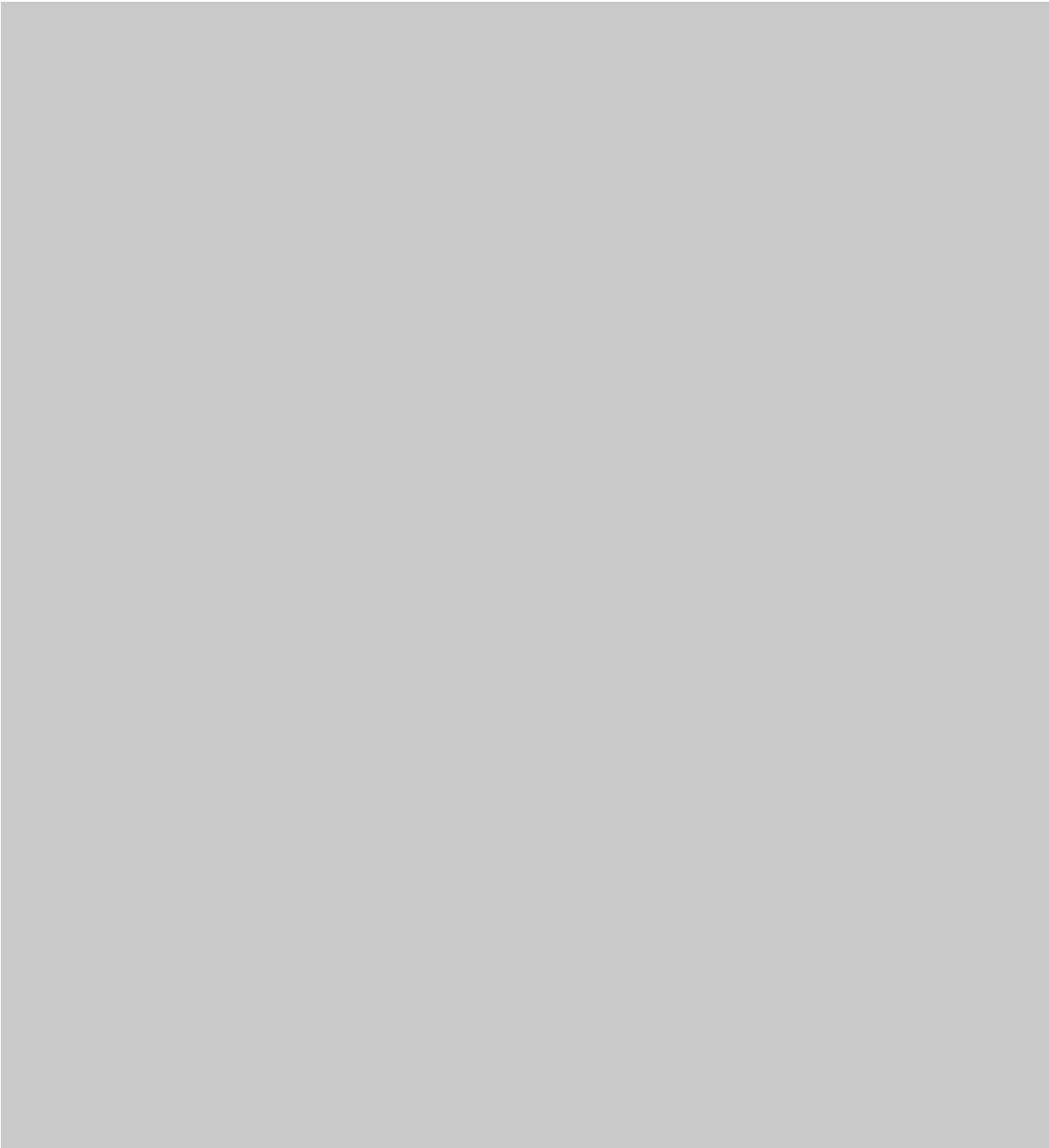


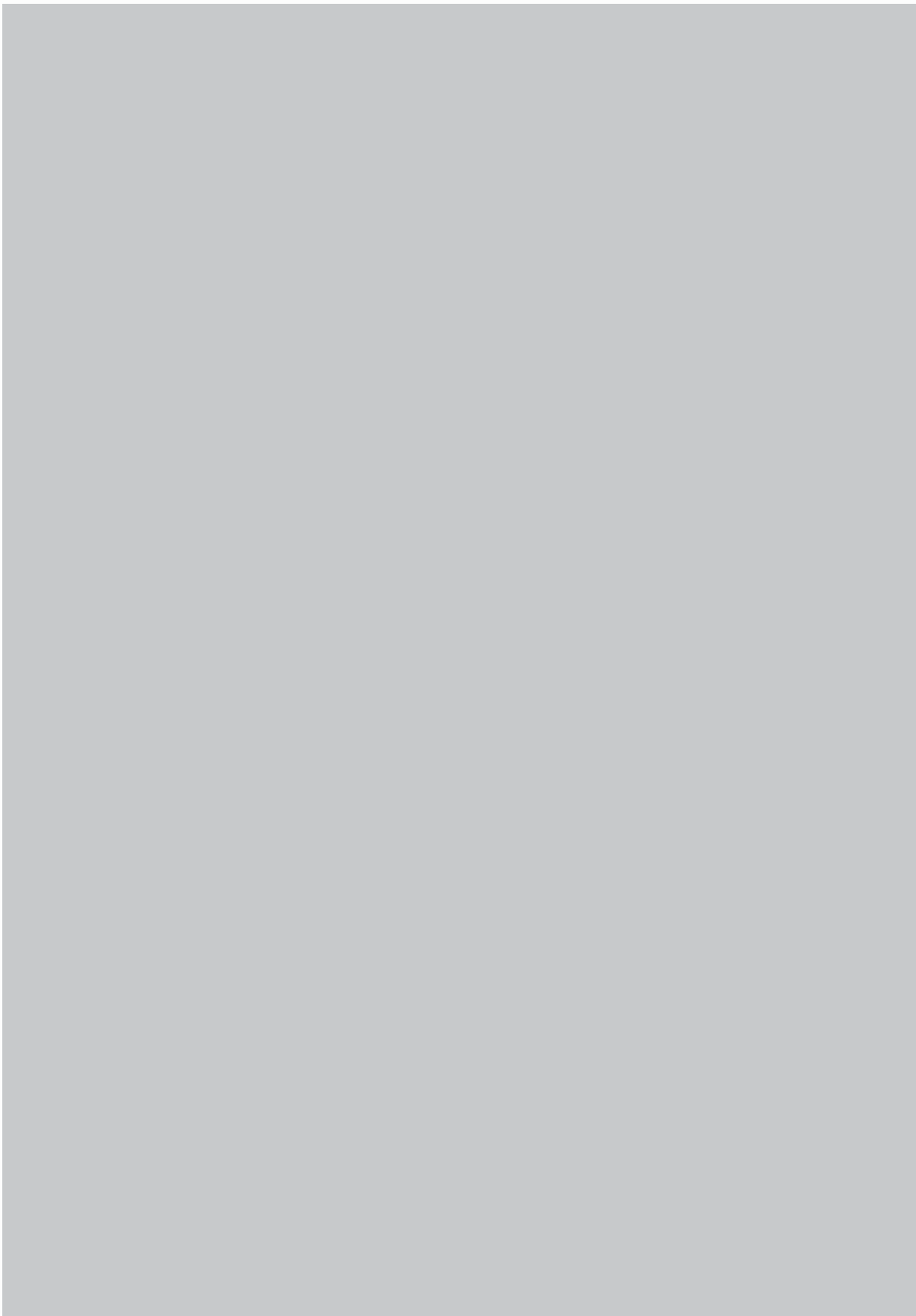


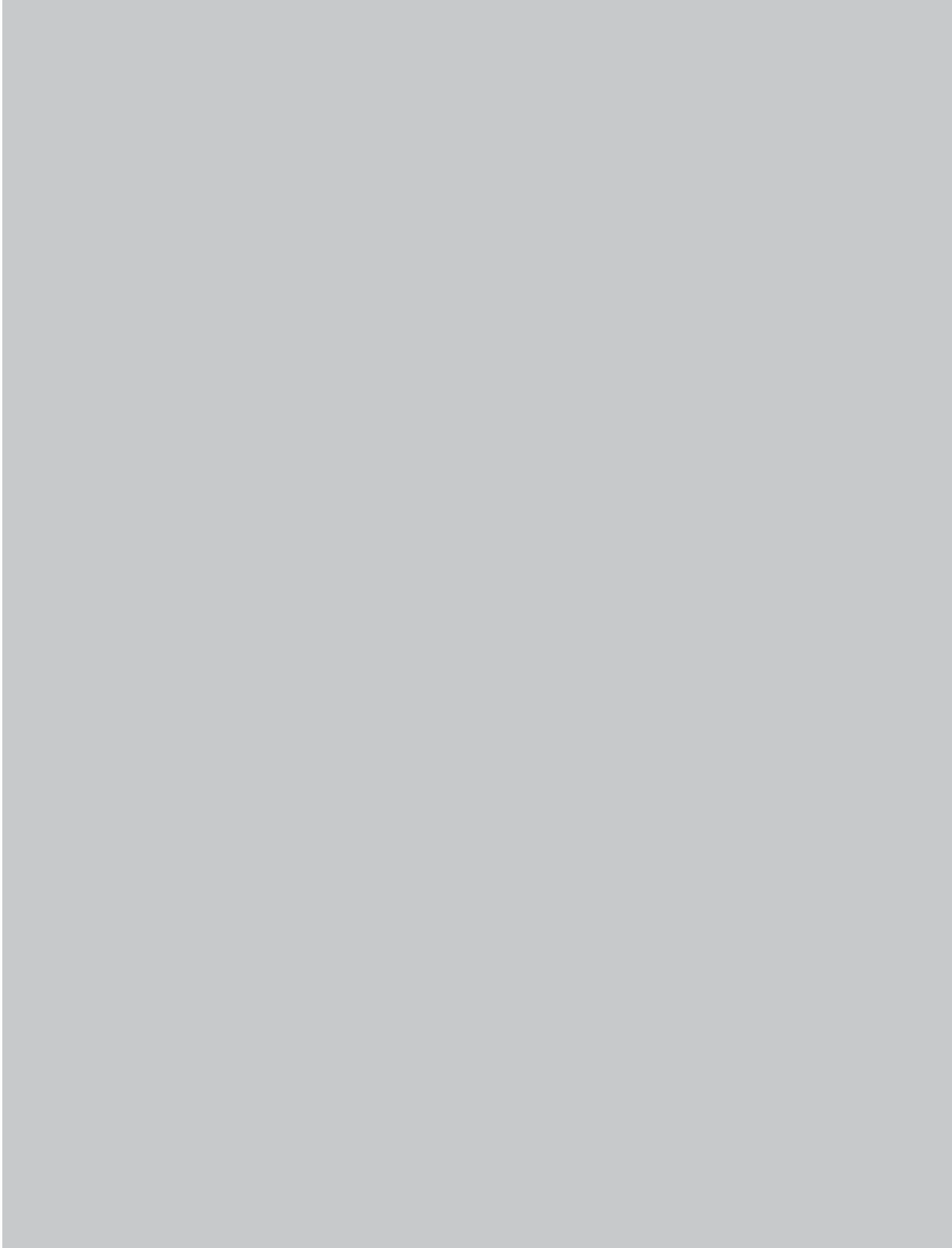
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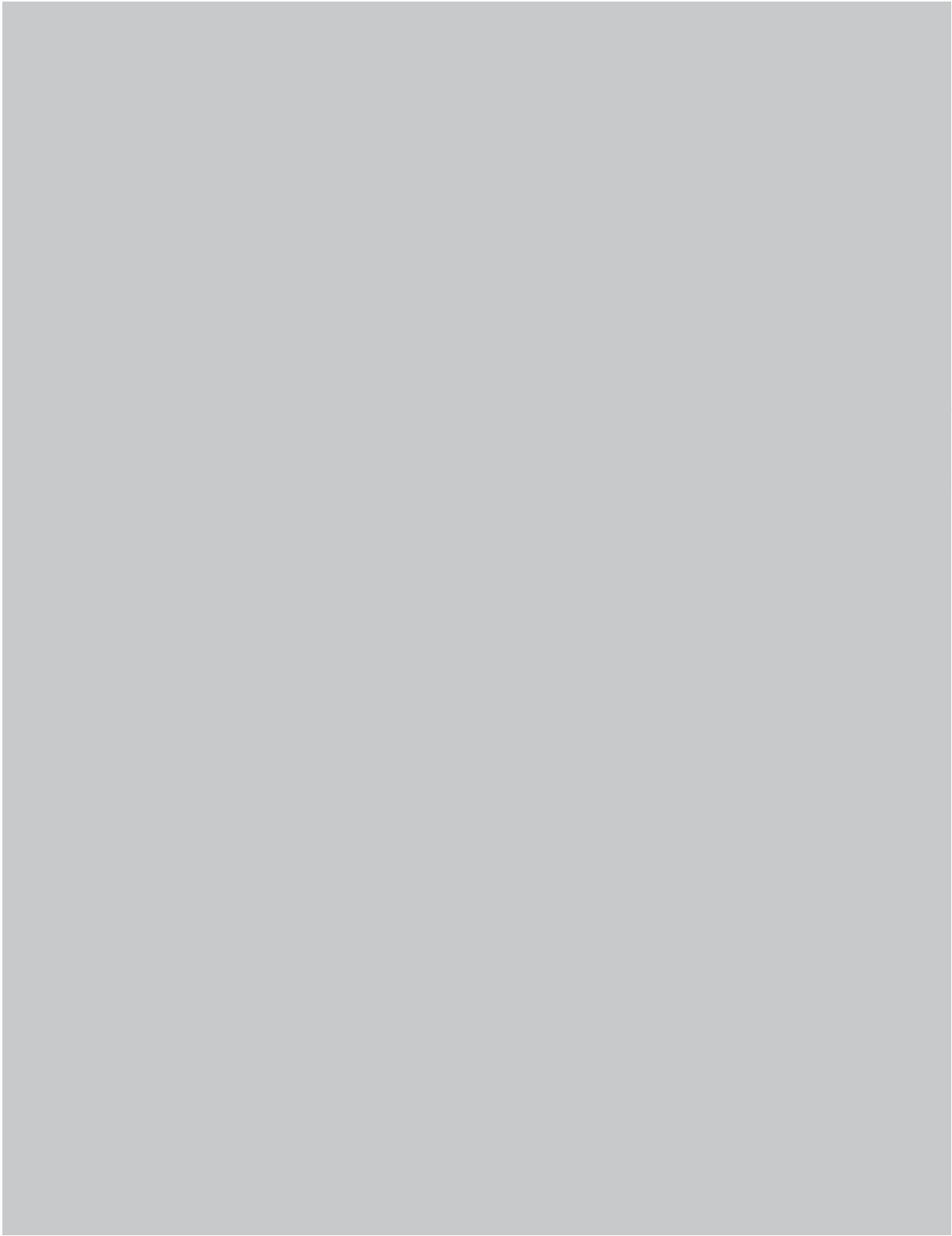
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Page 35





10
9
8
7
6
5
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