AUSTRALIAN BROADCASTING CONTROL BOARD

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ENGINEERING SERVICES DVISION

REPORT NO. 36

TITLE: UHF Television Survey in the Rushcutters Bay Area of Sydney

Issued By:

The Chairman,
Australian Broadcasting Control Board,
562-574 Bourke Street,
MELBOURNE, Vic., 3000

TECHNICAL REPORT NO. 36

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Technical Report — Forward Planning & Development

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UHF Television Survey in the Rushcutters Bay Area of Sydney

Introduction

A large number of discrete areas within metropolitan Sydney are known to have television reception problems which result in picture impairment of very minor to totally unacceptable. Picture impairment can be due to:

(a) ghosting,
(b) low signal strength, or
(c) a combination of ghosting and low signal strength.

The majority of problem areas result from Sydney's topography but there are a number of areas close to the city centre where high-rise office buildings and flats which have been buiilt in the last 10-15 years aggravate the problem. In these areas there are buildings ranging from single storey to 15 storeys alongside one another and it is in such circumstances that the greatest reception difficulties occur.

As a first approach to improving reception in all poorly served areas it was decided to investigate the means by which the problem may be overcome in one of the worst affected areas. The area selected for the initial investigation consists of parts of Rushcutters Bay, Elizabeth Bay, Kings Cross, Darlinghurst, Surrey Hills, Paddington, Edgecliff and Darling Point. These suburbs are on the souther harbour front just east of the city centre.

Features of the Survey Area

The area immediately south of Rushcutters Bay is in the form of a saucer with a ridge, forming the western boundary, running south from the Potts Point, Elizabeth Bay area through the centre of Kings Cross and Darlinghurst to Oxford Street. Oxford Street runs along the top of a ridge running approximately north-west to south-east and forms the southern boundary of the saucer. The eastern extremity is a ridge running down the centre of Darling Point, along Ocean Street, Edgecliff and around Jersey Road to Oxford Street.

The area around Weigall Sports Ground, White City Tennis Courts and Trumper Park is particularly low-lying and will be a difficult area to serve with television.

Around Elizabeth Bay and Kings Cross the majority of buildings are multistorey flats ranging up to 15 storeys or thereabouts with an occasional multistory office building. These buildings are developments of the last 10-15 years. Amongst them are many single and double storey homes.

Darlinghurst and Paddington are mainly residential areas with many of the streets lined with rows of single and double storey terrace houses. This area was once a lower income area but parts could now be classed as middle income since restoring the old terrace houses has become popular.

Problems of VHF Reception

VHF television reception is degraded by varying degrees in all of the areas previously mentioned. Even at the most ideal receiving sites there is still some low-level multiple ghosting evident where programme material contains large areas of high contrast, e.g. a white clock face on a black background.

Under normal programme conditions only an experienced observer would detect the ghosting. The foregoing comments relate only to reception of channel 2 as this was the channel used for translation to UHF during the survey and no observations were made of reception on channels 7, 9 and 10.

Although the survey area is only some 8 kilometres from the television transmitting towers at North Sydney the density of high-rise buildings in Kings Cross and Elizabeth Bay severely attenuates the signal in Rushcutters Bay and around the lower parts of Darlinghurst, Paddington and Edgecliff. In these areas reception difficulties are compounded by ghost signals reflected from surrounding high ground and high-rise buildings. Even at locations where reception is line-of-sight the problem of ghosting still exists and this point will be further discussed later in the report. The greatest problem probably exists in the low-rise buildings around Kings Cross and Elizabeth Bay which are surrounded by high-rise development and it is considered that reception in these buildings would be virtually non-existent.

Reception in many multi-storey buildings where MATV systems are installed is degraded by inferior equipment, poor installation and a lack of regular maintenance. Considerably improved performance could be achieved by attention to these matters.

Methods Available to Improve Reception

There are a number of methods available for improving the service in areas of poor television reception. These fall into three main categories i.e. VHF, UHF and Cable.

VHF systems could be VHF-VHF translators, non frequency changing translators (active deflectors) which are in effect a receiving aerial and a transmitting aerial with an amplifier in between or synchronised transmitters where the relay transmitter is accurately locked in frequency to the parent transmitter.

UHF systems could be straight UHF transmitter or VHF-UHF translators.

Cable systems would, in general, use a receiving aerial mounted in a location where reception of the local channels is satisfactory, and coaxial cables and wide-band amplifiers would be used to distribute the signals to the required points.

The investigations covered by this report were intended to evaluate the use of UHF transmissions in an area such as the Rushcutters Bay area.

Equipment Set-up for UHF Tests

Initial tests were carried out transmitting a white bar on a black background in order to assess the prevalence of ghosting in the Rushcutters Bay area. An Acrodyne T200V/U translator with a peak vision power output of 1 watt and translating from VHF channel 2 to UHF channel 43 was fed from a double sideband modulator modulated to approximately 5% carrier by a line rate square wave signal. The translator output was connected to a half-wave screen-backed dipole aerial via 30 feet of UR 67 coaxial cable. The transmitting aerial was constructed in the Board's laboratory and adjusted to have a VSWR of 1.40 near vision carrier, 1.18 at the channel centre and 1.31 near sound carrier.

The equipment was installed on the roof of "Winslow Gardens", a 14 storey block of flats, situated in Darling Point Road, Darling Point. From this location it was possible to transmit to almost all of the area around Rushcutters Bay which was experiencing VHF reception difficulties.

To assess UHF reception the Board's F100 survey vehicle was equipped with a UHF version of the Astor VRX receiver. This was fed from an 18 element UHF yagi aerial obtained from Antiference Ltd., England which was mounted on the vehicle's telescopic mast. Video outputs from the receiver were connected to a Tektronix 422 oscilloscope for waveform monitoring and a Tektronix 651 colour picture monitor for subjective picture assessement.

Results of the Tests

Measurements were made at 22 sites within the area it was intended to serve. The results of these measurements are tabulated in Table 1. At each site the aerial was raised to a height of 9 metres and a check was made of the horizontal standing wave pattern by moving the vehicle 4 to 5 metres. Similarly, the vertical standing wave pattern was checked as the aerial was lowered from its maximum height of 9 metres to the fully down position (about 2½ metres).

The sites were chosen to provide the widest range of reception conditions possible although most emphasis was placed on those sites which would have been difficult to serve under VHF conditions.

Of the 22 sites checked at only four was there any ghosting observed. These were low level, close-in ghosts and under normal programme conditions they would not be objectionable. However, at a number of the more difficult sites the picture was so noisy, due to low signal strengths, that no accurate assessment could be made as to whether ghosting was present or not. At four sites reception was subject to impulse or automobile ignition interference which was probably accentuated by the relatively low field strengths at these locations.

To gain some idea of the limit of the service area to the south, behind the ridge running along Oxford Street, three further readings were taken. These were at sites 29,30 and 32.

Polarisation discrimination was checked at site 33 which provided line-of-site reception with the foreground falling away towards the transmitter. The following results were obtained:-

1. Receiving aerial horizontally polarised -
   Aerial moved horizontally 42 - 45 dBU
   Aerial moved vertically 23 - 44 dBU

2. Receiving aerial vertically polarised -
   Aerial moved horizontally 17 - 31 dBU
   Aerial moved vertically 17 - 27 dBU

giving an apparent polarisation discrimination of approximately 15 dB.

As a further investigation the transmitting aerial was turned around so that it pointed across the harbour in the direction of Cremorne Point and Mosman so that the feasibility of providing a service to areas of Neutral Bay, Cremorne Point and Mosman could be assessed. Six sites were investigated of which two, near Mosman Bay were so severely shielded by local terrain that they received no detectable signals. The details of these measurements are included in Table 2. At site which was almost down to water level, but with line-of-sight reception, fading was observed, with rapid variations of around 3dB and one fade of 12 dB over a period of 5 minutes.

Demonstration of VHF-UHF Translator

To demonstrate reception of the translator under normal programme conditions a 6 element, channel 2 yagi aerial was mounted on the roof of the

block of flats. The aerial was connected to the translator input via a switchable attenuator which allowed the input signal to be adjusted to 2mV.

A check was made at several of the sites previously mentioned to compare the performance with programme material instead of the bar signal. As expected, ghosting was not observed with most programme material, although with caption material there was evidence of multiple, low-level ghosts.

A demonstration of the improved reception was arranged at the Florida Towers Motel, Rushcutters Bay. VHF reception at the motel is poor due to high ground and numerous high-rise buildings around Kings Cross and Elizabeth Bay attenuating the signals and causing ghosting. UHF reception was very good, with the path being line-of-sight and over flat ground.

Three receivers were set up side by side to give a direct comparison of performance. The first was the receiver provided in the motel room and connected to the MATV system of the motel. This gave a noisy picture with strong ghosts and would be representative of the picture many people in the survey area watch. The second was a Board owned receiver which was connected to a Channelmaster 3111 aerial on the motel roof via coaxial cable. This picture was less noisy but little improvement was observed in the amount of ghosting. The third receiver was also Board owned and was connected, via coaxial cable, to an Antiference 18 element UHF yagi aerial which was mounted on the motel roof and directed towards the UHF translator. The UHF translator provided reception at the motel virtually free from ghosting, that which remained being of a low level, perceptible only on caption pictures.

The demonstration was conducted for Board Members on 16th December, 1974, Engineers of the Post Office and A.B.C.B., together with Chief Engineers of the Sydney commercial television stations saw a similar demonstration on 17th December and were taken to view UHF reception at selected sites, the survey vehicle being used for this purpose.

Limitations of Tests and Demonstration

1. It became obvious fairly early in the tests that the effective radiated power from the translator was insufficient to produce noise-free pictures at locations which were difficult to serve. This in turn made it difficult to assess the degree of ghosting present at these locations.

2. The multiple, low-level ghosting observed when channel 2 was used as the translator input signal appears to be due to the performance of the VHF receiving aerial (translator input) being inadequate.

Discussion

From the point of view of reducing ghosting on television reception in the area around Rushcutters Bay it can be said that the use of UHF transmissions will considerably improve the situation due, mainly, to the superior directivity of the compact UHF receiving aerials and direct illumination of 90 percent of the area to be served.

The C.C.I.R. recommends that for television services in Band IV (UHF) the median field strength should not be lower than 65dBU. However, no indication

is given as to whether this applies to a rural or urban service.

The median field strength for the unobstructed sites listed in Table 1 is 62 dBU and for the obstructed sites 46 dBU. The median for the obstructed sites is 19 dB below the CCIR recommended level. An increase in field strength of 15 dB could be easily obtained through a 10dB increase in translator power output and a further 5dB transmitting aerial gain. As we are working in median figures it is clear there will be a considerable number of locations where the field strength will be well below the CCIR recommended figure. To obtain the recommended field strength in these locations would require E.R.P.'s which are excessive from an engineering point of view, when planning for the improvement of other areas of poor television reception in the Sydney metropolitan area is taken into account. The most acceptable approach would be to extend well designed MATV systems in high rise buildings to adjacent locations where reception is degraded. The extent of the cable systems would depend on the grade of service which is to be provided in the area.

As previously mentioned low level, multiple ghosts which are visible only on caption programme material on the UHF transmissions, when the translator is fed from the channel 2 receiving aerial, are due to limitations of the latter aerial. The aerial used was the largest domestic channel 2 aerial available and with a boom length of 10 feet was fairly cumbersome. Considerable engineering effort would seem to be necessary if the ghosting level incoming to the translator is to be reduced further.

Standing wave patterns experienced at most sites indicate that positioning of the UHF receiving aerials is fairly critical if a maximum signal level is to be achieved. Where more than one UHF channel is to be received at a particular location it may be possible to find a compromise position for the aerial which will give satisfactory reception on all channels.

Conclusion

The provision of UHF translator services in areas like Rushcutters Bay would, to a very large extent, solve the television reception problems experienced at present by those in the area if UHF tuners and receiving aerials were freely available. In cases where reception is inadequate due to shielding by tall buildings, a solution could be found by permitting the extension of MATV systems to the dwellings affected. The MATV distribution would be at VHF.

Attachments

1. Table 1. Field strength measurements - Rushcutters Bay.
2. Table 2. Field strength measurements - Cremorne Point.
3. Photographs of survey area at Rushcutters Bay.

Table 1

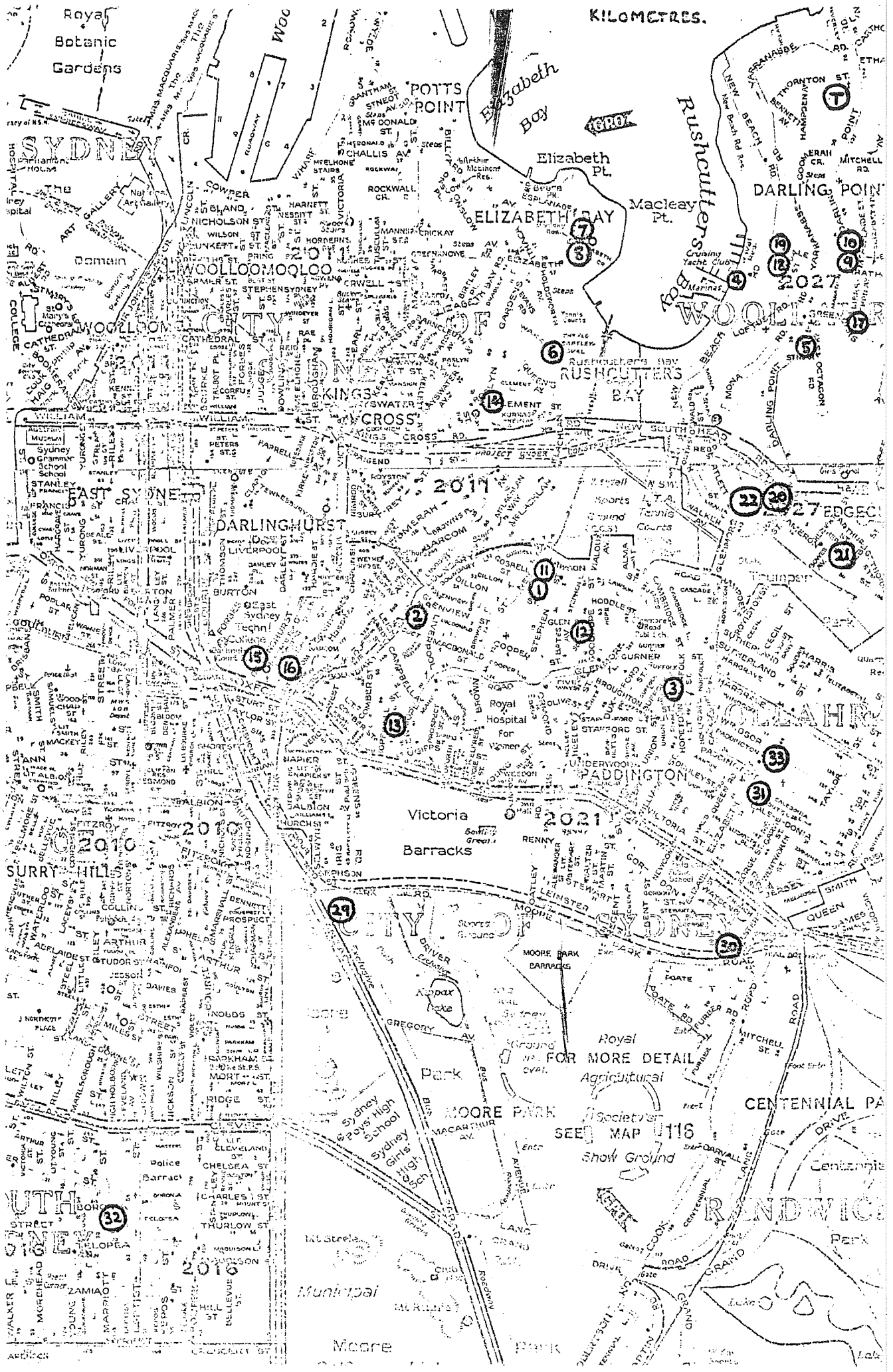
Site	Location	Description of Site	Field Strength (dBU) Horizontal Run	Vertical Run	Remarks
1	cnr. Dillon & Stephen Sts.	Line of sight. Fairly open area. Trees in foreground.	53-58	38-58	Unobstructed
2	cnr. Boundary St. & Boundary Lane.	Mainly 1 & 2 storey buildings. Grazing path around building.	17-33	17-33	Demonstration of refraction around obstacles.
3	cnr. Suffolk & Norfolk Sts.	Line of sight. Foreground open and falling away.	52-54	47-56	Slight ghosting
4	New Beach Road	Line of sight. Flat area with trees.	60-63	42-69	Slight ghosting
5	cnr St. Marks & Octagon Rds.	Behind 6 storey block of flats.	27-39	12-38	Badly obstructed
6	Reg. Bartley Oval, Waratah St.	At side of cricket ground. Path over oval then water.	58-60	53-63	Line of sight path.
7	Bay Rd.	Behind 4 storey bulding, otherwise unobstructed.	44-52	40-48	
8	Bay Rd. near site 7	Signals arriving between 4 storey buildings. High area overlooking water	50-62	46-54	Line of sight path
9	cnr. Mt. Adelaide St. & Marathon Rd.	Obstructed by 3 multi-storey buildings	36-50	12-51	Slight ghosting
10	cnr. Mt. Adelaide St. & Eastbourne Rd.	Obstructed by 2 multi-storey buildings	32-46	19-46	
11	cnr. Dillon & Stephen Sts.	Line of sight path. Foreground falling away.	52-58	37-56	
12	cnr. Glen & Goodhope Sts.	Site similar to site 11 but behind 3 storey flats	29-42	12-41	
13	Hopewell St.	High site falling away in foreground. 2 storey buildings.	53	38-53	
14	Florida Towers, Roslyn Gardens.	Low-lying, behind buildings	12-52	12-56	Badly obstructed.
15	Darlinghurst St. near Oxford St.	Behind 2 large buildings	12-30 (violent fluctuations)	12-23	Car ignition interference
16	Victoria St. near Oxford St.	Shopping Centre, 2 & 3 storey buildings	27-40	17-39	Impluse interference
17	Greenoaks Ave.	Low Area, badly obstructed	27-52	31-50	
18	Annandale St.	Behind 11 storey block of flats & 150 yards from them.	37-46	17-46	Slight ghosting

Table 1 - cont.

Site	Location	Description of te	Field Strength (dBU) Horizonta Run	Vertical Run	Remarks
19	Annandale St.	Same as site 18 but 30 yards from them	30-51	17-41	Impulse interference
20	cnr. McLean & Hart Sts.	Very low-lying area, badly obstructed	Not measured due to low signal	24-26	Reflected signal only. Very noisy picture monitor & C.R. displays.
21	cnr. Cameron & Glebe Sts.	Low-lying area, badly obstructed	21-31	12-29	Reflected signal only
22	McLean St.	Similar to site 20 but less obstructed	32-46	17-51	Can receive direct signal. Noisy picture monitor & C.R. displays.

Table 2

Site	Location	Description of Site	Field Strength (dBU) Horizontal Run	Vertical Run	Remarks
23	Milson Rd.	Flat area, mainly single storey buildings. Line of sight path	44-51	42-50	
24	Shell Cove Rd. near Gundimaine Ave.	Fairly flat area, grazing path over houses	35-45	34-46	
25	Kurraba Point	Site near water level & path completely over water	36-42	32-46	Sync. pulling on picture monitor. Rapid fading of 3d with one fade of 12 dB over 5 mins.
26	Avenue Rd.	Alongside steep rockface	No signal	No signal	No refraction of signal aro rockface
27	Mosman Wharf	Similar to site 26 although slightly more open	No signal	No signal	No refraction of signal aro rockface.
28	Wallaringa Ave.	Site near water level, grazing over buidings.	28-41	24-41	


KILOMETRES.
Royal Botanic Gardens
SYDNEY
POTTS POINT
Elizabeth Bay
Rushcutters Bay
Elizabeth Pt.
Macleay Pt.
DARLING POINT
ELIZABETH BAY
WOOLLOOMOOLOO
CITY OF SYDNEY
KINGS CROSS
RUSHCUTTERS BAY
WOOLLOOMOOLOO
EAST SYDNEY
DARLINGHURST
PADDINGTON
SURRY HILLS
Victoria Barracks
Royal Hospital for Women
Moore Park
Royal Agricultural Society Show Ground
CENTENNIAL PARK
Sydney Boys High School
Sydney Girls High School
Police Barracks
Municipal
Moore Park
FOR MORE DETAIL SEE MAP U16
2010
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2012
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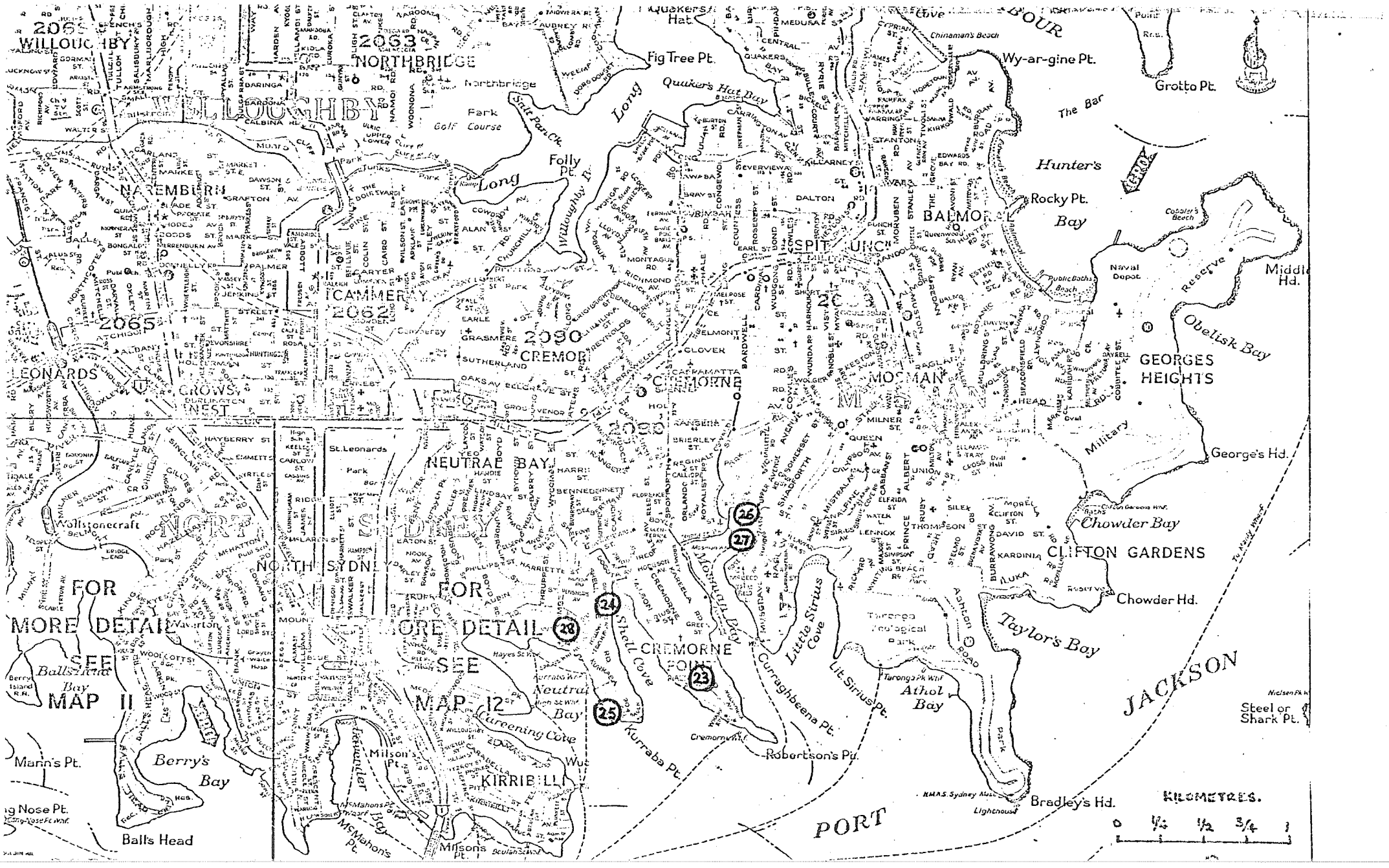
2016
2017
2021
2027


WILLOUGHBY
NORTHBRIDGE
Northbridge Park
Golf Course
Long Quakers Hat Bay
Salt Pan Ck.
Fig Tree Pt.
Wy-ar-gine Pt.
Grotto Pt.
The Bar
Hunter's Bay
Rocky Pt.
Folly Pt.
Willoughby B.
NAREMBURN
CAMMERAY
CREMORNE
CREMORNE POINT
MOSMAN
BALMORAL
SPIT JUNCTION
GEORGES HEIGHTS
Middle Hd.
Obelisk Bay
George's Hd.
Military
Naval Depot
Public Baths
Reserve
Cobaler's Beach
Chinaman's Beach
LEONARDS
CROWS NEST
NEUTRAL BAY
NORTH SYDNEY
FOR MORE DETAIL SEE MAP 11
FOR MORE DETAIL SEE MAP 12
Wollstonecraft
St. Leonards Park
Balls Head Bay
Berry's Bay
Mann's Pt.
Balls Head
Milson Pt.
McMahons Pt.
Milsons Pt.
KIRRIBILLI
Careening Cove
Neutral Bay
Shell Cove
Kurraba Pt.
Cremorne Wf.
Robertson's Pt.
Curraghbeena Pt.
Little Sirius Cove
Lit. Sirius Pt.
Athol Bay
Taronga Zoological Park
Taronga Pk Wharf
Ashton Road
Chowder Bay
CLIFTON GARDENS
Chowder Hd.
Taylor's Bay
JACKSON
Steel or Shark Pt.
Bradley's Hd.
R.M.A.S. Sydney
Lighthouse
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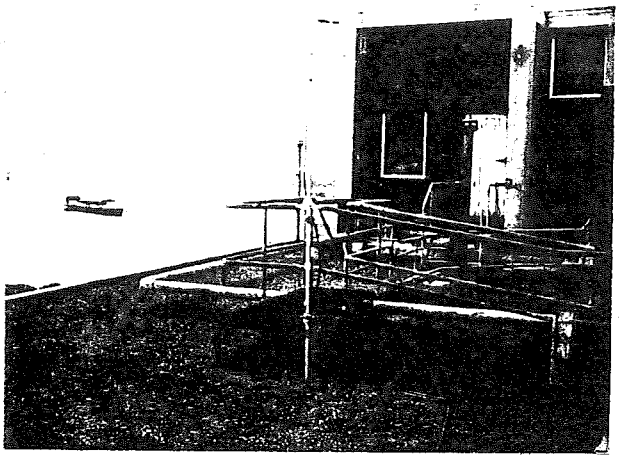
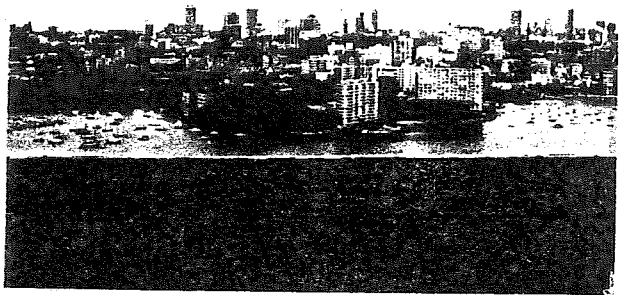
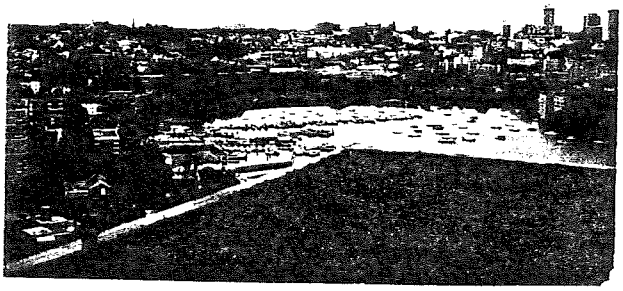


U.H.F. TRANSMITTING AERIAL.

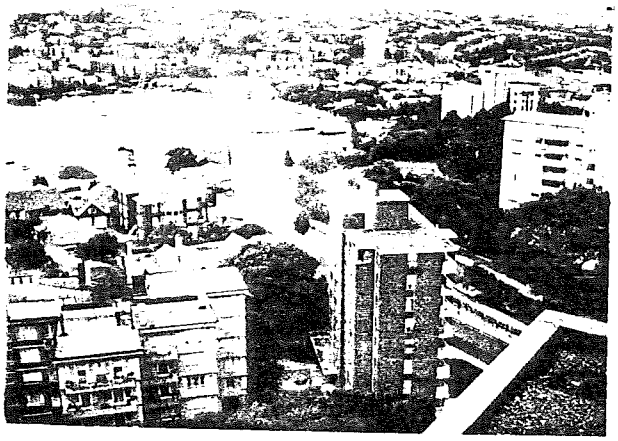


POTTS POINT, ELIZABETH BAY AND KINGS CROSS BEHIND.

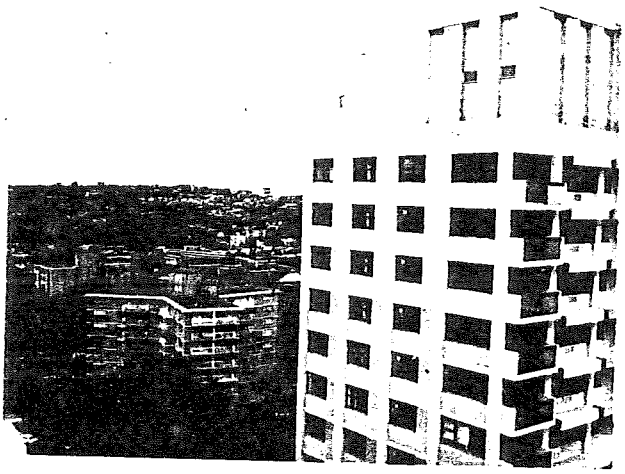
DARLING POINT WITH EDGECLIFF AND PADDINGTON BEHIND.



RUSHCUTTERS BAY AND KINGS CROSS, DARLINGHURST AND PADDINGTON BEHIND.



DARLING POINT WITH DOUBLE BAY BEHIND.



LOOKING TOWARDS PARTS OF DARLING POINT AND EDGECLIFF WITH DOUBLE BAY ON THE LEFT, REAR.