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TITLE: THE SELECTION OF A TELEVISION SITE TO SERVE THE SYDNEY AREA

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Prepared By: W. R. Baker.

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THE SELECTION OF A TELEVISION SITE TO SERVE THE SYDNEY AREA.

CONTENTS.

Selection of a Television Site to Serve the Sydney Area.

Abstract.

An examination has been made of possible television transmitting sites to serve the Sydney area. Comparisons are made of the predicted field intensities at a number of important receiving locations for various values of the operating frequency, transmitting antenna height, and radiated power. It is concluded that the best all round transmission, which can be provided with presently available equipment and under Department of Civil Aviation restrictions is a 50KW transmission (200KW radiated) operating in the 60mc band and located at Gore Hill at a height of 230 feet above ground level.

As an alternative, a 195mc, 5KW transmitter (20KW radiated) could be used at the same site with a slightly restricted coverage. A further alternative would be the provision of two transmissions, operating on different channels in the higher frequency band, one located at Eastwood (500 ft. antenna) and the other located at George' Heights (280 ft. antenna).

1. Introduction.

A television transmitting site should be chosen primarily to give adequate field intensity at all the important centres of population which it is considered desirable to serve with a single transmission. A secondary consideration is that the "ghost" image interference at these centres should not be such as to require elaborate receiving aerials for its elimination. If these two conditions can be satisfied with a transmitting site situated near the main centre of population and the studios, the choice should be satisfactory. If the site having the best "coverage" characteristics is not conveniently placed with respect to the studios, a coaxial cable or a V.H.F. radio can be used to link the studios and the transmitter.

To serve a metropolis such as Sydney the best site that could be found would be one situated at the top of the Sydney Harbour Bridge, with the aerial raised to such a height that the field intensi at outlying places such as Penrith, Windsor, Newport, Camden and Campbelltown is adequate to ensure satisfactory reception. Then it would be found that other centres of population, which it is considered necessary to serve, are in fact adequately served. This would provide the highest field intensities in the city proper, the area in which man-made noise and the shadowing effects of obstacles each has its greatest effect in reducing the received signal to noise ratio. It would also eliminate the Bridge as a reflector, which causes "ghost" images on the television screen. Unfortunately the required height for such an aerial would be outside the limits set by the Department of Civil Aviation, and in any case there would be a number of practical difficulties to be surmounted.

The ground at Gore Hill on the North Shore is 300 feet above sea level and a mast 230 feet above ground could be erected within the restrictions imposed by the Department of Civil Aviation for the protection of aircraft using Mascot airport. The Department of Civil Aviation's restrictions are very drastic for such sites located in the Sydney area, and in order to give reasonable field intensities at the above mentioned outlying places it would be desirable to use a transmitted power higher than the 20KW currently provided by 200mc transmitters and aerials. 50KW transmitters have been constructed for 60mc operating frequencies, and if economically available should be used in the present case. The transmitted power is 200KW with normal transmitting aerials.

The high ground at Roseville is 300 feet above sea level and is just over 6 miles from the centre of the city. A mast 500 feet above ground level could be erected within the Department of Civil Aviation restrictions. Such a site would give an inferior signal in the city behind large buildings to that given by Gore Hill site; but it would be adequate in the 60mc, 50KW case and barely adequate in the 200mc, 5KW case. For both the Roseville and Gore Hill sites, the 60mc 50KW transmitter would provide considerably stronger signals in areas not appreciably affected by motor-car ignition noise, a simple half-wave dipole being assumed as the receiving aerial in each case.

If it is considered that the 60mc, 50KW transmitter is not a practicable proposition and that the 195mc, 5KW transmitter gives inadequate field intensity in some localities, then an alternative proposition is to use two of the higher frequency 5KW transmitters at different transmitting localities. George's Heights and Eastwood are a pair of sites which would be satisfactory.

2. <u>Calculated Field Intensities.</u>

Field intensities have been calculated for the Gore Hill and Roseville sites, assuming the use of a 500 ft. tower at Roseville and a 230 ft. tower at Gore Hill, these being the maximum heights permissible under Department of Civil Aviation regulations. The frequency is assumed to be either 63 or 195mc and the transmitted power is assumed to be 20KW for 195mc transmissions and either 20 or 200KW for 63mc transmissions. Calculations have also been made for the Gore Hill site assuming antenna heights greater than those permitted by the Department of Civil Aviation.

Two distinct types of calculation have been made for each receiving site under consideration as explained below.

2.1 <u>Computation of Constant Distance Median Field Intensity (Method I).</u>

This is done by the methods of Norton, Schulkin and Kirby (Ref. 2), which are backed by a very large number of measurements made with actual television stations in the U.S.A. The smooth earth ground wave field intensity is first computed, taking the effective transmitting antenna height as the height above average terrain at distances from 2-10 miles from the transmitter and assuming a 30 ft. receiving antenna. An empirical reduction factor, which depends only on the frequency and the transmitter-receiver distance, is then applied. These reduction factors are plotted in graphical form in reference 2. It is evident that the resulting field intensity is independent of the nature of the terrain at the receiving point. If a large number of these computations are made at a constant distance from the transmitter in various directions in azimuth, a median value can be found for this distance. The median value is that value which is exceeded at 50% of a large number of locations. Measurements in the U.S.A. have confirmed that the constant distance median value computed in this way is the same as the median value of a large number of measurements made around an actual station at this particula distance.

In the next section (2.2) computations are made for particular localities, taking account of losses caused by hills, etc., the object being to obtain the precise field intensity at any given point. If this is repeated at a large number of points equi-distant from the transmitter, a median value of field intensity can be obtained for thi particular distance. If the computations have been accurately made, the resulting median value should agree with that obtained above by the method of Norton, Schulkin and Kirby for the same distance, and the distribution of field intensities about the median value should be long-normal with a standard deviation of approximately 8 db, i.e. 15% of the values should be 8 db higher than the median value and 15% should be 8 db lower than the median value. This is an indirect method of checking calculations against actual measurements made on television stations.

The labor involved in making a large number of calculations for each distance of interest becomes prohibitive and it is sufficient to make one of each type of calculation for each receiving locality of interest. Then the median values of each set of calculations should b substantially equal provided a large number of directions in azimuth are represented. This plan has been followed in the following tables, at the bottom of which the median values have been stated from the results of calculations which are tabulated for 25 localities. The city of Sydney has been omitted in selecting the median field intensity Table I calculations have been made by method I above.

2.2 Computation of "local" median field intensity.

It has been found experimentally in U.S.A. from measurements made on a large number of television and F.M. stations that the distribution of field intensity over a small section (1 - 2 miles) of a radial from the transmitter follows approximately a log-normal distribution with a standard deviation of between 5 and 6 db. Briefly this means that if a large number of measurements are made along the sector, 15% will have values approximately $5\frac{1}{2}$ db. greater than the median value and 15% will have values approximately $5\frac{1}{2}$ db less than the median value. If these median values are taken at a large number of directions in azimuth and equi-distant from the transmitter, then the median of all these local median values is equal to the median obtained by method I (section 2.1) for the same distance. To compute these "local" median values for important receiving localities the following method was used:-

Profiles of the ground radiating from each of the transmitting sites were drawn passing through each of the desired receiving sites, using an effective earth radius of 5280 miles to allow for the refraction caused by the earth's atmosphere in a normal state. The profile was then used to compute the field intensity at a particular locality under the various assumed conditions of frequency, power and antenna heights. A receiving antenna height of 30 ft. was assumed in all cases. The smooth earth field intensities were first computed from the charts published in the N.A.B. Handbook, and a "shadow" loss factor was then applied. The "shadow" constants were obtained from the profile diagrams and the resulting "shadow loss" was obtained from Bullington's nomagrams (ref. 1). The results have been tabulated in Table II which follows. The results for individual locations vary from those of Table I because of variation in local receiving condition: For example, the case of the centre of Sydney in Table II allows for the shielding of a receiving aerial located 30 ft. above ground behind a large building.

3. <u>Selection of a transmitting site based on field intensity calculations.</u>

A comparison of Tables I and II indicate that the median values under the various conditions are substantially equal when calculated by the two methods, that is the median values of column 3, Table I, is compared with the median values of column 3, Table II, and so on for the other columns. The median values of field intensity may be taken as an approximate guide to the relative merit of the conditions represented by the various columns of Tables I and II. First of all columns 8 and 11 (Gore Hill, 500 ft.) can be eliminated from consideration since the antenna height condition infringes the Department of Civil Aviation regulations. Columns 4 (Roseville 60mc, 20Kw, 500 ft.) and 9 (Gore Hill, 60mc, 20kw, 230 ft.) can next be eliminated for the dual reasons that the median values are considerably lower than those for the other columns and the field intensity in the City of Sydney behind large buildings is too low. Column 3 (Roseville, 195mc, 20Kw, 500 ft.) is the next to be eliminated because of the rather low field intensity in Sydney behind large buildings. This leaves only columns 5, 7 and 10 for consideration and column 10 (Gore Hill, 60mc, 200kw, 230 ft.) is preferred to column 5 (Roseville, 60mc, 200kw, 500 ft.) because of the superior signal in the City of Sydney. This leaves only columns 10 and 7 (Gore Hill, 195mc, 20kw, 230 ft.) for consideration. It is seen from Table I that the ratio of median values in these two cases is 15.5 to 7 mv/m in favour of the lower frequency and from Table II the ratio is 13.6 to 9.75. Slightly more weight should be placed on Table I since these figures have some experimental backing. In the case of the field intensity in Sydney streets behind large buildings, the ratio from Table II is 14.2 to 8 mv/m, again in favour of 60 mc.

In a companion report (ref. 3) it is shown that the field intensity of motor-car ignition interference tends to be slightly less at 60mc than at 195mc. If it is taken to be equal at the two frequencies then it is evident that a 60mc, 20kw transmitter gives signal-noise ratios which are about 6 db greater than those given by a 195mc, 5kw transmitter. In localities where ignition noise is negligible and the receiver noise is the limiting noise, the signal-noise ratio in the receiver is now about 16db greater in the 60mc case. This assumes the use of a half-wave dipole receiving aerial in each case. The F.C.C. set a figure of 0.22 mv/m as the minimum necessary to overcome set noise in the 60mc case; a glance at column 10 of Table II indicates that the field intensity at all of the 26 localities for which calculations were made exceed this minimum requirement. On the other hand, for 195mc. the minimum field intensity is given as 0.7 mv/M, and reference to column 7 of Table II indicates that the field intensity is below this minimum value for 5 of 26 localities.

From the above considerations it would appear that if economically practicable the 60mc, 50kw transmitter should be used in preference to the 195mc, 5kw transmitter.

4. Ghost Images.

It is possible that appreciable reflection may occur from the Sydney Harbour Bridge and cause "ghost" images at some receiving points in the suburbs of Sydney. Trouble can be caused by "ghost" images when the path difference of the direct and reflected signals is as low as 100 feet. This is in contrast to ± 75kc deviation F.M. transmissions, for which the smallest path difference which can cause trouble is 1 mile. To measure small path differences such as 100 feet, a pulse transmitter and receiver is usually required. The strength of the signal originating from the North Sydney F.M. transmitter and reflected by the Harbour Bridge could in some instances be simply measured.

If "ghost" images exist due to the Harbour Bridge it is unlikely that any other site will be noticeably better except the top of the Bridge itself. It seems that any "ghost" image trouble experienced in service will have to be eliminated at the receiving end by delay line types of "ghost" suppressor and/or directional aerials. It is unlikely that the "ghost" to signal ratio in the case of the Sydney Harbour Bridge will be as high as that which could be experienced in the far Eastern suburbs of Melbourne due to such reflectors as the Dandenong ranges, but its effects could be felt over areas embracing very much larger populations.

5 Other Sites Considered.

A number of other likely sites in the vicinity of Sydney were considered. The sites and the reason for discarding them are listed below -

(a) Crows Nest.

There is little to choose between this and the Gore Hill site except that an extra 50 feet in height can be gained at the latter.

(b) Waverley and Woollahra.

Areas exist at these places, which are

300 feet and more above sea-level, but the height of mast that can be erected is severely limited by the proximity of Mascot Aerodrome.

(c) Vaucluse.

A 300 feet area exists at Vaucluse. It is approximately 5 miles further than Gore Hill from the majority of the Western suburbs, without offering an appreciable advantage in the Eastern suburbs. This leaves the advantage with Gore Hill for service to such places as Penrith, Windsor, Parramatta and Riverstone.

(d) George's Heights.

This is a better choice than Vaucluse but it has similar disadvantages when compared with Gore Hill. It has slight advantages over Gore Hill in being closer to Sydney, and a mast slightly higher with respect to sea level could be erected. Service to coastal populations would also be some-what improved since there are fewer obstructions in the paths.

(e) Middle Harbour.

The various high spots adjacent to Middle Harbour were considered but they all had the disadvantages of being too far from the centre of population, too far from Sydney, and they would serve very little population in an Easterly direction.

(f) Western Suburban Sites.

Various points in the Western suburbs were considered but all suffer by being either too close to [illegible] or too far from the main centres of population, including the City of Sydney.

(g) The North Shore Line.

Roseville was the best choice of the high ground between [illegible] and [illegible] and

Roseville has been considered in the body of this report.

6. <u>Alternative proposal involving two transmitting sites.</u>

If it is considered that the 60mc, 50kw proposition is impracticable and that the 195mc, 5kw proposal does not give an adequate service in some localities, then an alternative plan would be to use two transmitters, one located at George's Heights and the other at a Westerly location such as Eastwood. The frequencies of the transmissions could be located somewhere in the 200mc band and spaced two channels apart and a power of 5kw would be adequate in each case. The George's Heights antenna would be 560 feet above sea level and the service provided to the coastal populations and to the City of Sydney would be superior to that provided by a similar transmitter at Gore Hill. The Eastwood antenna could be 800 feet or more above sea level (i.e. a 500 ft. mast) and a good service would be provided at all of the Westerly locations at which low field intensities are provided by the George's Heights transmitter A considerable percentage of the total population to be served would receive good field intensities from both transmitters.

7. <u>Conclusions.</u>

(a) The best transmission that could be provided with presently available equipment is a 50kw (200kw radiated) transmitter operating on a frequency of 60mc and located at Gore Hill with the aerial raised 230 feet above ground level, or 530 feet above sea level, and such a transmitter would provide service at all the locations considered in the environment of Sydney, sufficient to overcome receiver noise, and unsatisfactory reception at only the following places in the presence of severe motor car noise:-

Palm Beach
Newport
Narrabeen
Campbell-town
Camden
Penrith
Riverstone
Windsor

(b) A service could be provided by a 195mc, 5kw (?0kw radiated) transmitter located at the same place. The field intensity would be below the level required for that necessary to overcome receiver noise at a number of outlying places namely -

Palm Beach
Camden
Penrith
Riverstone
Windsor

and unsatisfactory at the following additional places in the presence of severe motor car noise, namely -

Newport
Narrabeen
Campbelltown

The field intensity in the city behind large buildings would provide little margin for service in the presence of severe motor car noise.

(c) A satisfactory service could be provided by two 5kW transmitters. One antenna could be located at George's Heights 280 feet above ground level and 580 feet above sea level and the other at Eastwood 500 feet above ground level and 800 feet above sea level. The field intensity at all outlying parts of the service area would be satisfactory and considerable overlap of service would occur. The operating frequencies would be at least two channels apart. This is considered a less satisfactory solution economically and in wastage of channels than the first solution of a 50kW transmitter

(d) The cases of a 500 feet mast with 5kW and 50kW transmitters at Gore Hill have been calculated having in mind the possibility of approaching the Department of Civil Aviation for relaxation of regulations if a great advantage were evident. The case for such a mast is considered insufficient to approach the Department of Civil Aviation.

REFERENCES.

1. "Radio Propagation at Frequencies above 30 megacycles" - Kenneth Bullington - Proceedings of the I.R.E., October 1947.

2. "Ground - wave Propagation over Irregular Terrain at Frequencies above 50mc" - Norton, Schulkin and Kirby National Bureau of Standards Report

3. "The effect of Motor Car Ignition Noise on Television Services" - Australian Broadcasting Control Board Technical Report No .3..

TABLE 1.

Field Intensities Computed by Method I (Ref. 2) expressed in Millivolts per Metre. Receiving Antenna Height 30 feet in all cases.

Receiving Location.	Transmitting Sites - Locality, distance to receiving site, frequency, power and height — ROSEVILLE LOCALITY: Distance to Receive Site - Miles	Field Intensity - mV/m: 195 mC/s. 20 K. watt 500' high	60 mC/s. 20 K. watt 500' high	60 mC/s. 200 K.watt 500' high
COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5
PALM BEACH	15.6	4.65	3.45	10.9
NEWPORT	12.1	9.75	7.1	22.4
NARRABEEN	8.7	9.9	7.5	23.7
DEE-WHY	7.2	26	20.5	65.5
MANLY	6.0	35	26.7	84.5
VAUCLUSE	7.6	23.9	17.5	55.3
WAVERLEY	8.6	16.3	12.1	44.6
BRONTE	9.15	18.3	13.6	43
MAROUBRA	11.6	15.2	9.75	30.8
SYDNEY	6.05	45.5	35.3	115
MATRAVILLE	12.4	12.8	9.25	29.3
CRONULLA	18.3	5.7	4.2	13.5
MIRANDA	17.6	7.2	4.6	14.6
SUTHERLAND	18.0	6.5	4.22	13.4
PUNCHBOWL	11.7	15	11	34.8
BANKSTOWN	12.1	13.6	9.55	30.2
CAMPBELLTOWN	28.2	2.6	1.55	4.9
CAMDEN	33.2	1.9	1.1	3.32
LIVERPOOL	17.0	[illegible]	4.8	15.2
FAIRFIELD	14.1	[illegible]	7.1	22.5
MERRYLANDS	11.2	15	11	34.8
WENTWORTHVILLE	11.75	[illegible]	[illegible]	28.2
PENRITH	27.6	[illegible]	[illegible]	3.8
RIVERSTONE	19.7	[illegible]	2.35	7.43
WINDSOR	24.2	[illegible]	[illegible]	4.04
HORNSBY	7.5	39.[illegible]	[illegible]	48.1
MEDIAN		11.7	7.5	23.7

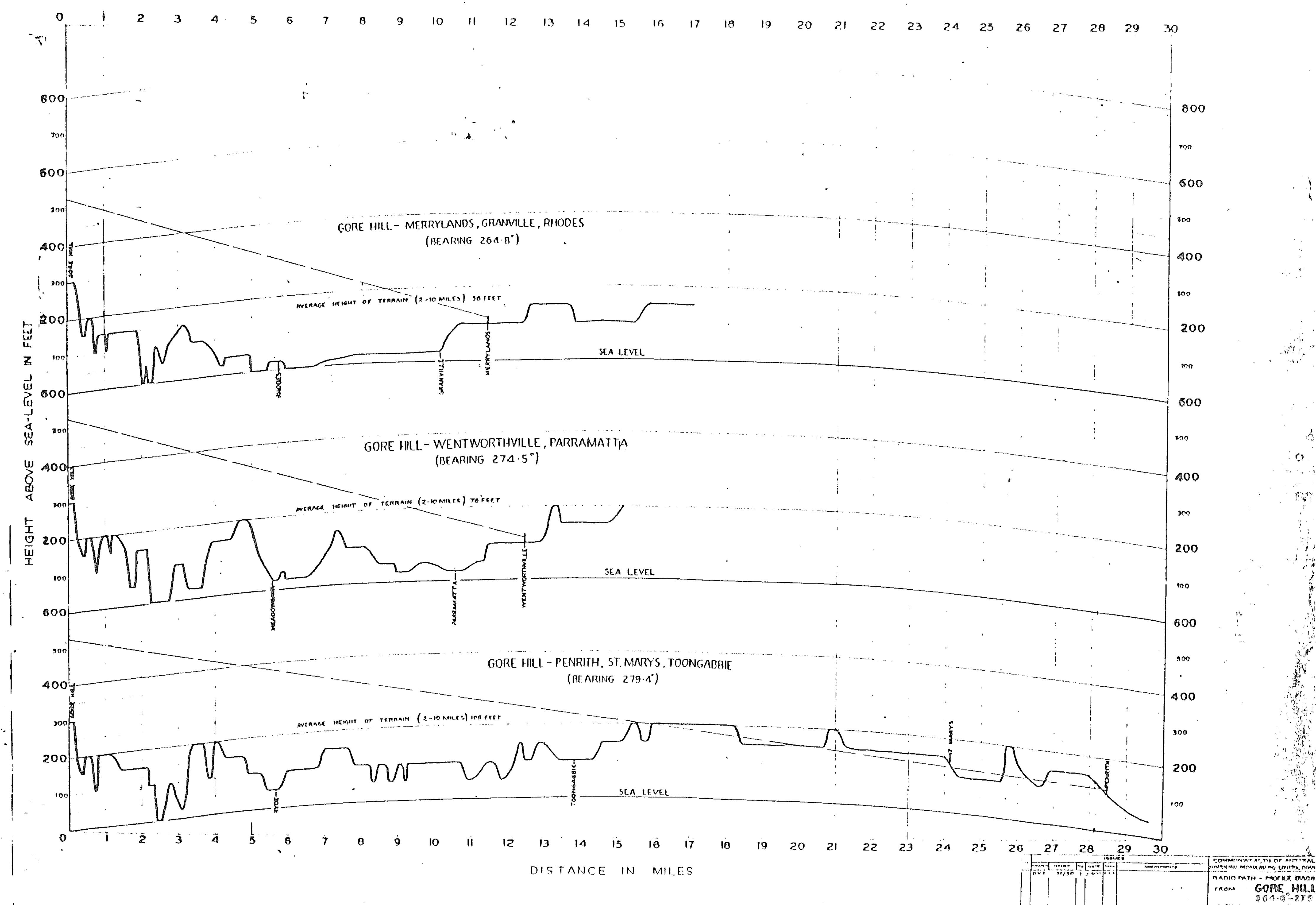
TABLE 2 (cont.)

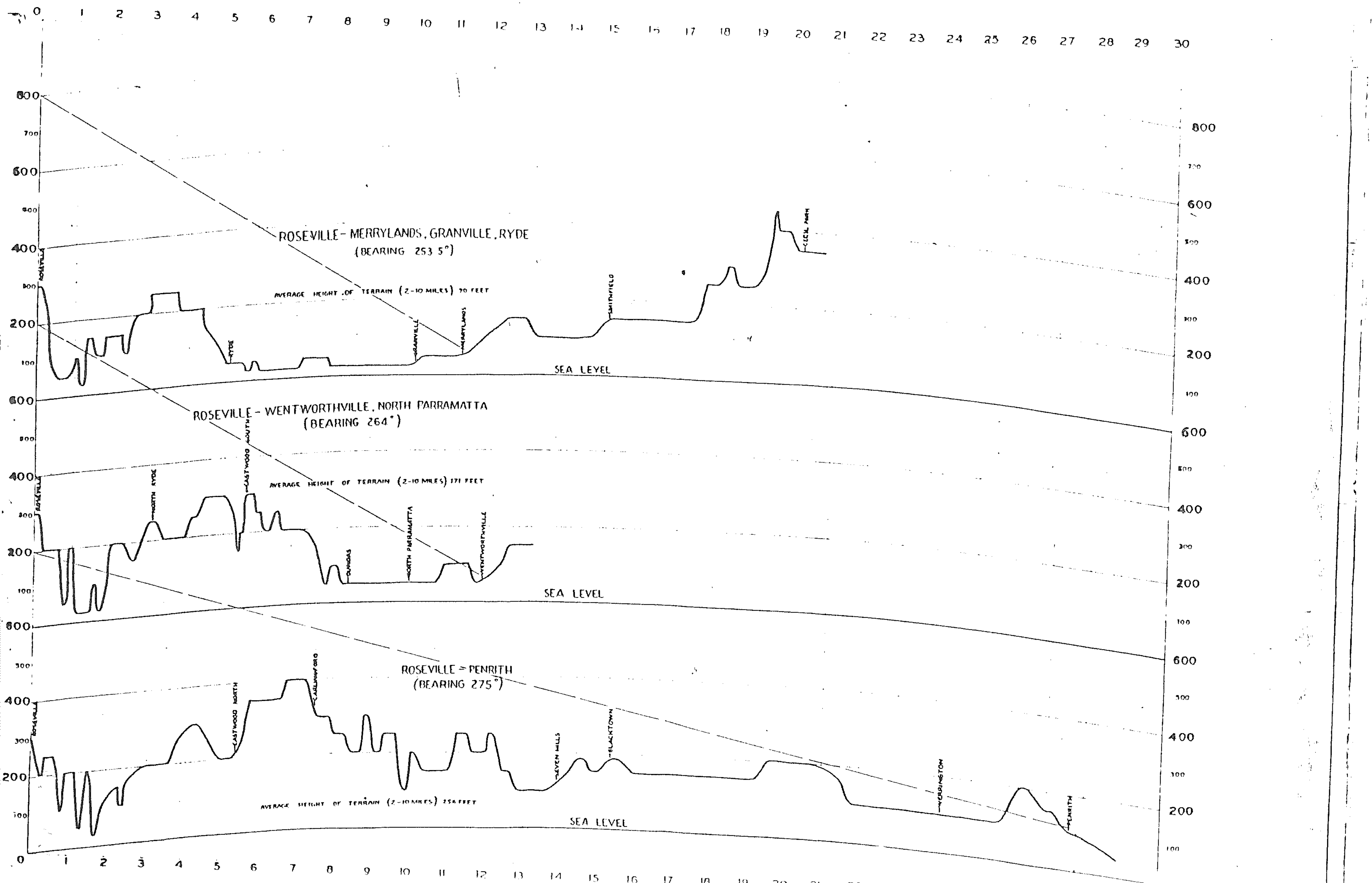
Receiving Location.	Transmitting Sites - Locality, distance to receiving site. Frequency, power and height. GORE HILL LOCALITY. Distance to Receive Site-Miles	Field Intensity - MV/m 195mc/s 20K.watt 250' high	195mc/s 20K.watt 500' high	60mc/s 20K.watt 250' high	60mc/s 200K.watt 250' high	60mc/s 200K.w 500' hi
	COLUMN 6	COLUMN 7	COLUMN 8	COLUMN 9	COLUMN 10	COLUMN 11
PALM BEACH	17.2	3.4	5.5	1.5	4.74	9.73
NEWPORT	13.7	5.3	7.5	2.7	8.5	16.8
NARRABEEN	9.95	5.6	12.2	4.55	15.8	29.9
DEE-WHY	7.65	13.2	25.9	9.05	28.5	56.2
MANLY	5.9	19.4	37.5	13.0	47.4	93.2
VAUCLUSE	5.75	20.9	[illegible]	15.9	57.4	105
WAVERLEY	6.7	20.4	[illegible]	19.0	50.0	97.7
BRONTE	7.4	15.6	[illegible]	12.2	36.5	70.2
MAROUBRA	9.3	12.8	21.5	8.6	27.3	46.3
SYDNEY	3.75	53	106	37.2	182	347
MATRAVILLE	10.1	11.2	12.8	8.5	27.8	44.2
CRONULLA	16.5	4.9	7.55	3.43	10.9	16.7
MIRANDA	15.5	5.3	[illegible]	3.07	11.5	18.3
SUTHERLAND	16.0	5.0	7.[illegible]	3.2	10.1	15.9
PUNCHBOWL	10.4	11	17.5	5.0	25.3	40.2
BANKSTOWN	11.0	10.2	16.0	7.4	25.6	37.6
CAMPBELLTOWN	27.2	1.55	2.45	1.04	3.22	5.05
CAMDEN	32.5	1.03	1.35	0.37	2.12	3.32
LIVERPOOL	15.7	[illegible]	7.5	3.[illegible]	9.5	15.4
FAIRFIELD	13.9	7.2	10.[illegible]	4.9	15.5	25.1
MERRYLANDS	11.4	10.6	15.5	7.25	22.3	35.5
WENTWORTHVILLE	12.4	[illegible]	[illegible]	[illegible]	[illegible]	29.4
PENRITH	23.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RIVERSTONE	24.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WINDSOR	25.9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
HORNSBY	9.7	[illegible]	[illegible]	4.9	[illegible]	[illegible]
MEDIAN		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE II

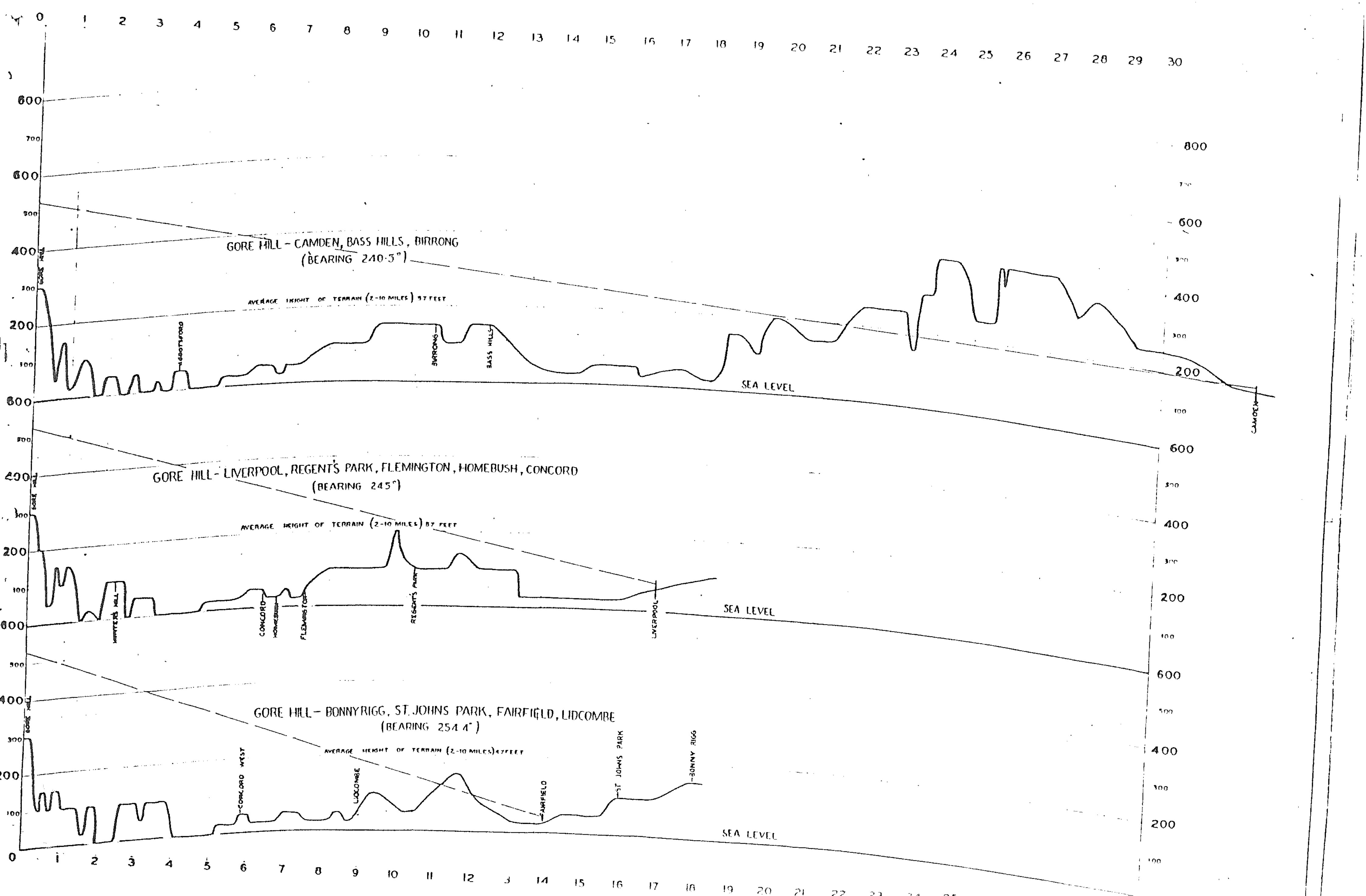
Median Field Intensities at [illegible] Important Localities expressed in millivolts per metre. [illegible]

Receiving Location	Transmitting site: [illegible] distance to receiving site, frequency, power and heights [illegible]			
	Distance to Receive Site-Miles	Field Intensity [illegible]		
		[illegible]mc/s 20K.watt [illegible] high	[illegible]mc/s 20K.watt [illegible] high	[illegible]mc/s [illegible]K.watt 500' high
COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5
PALM BEACH	15.6	0.47	0.225	0.93
NEWPORT	12.1	3.4	2.05	6.5
NARRABEEN	8.7	[illegible]	[illegible]	[illegible]
DEE-WHY	7.2	[illegible]	[illegible]	[illegible]
MANLY	6.0	10.5	[illegible]	[illegible]
VAUCLUSE	7.6	51.0	[illegible]	[illegible]
WAVERLEY	8.6	[illegible]	[illegible]	27.0
BRONTE	9.15	12.2	7.0	22.1
MAROUBRA	11.6	7.0	[illegible]	5.0
SYDNEY	5.05	[illegible]	7.75	[illegible]
MATRAVILLE	12.4	[illegible]	[illegible]	17.7
CRONULLA	19.3	15.3	[illegible]	15.5
MIRANDA	17.6	16.6	[illegible]	[illegible]
SUTHERLAND	16.0	15.3	[illegible]	[illegible]
PUNCHBOWL	11.7	42.0	[illegible]	[illegible]
BANKSTOWN	12.1	10.0	[illegible]	[illegible]
[illegible]TOWN	28.2	1.27	[illegible]	[illegible]
CAMDEN	33.1	0.305	[illegible]	[illegible]
LIVERPOOL	17.3	12.5	[illegible]	[illegible]
FAIRFIELD	14.1	12.8	[illegible]	[illegible]
MERRYLANDS	11.2	22.3	[illegible]	[illegible]
WENTWORTHVILLE	11.75	12.6	[illegible]	[illegible]
PENRITH	27.6	0.445	0.315	[illegible]
RIVERSTONE	19.7	[illegible]	[illegible]	[illegible]
WINDSOR	21.2	0.37	[illegible]	[illegible]
HORNSBY	7.5	25.6	[illegible]	[illegible]
MEDIAN of MEDIANS		[illegible]	[illegible]	[illegible]

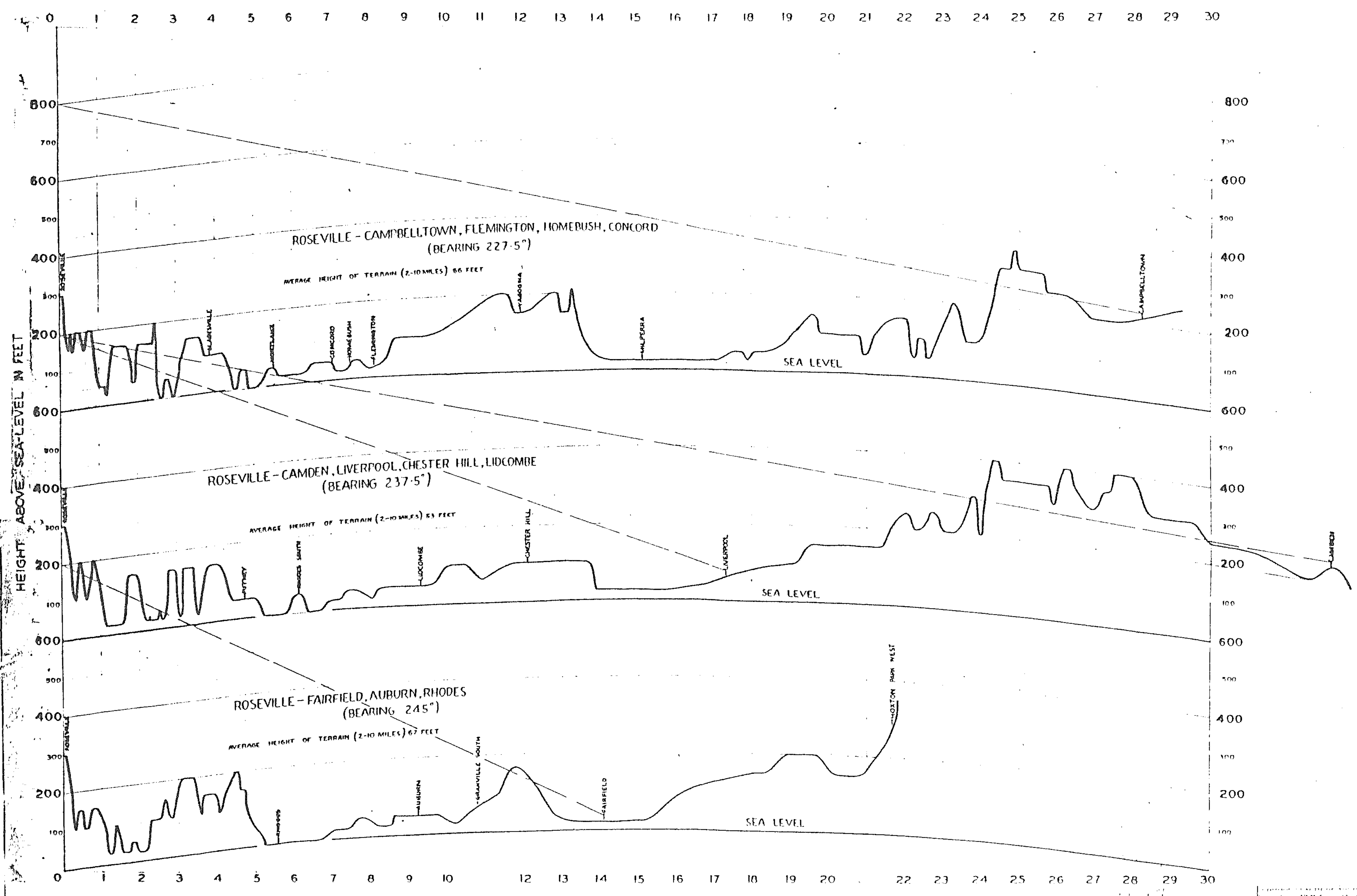

HEIGHT ABOVE SEA-LEVEL IN FEET
DISTANCE IN MILES
GORE HILL - MERRYLANDS, GRANVILLE, RHODES
(BEARING 264·8°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 50 FEET
RHODES
GRANVILLE
MERRYLANDS
SEA LEVEL
GORE HILL - WENTWORTHVILLE, PARRAMATTA
(BEARING 274·5°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 76 FEET
MEADOWBANK
PARRAMATTA
WENTWORTHVILLE
SEA LEVEL
GORE HILL - PENRITH, ST. MARYS, TOONGABBIE
(BEARING 279·4°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 108 FEET
RYDE
TOONGABBIE
ST MARYS
PENRITH
SEA LEVEL
COMMONWEALTH OF AUSTRAL
RADIO PATH - PROFILE DIAGR
FROM GORE HILL



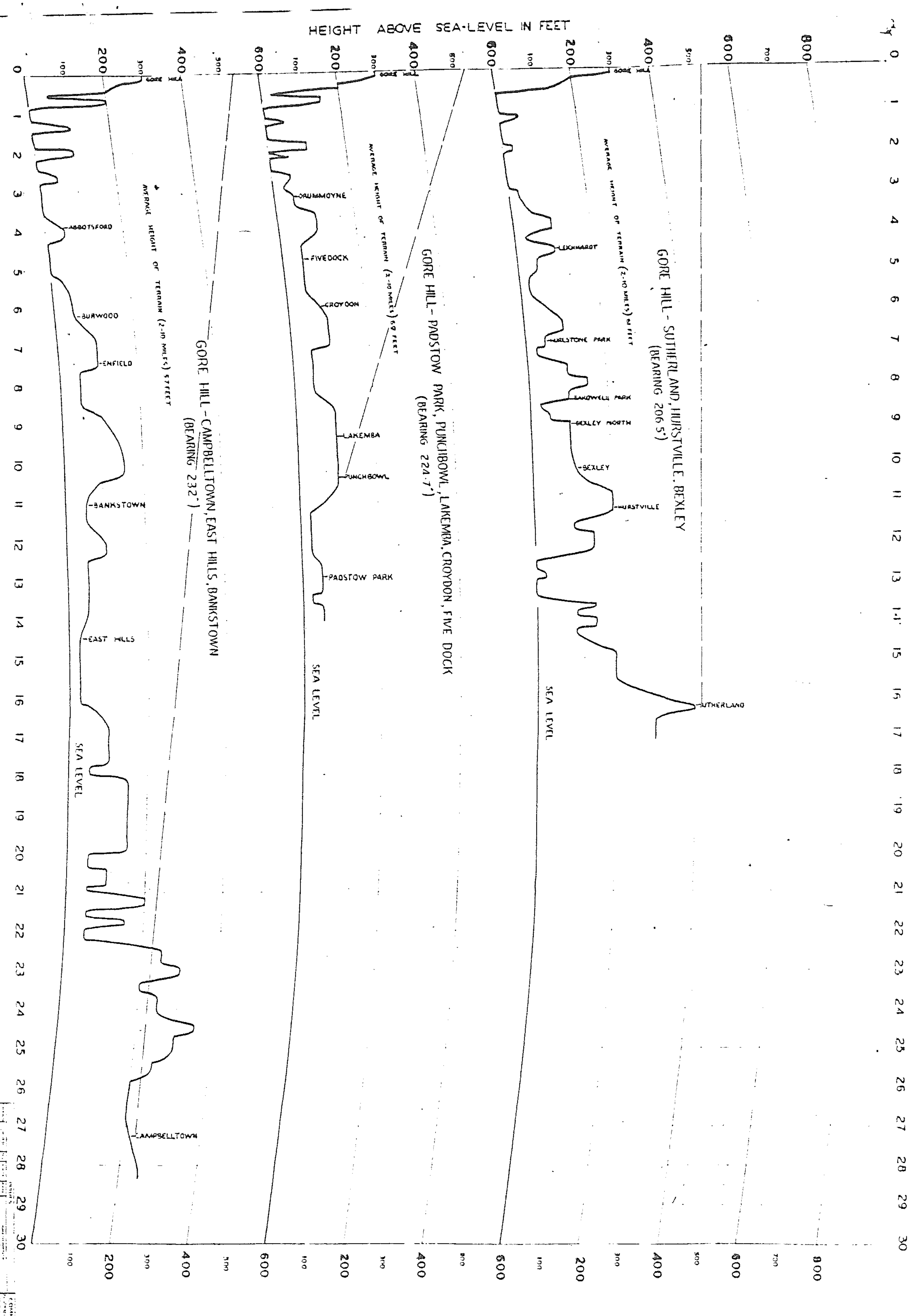
ROSEVILLE - MERRYLANDS, GRANVILLE, RYDE
(BEARING 253.5°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 70 FEET
ROSEVILLE
RYDE
GRANVILLE
MERRYLANDS
SMITHFIELD
CECIL PARK
SEA LEVEL
ROSEVILLE - WENTWORTHVILLE, NORTH PARRAMATTA
(BEARING 264°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 171 FEET
ROSEVILLE
NORTH RYDE
EASTWOOD SOUTH
DUNDAS
NORTH PARRAMATTA
WENTWORTHVILLE
SEA LEVEL
ROSEVILLE = PENRITH
(BEARING 275°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 256 FEET
ROSEVILLE
EASTWOOD NORTH
CARLINGFORD
SEVEN HILLS
BLACKTOWN
WERRINGTON
PENRITH
SEA LEVEL

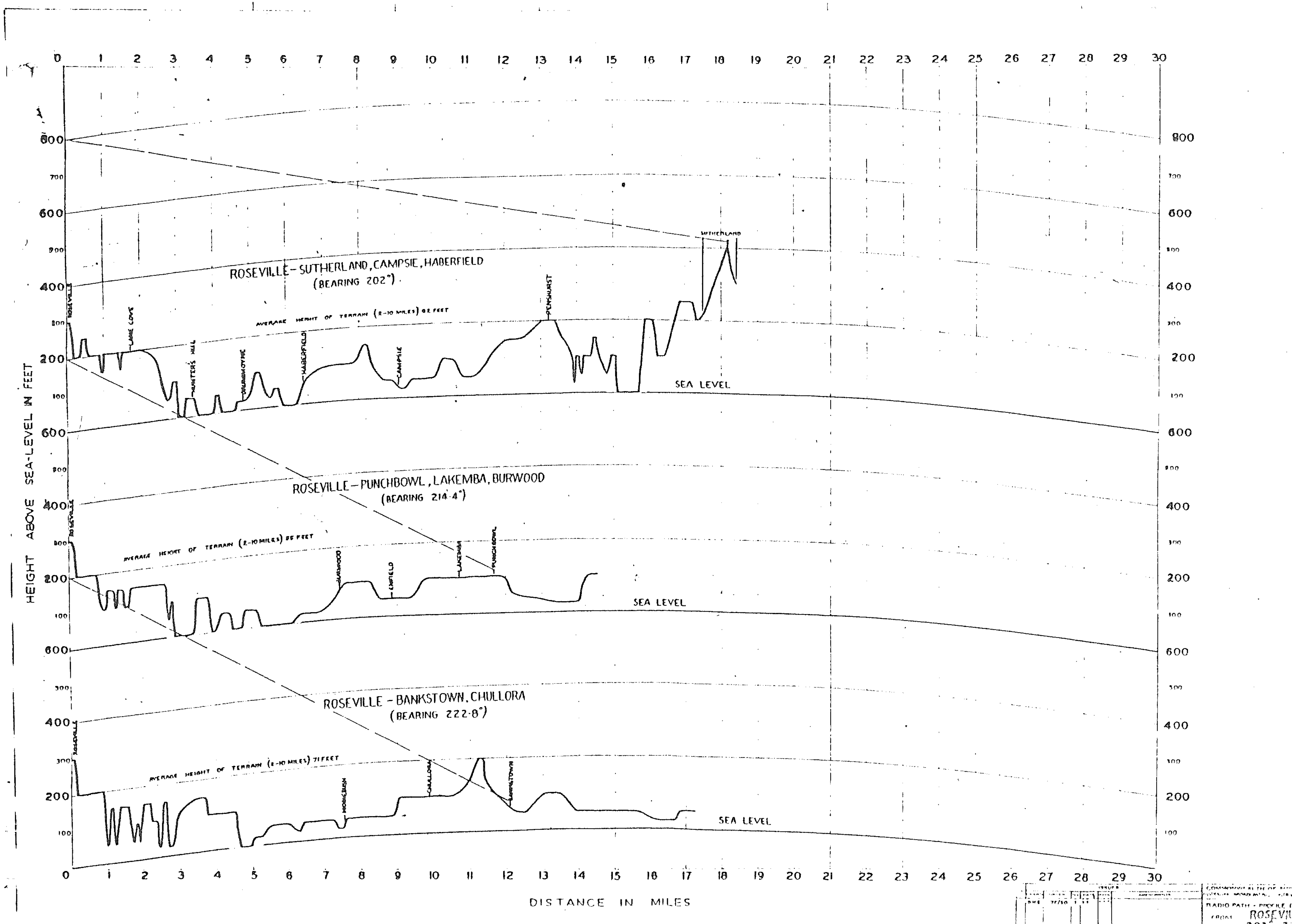


GORE HILL - CAMDEN, BASS HILLS, BIRRONG
(BEARING 240·5°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 87 FEET
ABBOTSFORD
BIRRONG
BASS HILLS
CAMDEN
SEA LEVEL
GORE HILL - LIVERPOOL, REGENT'S PARK, FLEMINGTON, HOMEBUSH, CONCORD
(BEARING 245°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 87 FEET
CONCORD
HOMEBUSH
FLEMINGTON
REGENT'S PARK
LIVERPOOL
SEA LEVEL
GORE HILL - BONNYRIGG, ST. JOHNS PARK, FAIRFIELD, LIDCOMBE
(BEARING 254.4°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 47 FEET
CONCORD WEST
LIDCOMBE
FAIRFIELD
ST JOHNS PARK
BONNY RIGG
SEA LEVEL

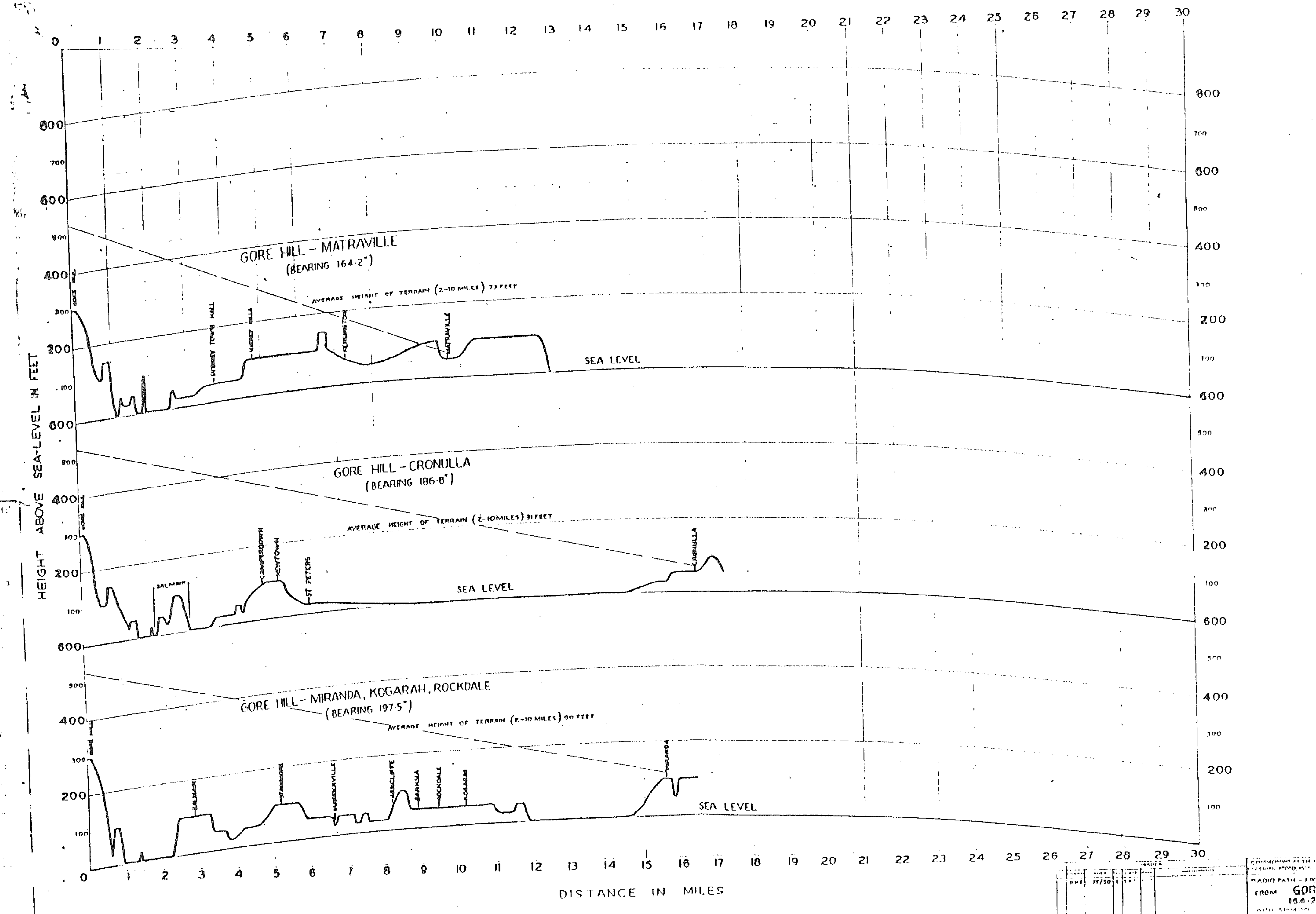


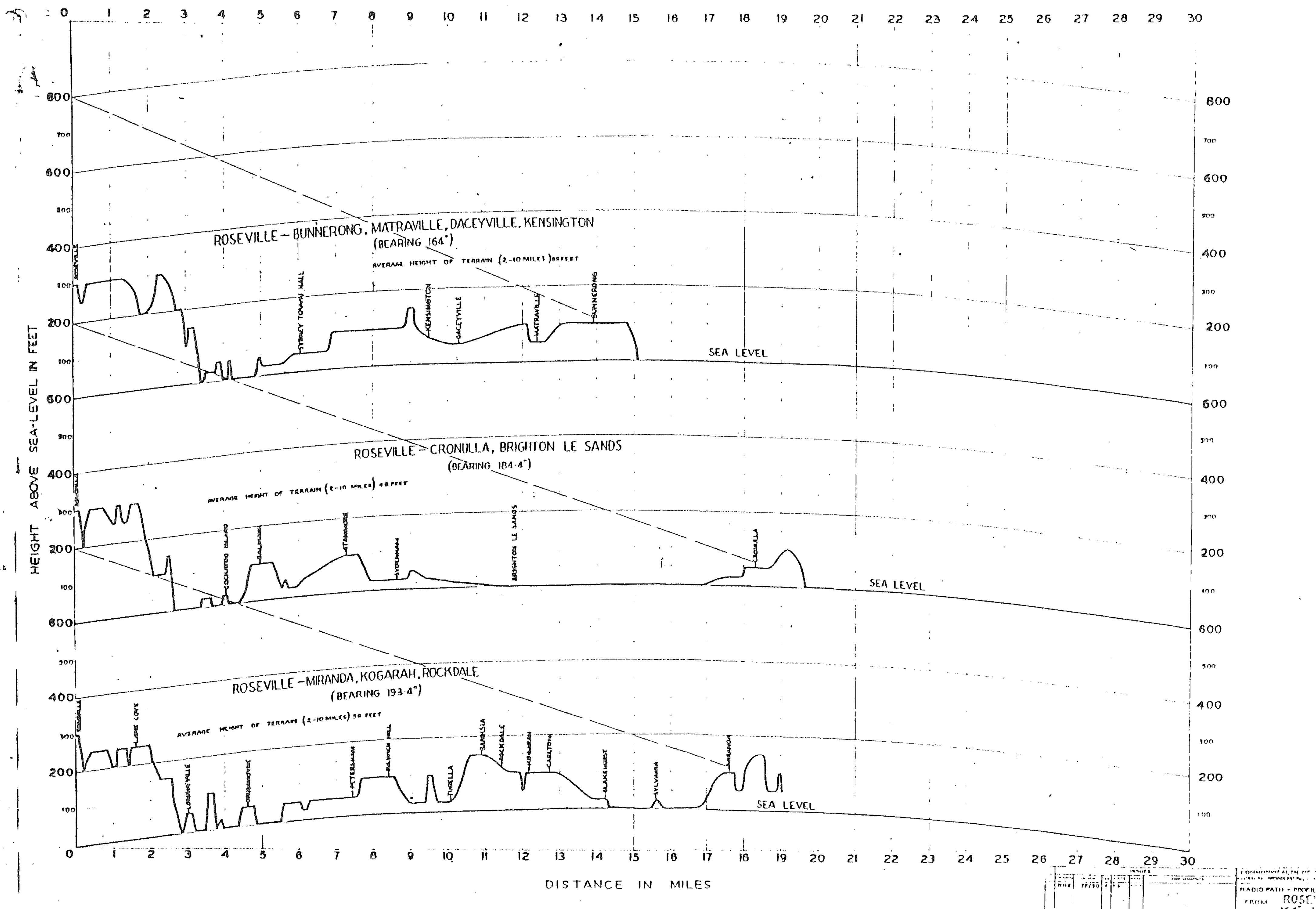
HEIGHT ABOVE SEA-LEVEL IN FEET
ROSEVILLE - CAMPBELLTOWN, FLEMINGTON, HOMEBUSH, CONCORD
(BEARING 227·5°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 66 FEET
ROSEVILLE
GLADESVILLE
MORTLAKE
CONCORD
HOMEBUSH
FLEMINGTON
YAGOONA
MILPERRA
CAMPBELLTOWN
SEA LEVEL
ROSEVILLE - CAMDEN, LIVERPOOL, CHESTER HILL, LIDCOMBE
(BEARING 237·5°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 63 FEET
ROSEVILLE
PUTNEY
RHODES SOUTH
LIDCOMBE
CHESTER HILL
LIVERPOOL
CAMDEN
SEA LEVEL
ROSEVILLE - FAIRFIELD, AUBURN, RHODES
(BEARING 245°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 67 FEET
ROSEVILLE
RHODES
AUBURN
GRANVILLE SOUTH
FAIRFIELD
HOXTON PARK WEST
SEA LEVEL

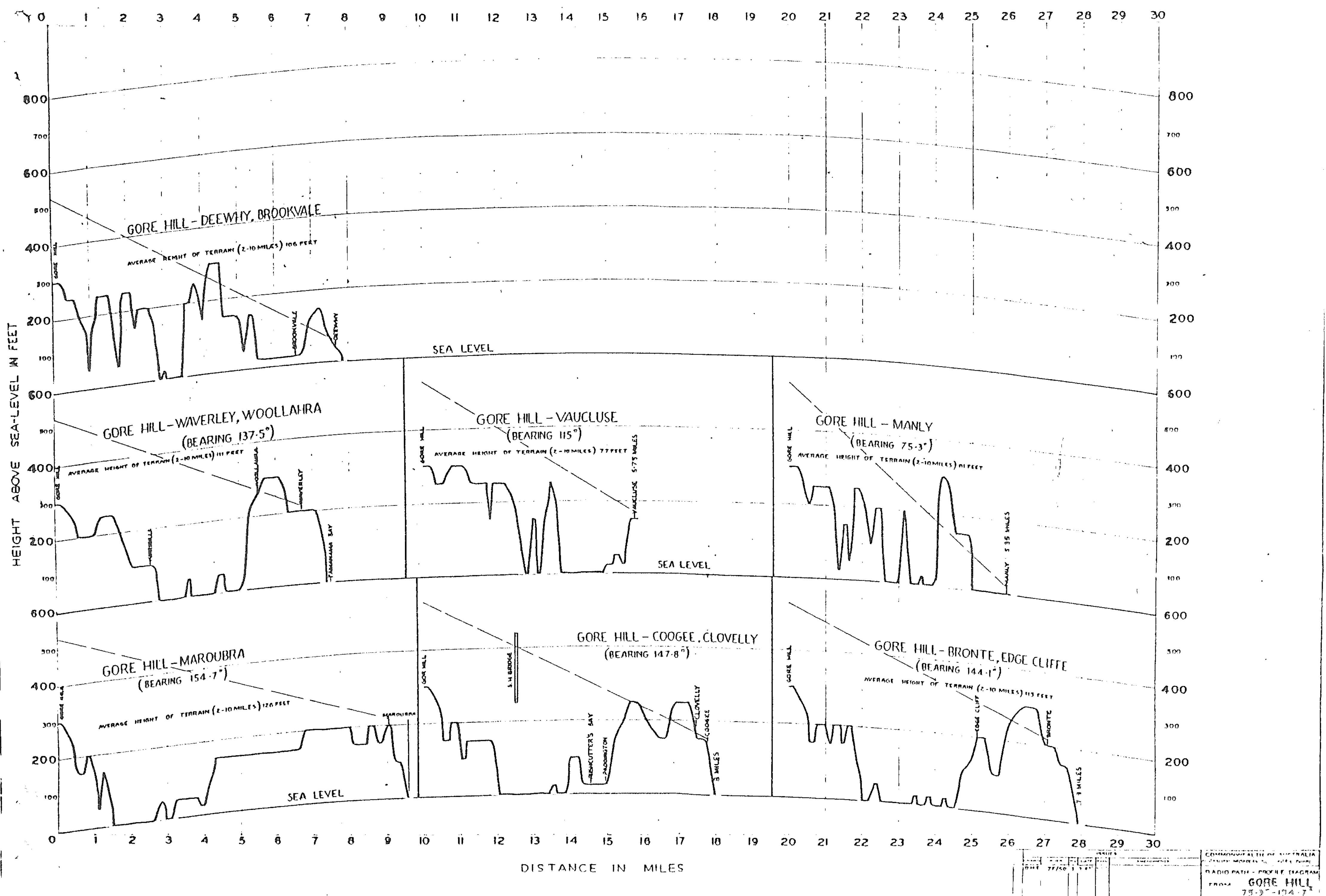

HEIGHT ABOVE SEA-LEVEL IN FEET
GORE HILL - SUTHERLAND, HURSTVILLE, BEXLEY
(BEARING 206.5°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES)
GORE HILL
LEICHHARDT
HURLSTONE PARK
BARDWELL PARK
BEXLEY NORTH
BEXLEY
HURSTVILLE
SUTHERLAND
SEA LEVEL
GORE HILL - PADSTOW PARK, PUNCHBOWL, LAKEMBA, CROYDON, FIVE DOCK
(BEARING 224.7°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 69 FEET
GORE HILL
DRUMMOYNE
FIVEDOCK
CROYDON
LAKEMBA
PUNCHBOWL
PADSTOW PARK
SEA LEVEL
GORE HILL - CAMPBELLTOWN, EAST HILLS, BANKSTOWN
(BEARING 232°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 57 FEET
GORE HILL
ABBOTSFORD
BURWOOD
ENFIELD
BANKSTOWN
EAST HILLS
CAMPBELLTOWN
SEA LEVEL

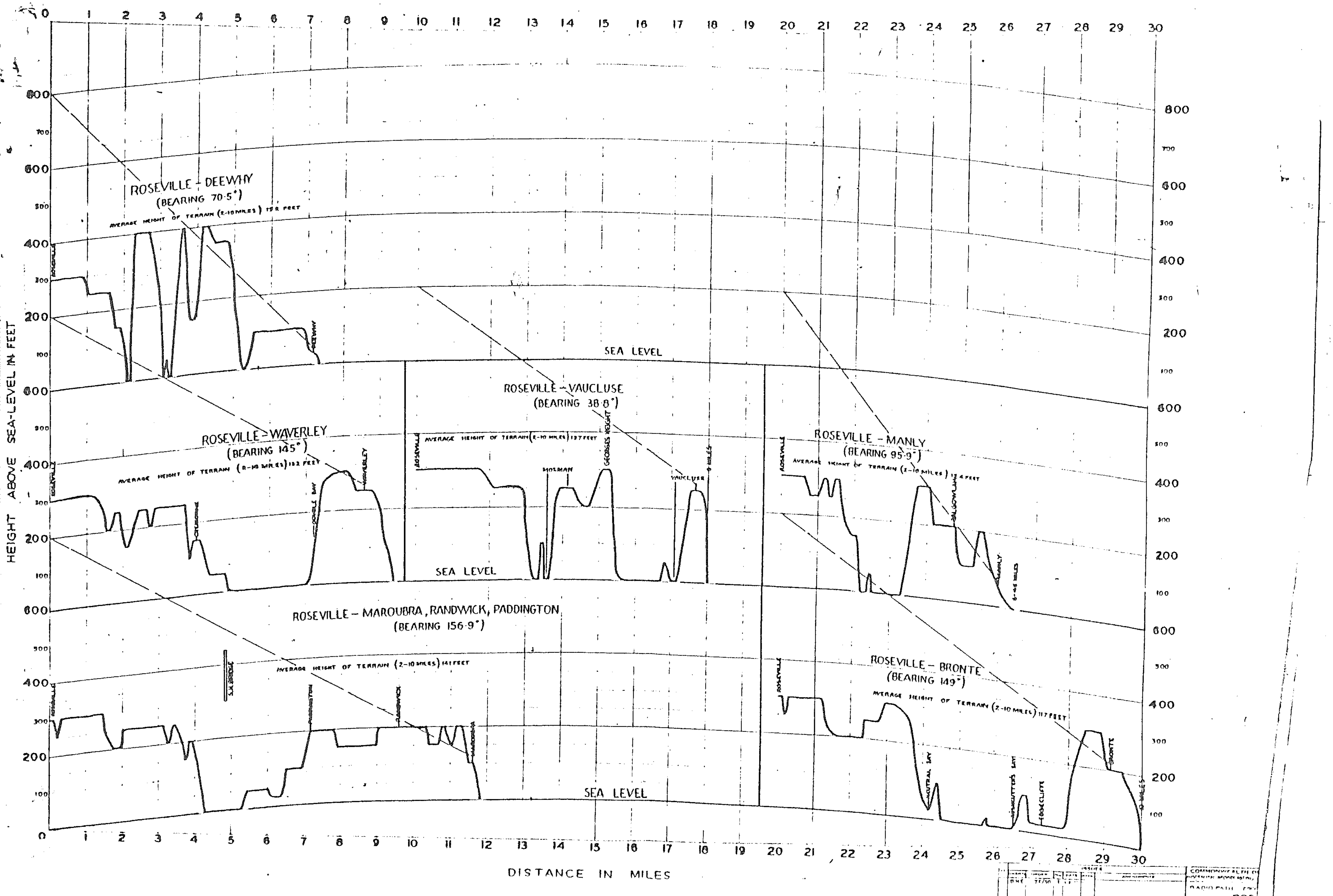


HEIGHT ABOVE SEA-LEVEL IN FEET
DISTANCE IN MILES
ROSEVILLE-SUTHERLAND, CAMPSIE, HABERFIELD
(BEARING 202°)
ROSEVILLE-PUNCHBOWL, LAKEMBA, BURWOOD
(BEARING 214·4°)
ROSEVILLE - BANKSTOWN, CHULLORA
(BEARING 222·8°)
SEA LEVEL
ROSEVILLE
LANE COVE
HUNTERS HILL
HABERFIELD
CAMPSIE
PENSHURST
SUTHERLAND
BURWOOD
ENFIELD
LAKEMBA
PUNCHBOWL
HOMEBUSH
CHULLORA
BANKSTOWN
RADIO PATH - PROFILE
ROSEVIL

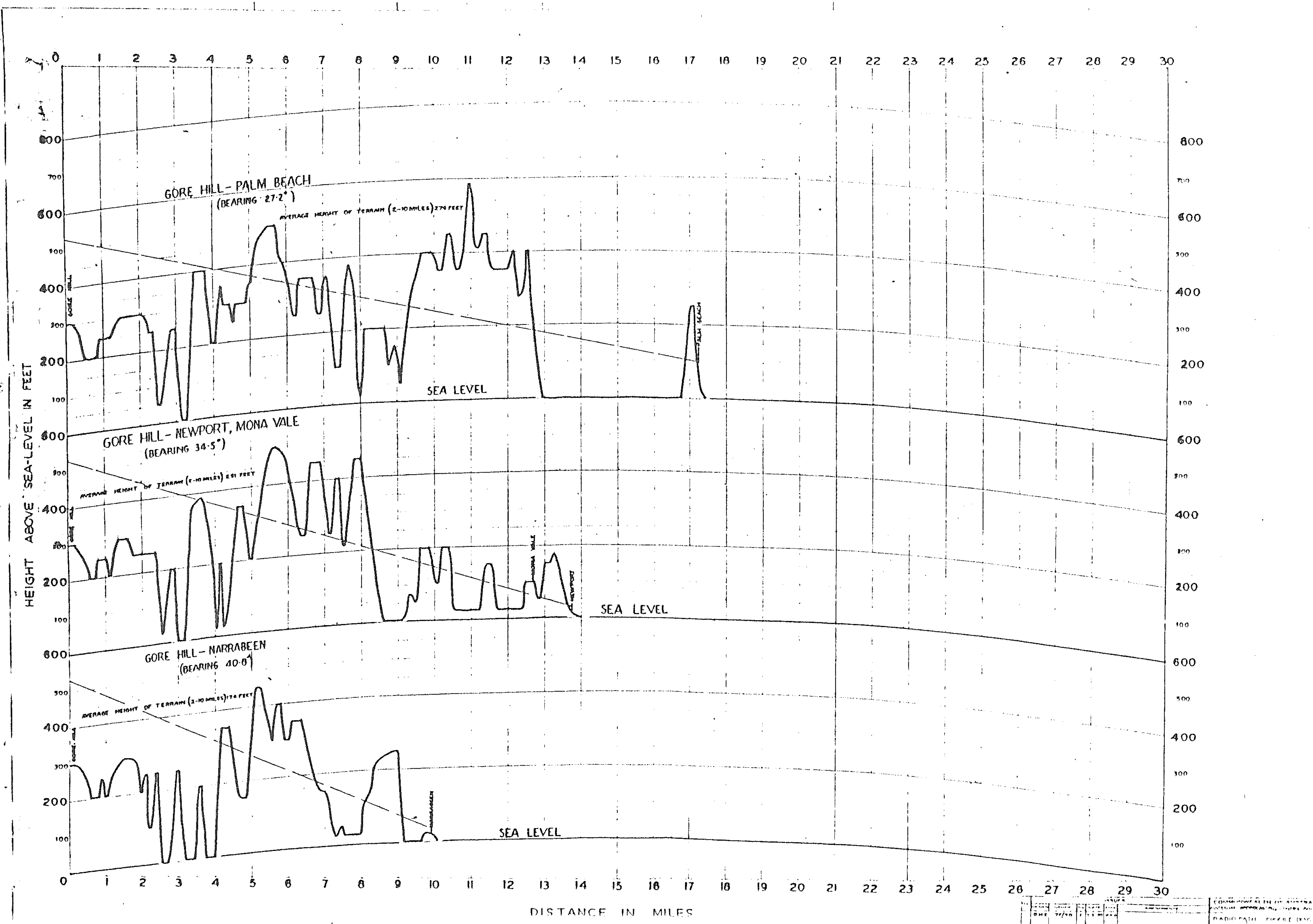

HEIGHT ABOVE SEA-LEVEL IN FEET
DISTANCE IN MILES
GORE HILL - MATRAVILLE
(BEARING 164·2°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 73 FEET
SYDNEY TOWN HALL
KENSINGTON
MATRAVILLE
GORE HILL - CRONULLA
(BEARING 186·8°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 31 FEET
BALMAIN
CAMPERDOWN
NEWTOWN
ST PETERS
CRONULLA
GORE HILL - MIRANDA, KOGARAH, ROCKDALE
(BEARING 197·5°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 60 FEET
BALMAIN
STANMORE
MARRICKVILLE
ARNCLIFFE
BANKSIA
ROCKDALE
KOGARAH
MIRANDA
SEA LEVEL
SEA LEVEL
SEA LEVEL
GORE HILL


ROSEVILLE – BUNNERONG, MATRAVILLE, DACEYVILLE, KENSINGTON
(BEARING 164°)
AVERAGE HEIGHT OF TERRAIN (2–10 MILES)
SYDNEY TOWN HALL
KENSINGTON
DACEYVILLE
MATRAVILLE
BUNNERONG
SEA LEVEL
ROSEVILLE – CRONULLA, BRIGHTON LE SANDS
(BEARING 184·4°)
AVERAGE HEIGHT OF TERRAIN (2–10 MILES) 40 FEET
COCKATOO ISLAND
BALMAIN
STANMORE
SYDENHAM
BRIGHTON LE SANDS
CRONULLA
SEA LEVEL
ROSEVILLE – MIRANDA, KOGARAH, ROCKDALE
(BEARING 193·4°)
AVERAGE HEIGHT OF TERRAIN (2–10 MILES) 50 FEET
LANE COVE
LONGUEVILLE
DRUMMOYNE
PETERSHAM
DULWICH HILL
TURELLA
BANKSIA
ROCKDALE
KOGARAH
CARLTON
BLAKEHURST
SYLVANIA
MIRANDA
SEA LEVEL
HEIGHT ABOVE SEA-LEVEL IN FEET
DISTANCE IN MILES
RADIO PATH – PROFILE
FROM ROSEVILLE

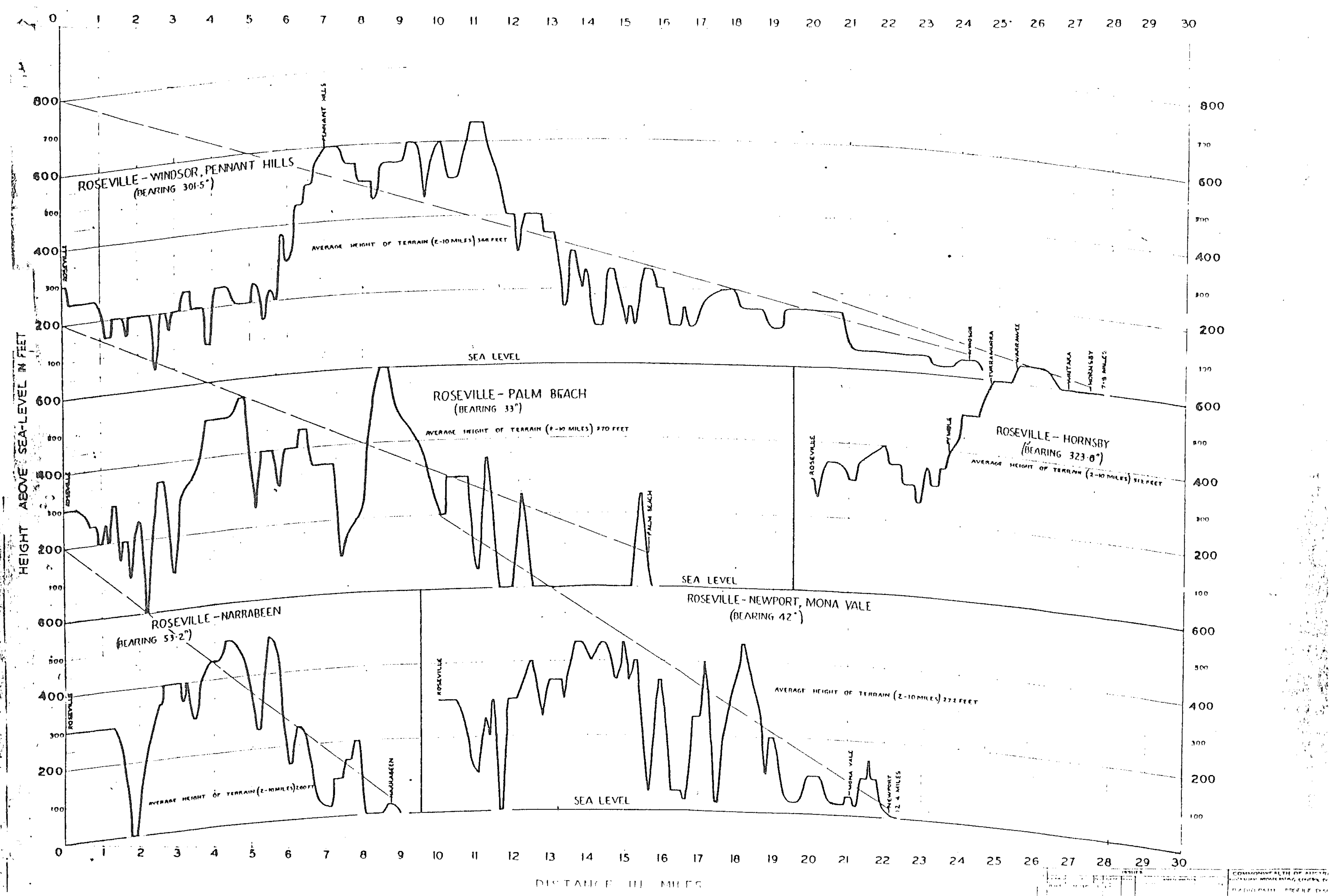

HEIGHT ABOVE SEA-LEVEL IN FEET
DISTANCE IN MILES
GORE HILL - DEEWHY, BROOKVALE
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 106 FEET
BROOKVALE
DEEWHY
SEA LEVEL
GORE HILL - WAVERLEY, WOOLLAHRA
(BEARING 137·5°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 111 FEET
WOOLLAHRA
WAVERLEY
TAMARAMA BAY
GORE HILL - VAUCLUSE
(BEARING 115°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 77 FEET
VAUCLUSE 5·75 MILES
GORE HILL - MANLY
(BEARING 75·3°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 81 FEET
MANLY 5·35 MILES
GORE HILL - MAROUBRA
(BEARING 154·7°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 126 FEET
MAROUBRA
GORE HILL - COOGEE, CLOVELLY
(BEARING 147·8°)
S.H. BRIDGE
RUSHCUTTER'S BAY
PADDINGTON
CLOVELLY
COOGEE
8 MILES
GORE HILL - BRONTE, EDGE CLIFFE
(BEARING 144·1°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 113 FEET
EDGE CLIFF
BRONTE
7·9 MILES
GORE HILL
ISSUES
COMMONWEALTH OF AUSTRALIA
RADIO PATH - PROFILE DIAGRAM
FROM GORE HILL
75·3°-154·7°



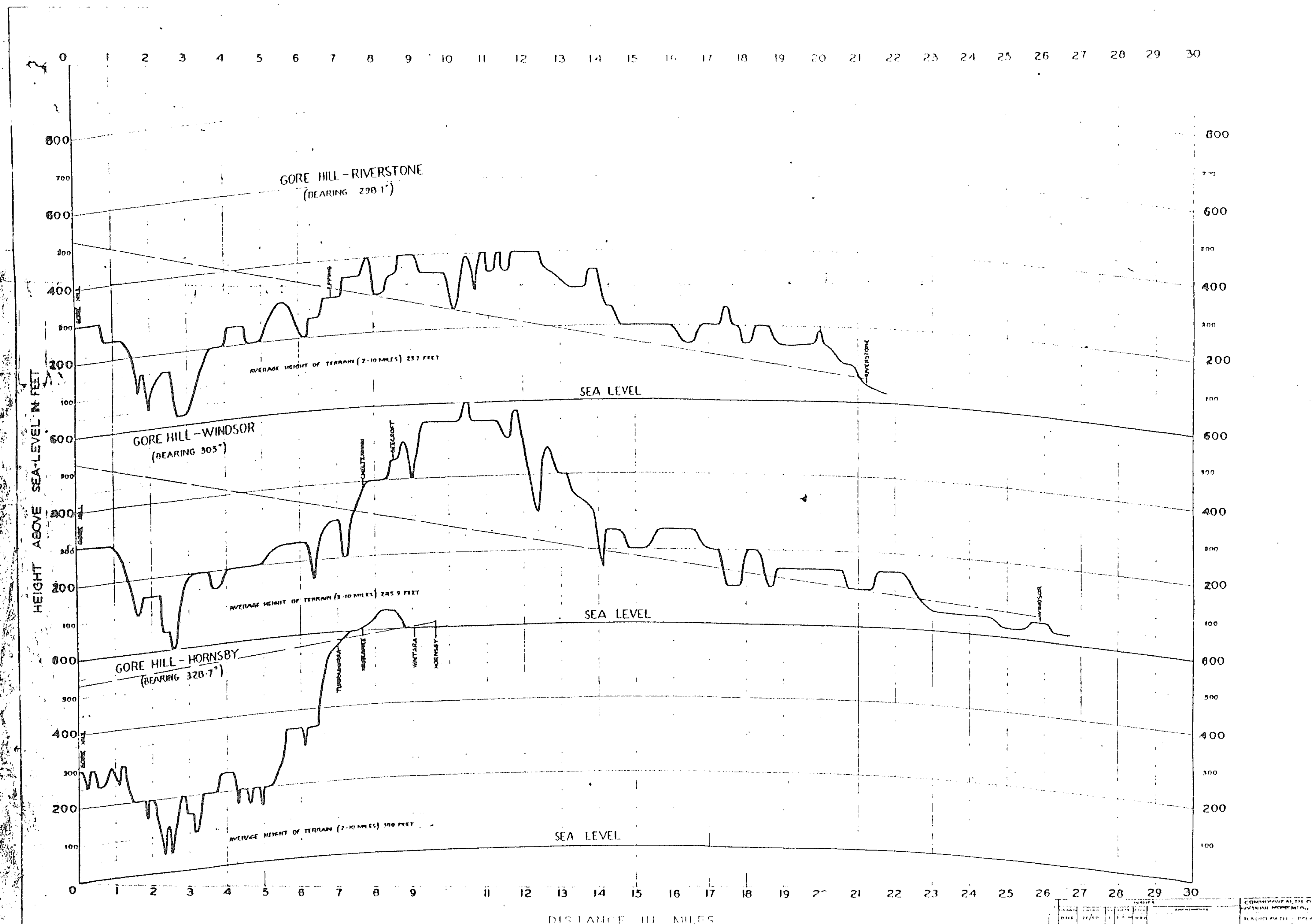
HEIGHT ABOVE SEA-LEVEL IN FEET
DISTANCE IN MILES
ROSEVILLE - DEEWHY
(BEARING 70·5°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 152 FEET
ROSEVILLE - WAVERLEY
(BEARING 145°)
ROSEVILLE - VAUCLUSE
(BEARING 38·8°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 137 FEET
ROSEVILLE - MANLY
(BEARING 95·9°)
ROSEVILLE - MAROUBRA, RANDWICK, PADDINGTON
(BEARING 156·9°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 141 FEET
ROSEVILLE - BRONTE
(BEARING 149°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 117 FEET
SEA LEVEL
MOSMAN
GEORGES HEIGHT
VAUCLUSE
S.H. BRIDGE
PADDINGTON
RANDWICK
MAROUBRA
BRONTE
EDGECLIFFE



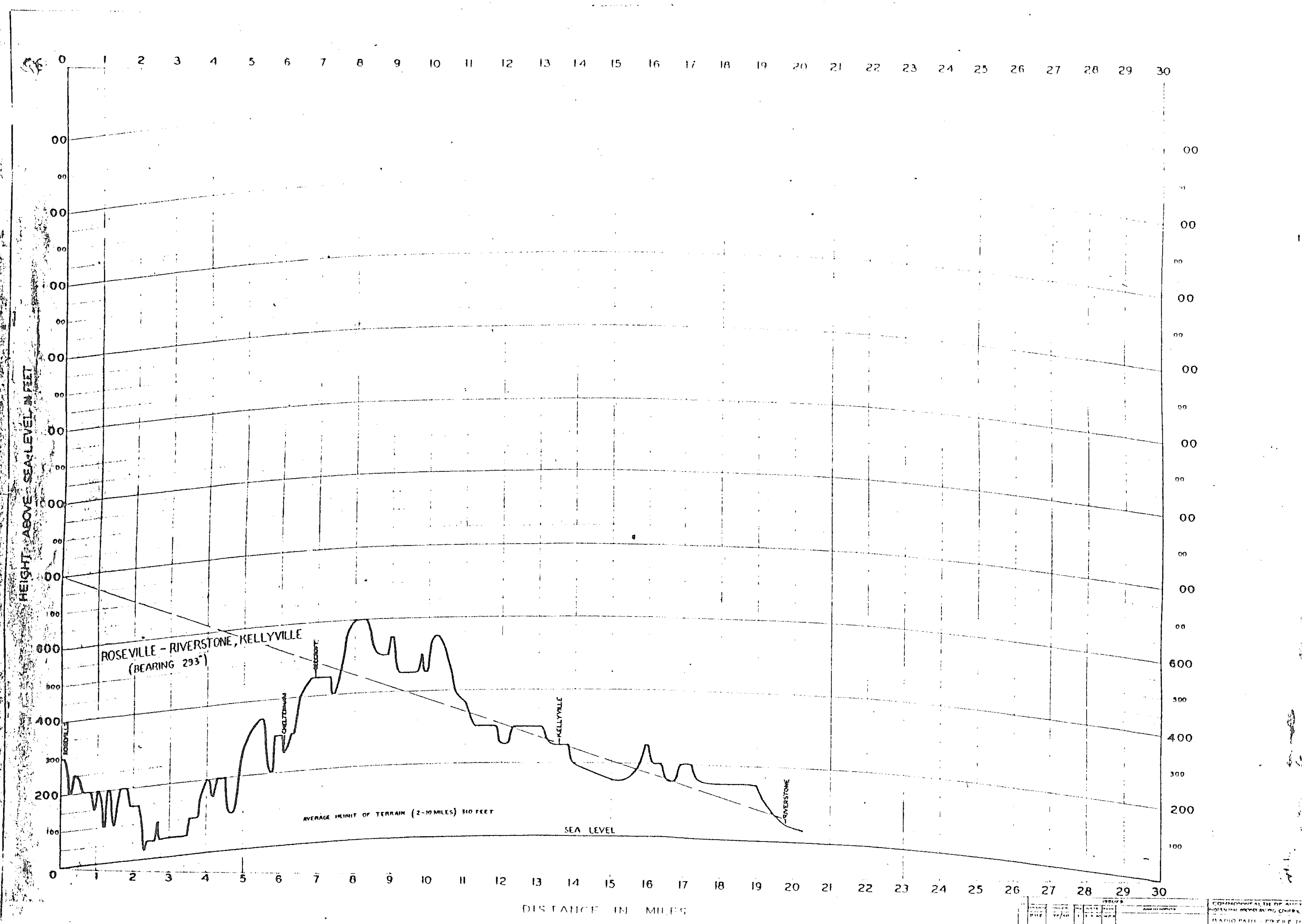
HEIGHT ABOVE SEA-LEVEL IN FEET
DISTANCE IN MILES
GORE HILL - PALM BEACH
(BEARING 27·2°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 270 FEET
GORE HILL - NEWPORT, MONA VALE
(BEARING 34·5°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 281 FEET
GORE HILL - NARRABEEN
(BEARING 40·0°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 174 FEET
SEA LEVEL
GORE HILL
PALM BEACH
MONA VALE
NEWPORT
NARRABEEN



HEIGHT ABOVE SEA-LEVEL IN FEET
DISTANCE IN MILES
ROSEVILLE - WINDSOR, PENNANT HILLS
(BEARING 301·5°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 368 FEET
ROSEVILLE
PENNANT HILLS
WINDSOR
TURRAMURRA
WARRAWEE
WAITARA
HORNSBY
7·9 MILES
SEA LEVEL
ROSEVILLE - PALM BEACH
(BEARING 33°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 370 FEET
PALM BEACH
ROSEVILLE - HORNSBY
(BEARING 323·8°)
PYMBLE
ROSEVILLE - NARRABEEN
(BEARING 53·2°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 200 FT
NARRABEEN
ROSEVILLE - NEWPORT, MONA VALE
(BEARING 42°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 373 FEET
MONA VALE
NEWPORT
12·4 MILES



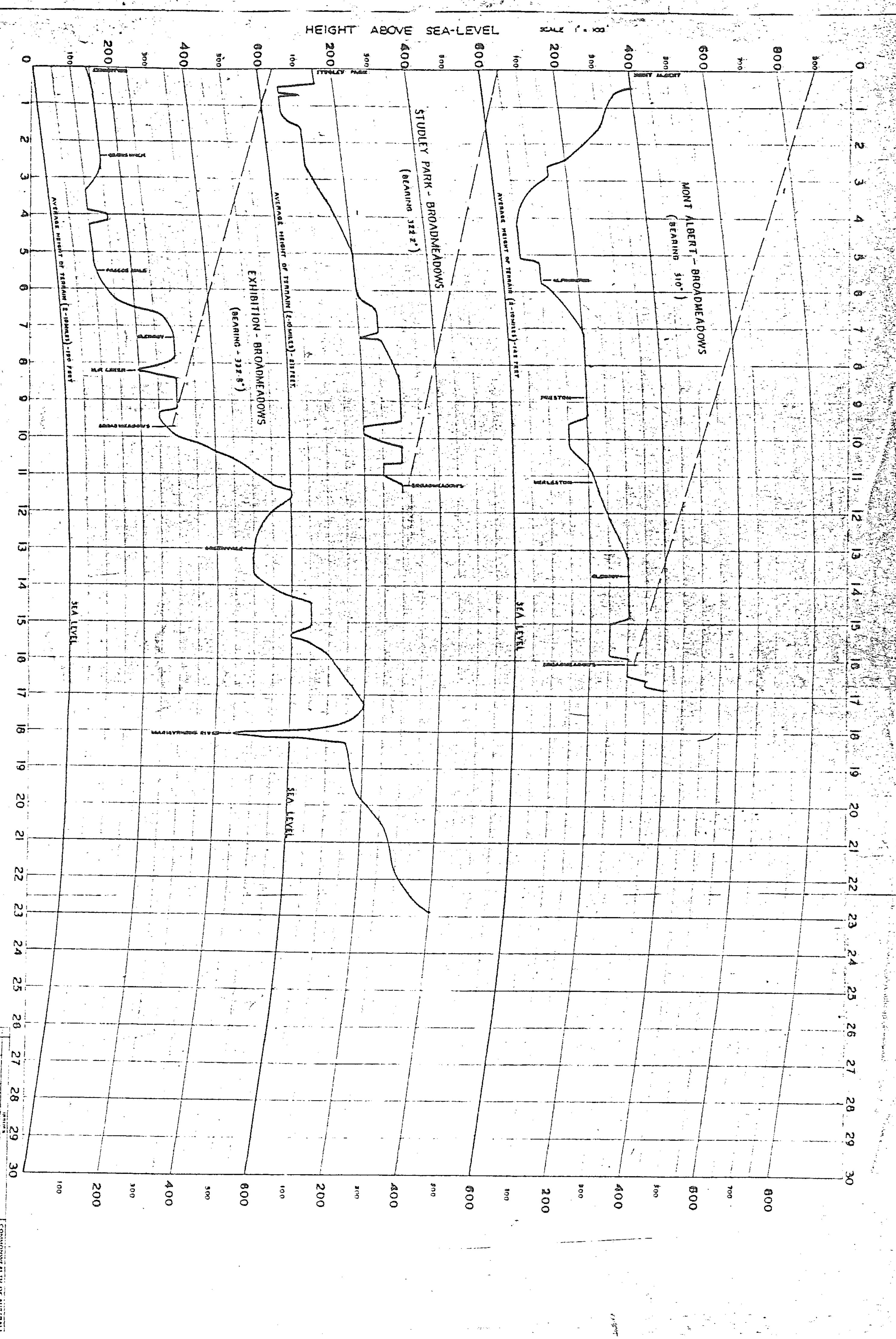
HEIGHT ABOVE SEA-LEVEL IN FEET
GORE HILL - RIVERSTONE
(BEARING 298·1°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 257 FEET
EPPING
RIVERSTONE
SEA LEVEL
GORE HILL - WINDSOR
(BEARING 305°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 285·9 FEET
SEA LEVEL
WINDSOR
GORE HILL - HORNSBY
(BEARING 328·7°)
WAITARA
HORNSBY
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 300 FEET
SEA LEVEL
DISTANCE IN MILES



HEIGHT ABOVE SEA-LEVEL IN FEET
ROSEVILLE - RIVERSTONE, KELLYVILLE
(BEARING 293°)
ROSEVILLE
CHELTENHAM
BEECROFT
KELLYVILLE
RIVERSTONE
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) 310 FEET
SEA LEVEL
DISTANCE IN MILES

TABLE IX (Cont.)

Receiving Location.	Transmitting Sites - Locality, distance to receiving site, frequency, power and heights. (Sydney area [illegible])					
	Distance to Receive Site-Miles	Field Intensity - μV/m.				
		195mc/s 20K. watt 250' high	195mc/s 20K. watt 500' high	[illegible] mc/s [illegible] K. watt 250' high	500mc/s 200K. watt 240' high	60mc/s 200K. watt 500' high
	COLUMN 6	COLUMN 7	COLUMN 8	COLUMN 9	COLUMN 10	COLUMN 11
PALM BEACH	17.2	0.46	0.80	[illegible]	0.47	0.97
NEWPORT	13.7	0.94	[illegible]	[illegible]	[illegible]	3.54
NARRABEEN	9.95	2.46	[illegible]	[illegible]	[illegible]	10.3
DEE-WHY	7.55	[illegible]	[illegible]	[illegible]	[illegible]	23.3
MANLY	5.9	15.0	25.5	0.73	27.5	54.2
VAUCLUSE	3.75	[illegible]	[illegible]	[illegible]	50.	119
WAVERLEY	5.7	[illegible]	[illegible]	[illegible]	30.	64.3
BRONTE	7.1	12.0	21.	[illegible]	21.	38.7
MAROUBRA	9.3	3.75	11.	[illegible]	12.	20.5
SYDNEY	3.75	[illegible]	[illegible]	[illegible]	[illegible]	24.6
HURSTVILLE	10.1	9.75	[illegible]	[illegible]	[illegible]	27.4
CRONULLA	16.5	12.0	[illegible]	[illegible]	[illegible]	21.2
MIRANDA	15.5	[illegible]	21.	[illegible]	[illegible]	25.5
SUTHERLAND	16.0	12.6	19.0	[illegible]	15.	21.4
PUNCHBOWL	10.4	32.7	[illegible]	[illegible]	[illegible]	35.2
BANKSTOWN	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	25.1
CAMPBELLTOWN	27.2	0.5	[illegible]	[illegible]	[illegible]	2.82
CAMDEN	32.8	[illegible]	[illegible]	[illegible]	[illegible]	1.40
LIVERPOOL	16.7	[illegible]	[illegible]	[illegible]	[illegible]	13.9
FAIRFIELD	13.9	8.45	[illegible]	[illegible]	15.0	20.3
MERRYLANDS	11.	21.2	[illegible]	[illegible]	[illegible]	49.0
WENTWORTHVILLE	12.	[illegible]	[illegible]	[illegible]	[illegible]	30.5
PENRITH	25.5	[illegible]	[illegible]	[illegible]	[illegible]	1.22
RIVERSTONE	21.5	[illegible]	[illegible]	[illegible]	[illegible]	1.86
WINDSOR	25.9	[illegible]	[illegible]	[illegible]	[illegible]	1.66
[illegible]	9.7	[illegible]	[illegible]	[illegible]	13.8	30.6
MEDIAN OF MEDIANS		[illegible]	[illegible]	[illegible]	[illegible]	24



HEIGHT ABOVE SEA-LEVEL
SCALE 1" = 100'
DISTANCE IN MILES
STUDLEY PARK - BROADMEADOWS
(BEARING 322.2°)
MONT ALBERT - BROADMEADOWS
(BEARING 310°)
EXHIBITION - BROADMEADOWS
(BEARING - 322.8°)
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) - 190 FEET
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) - 115 FEET
AVERAGE HEIGHT OF TERRAIN (2-10 MILES) - 245 FEET
SEA LEVEL
STUDLEY PARK
BROADMEADOWS
PRESTON
BROADMEADOWS