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THE PARLIAMENT OF THE COMMONWEALTH OF AUSTRALIA

PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS

R E P O R T

relating to the proposed

GROUND PREPARATION FOR INSTRUMENT LANDING SYSTEM

at

SYDNEY (KINGSFORD-SMITH) AIRPORT

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PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS

GROUND PREPARATION FOR INSTRUMENT LANDING SYSTEM  
AT SYDNEY (KINGSFORD-SMITH) AIRPORT

R E P O R T

On 18th May, 1965 the House of Representatives referred to the Parliamentary Standing Committee on Public Works for investigation and report, the proposal to carry out the ground preparation for an instrument landing system at Sydney (Kingsford-Smith) Airport.

GENERAL

1. The proposal is one of a number of major development works designed to allow Sydney airport to handle an increasing volume of air traffic. Other phases of the development include:-
  - (a) the southern extension of the 16/34 runway;
  - (b) the site preparation of the north-west building area;
  - (c) the buildings, roadways and engineering services for the international terminal complex and associated aircraft pavements; and
  - (d) the operations and control tower buildings.
2. The southern extension of the 16/34 runway was investigated by the Committee in 1963. In a report presented to the House of Representatives on 22nd August, 1963 we recommended that the runway length be 8,500 feet instead of the 7,900 feet proposed. The recommendation was accepted and construction of the extension is in progress at the present time. The remaining four projects have now been referred to the Committee, including the work which is the subject of this report. Reports on the other references will be presented separately.

SYDNEY (KINGSFORD-SMITH) AIRPORT

3. Sydney airport is situated on the northern shore of Botany Bay, in an area enclosed by General Holmes Drive and the Bay in the south, Cooks River and Alexandra Canal in the west, the canal and a railway line

in the north and the railway line and General Holmes Drive in the east. The total area available for development, apart from expansion into Botany Bay, is 1,420 acres. Progressive development since the early post-war years has involved such major work as the diversion of Cooks River and some reclamation of Botany Bay. The present installations represent a very substantial public investment.

4. Runways There are two runways at the airport - the 07/25 runway with a length of 8,300 feet, and the 16/34 runway, 5,500 feet long which is being extended into Botany Bay to a length of 8,500 feet. The 07/25 runway, which runs from east to west across the airport, is at present the main runway but it is not capable of further extension. The 16/34, or the north-south, runway will become the main runway when the current extension work is finished. Both the 16/34 and 07/25 runways are equipped with an I.L.S. at their northern and eastern ends respectively.

5. Terminals At present both the international and domestic terminals are located in the building area in the north-eastern corner of the airport. It is proposed to develop a new international terminal and subsequently new domestic terminals on an area of land in the north-west. Although this is not an optimum area, it will be large enough to handle the immediate needs of the airport.

6. As the new international terminal will be in operation while the domestic terminals are still in their present location, it will be necessary to provide a public access road between the north-west and north-east building areas around the southern bank of Alexandra Canal.

7. Alexandra Canal A short distance north of the 16/34 runway, and flowing roughly at right angles to it, is the Alexandra Canal. At its nearest point the canal is about 300 feet from the northern end of the runway. The canal extends about  $1\frac{1}{2}$  miles upstream from the northern boundary of the airport and drains a large catchment in the Marrickville, Botany and Sydney Council areas.

THE PRESENT REFERENCE

8. The reference on which the Committee is now reporting concerns ground preparation for the glide path equipment, which is a part of the instrument landing system to be installed on the 16/34 runway. The other parts of the system are the locators, markers and localiser. Locators and markers for the 16/34 runway are installed and functioning in conjunction with the existing glide path equipment. The localiser will be situated south of the extended runway on the end of the reclamation now under construction. Preparation of the ground area required for this localiser is being carried out as part of the contract for the extension of the runway.

9. The works involved in the present reference are:-

- (a) diversion of Alexandra Canal and the filling and grading of portion of the canal to be closed;
- (b) ground preparation for the glide path equipment area;
- (c) construction of 600 feet of stopway pavement on the reclamation at the southern end of the extended 16/34 runway; and
- (d) relocation of the airport perimeter road and the proposed access or public road between the north-east area and the new terminal area.

COMMITTEE'S INVESTIGATION

10. The Committee received submissions concerning the proposals from the Departments of Civil Aviation and Works. At the airport we inspected the area to be prepared for the glide path equipment, Alexandra Canal in the vicinity of the proposed diversion and the work at present being carried out on the runway extension. Evidence was taken in Sydney from representatives of the Departments of Civil Aviation and Works, Qantas Empire Airways Limited and Marrickville Municipal Council.

INSTRUMENT LANDING SYSTEM

11. An instrument landing system (I.L.S.) is a navigational facility to assist landing aircraft, not only in conditions of low visibility, but also, in the case of large high speed aircraft, in conditions of full visibility. The system is of four parts - the locators, the markers, the localiser and the glide path equipment.
12. Locators These are radio beacons which guide the pilot to the I.L.S. approach path and provide a check on the approach. One locator is usually placed 3,500 feet from the threshold of the runway and the other at a point six to ten miles from the end of the runway, depending on local circumstances. Both are on the extended runway centre line.
13. Markers These are vertical radio beams placed on the extension of the centre line of the runway at points 3,500 feet and 3.9 miles from the threshold. The pilot flying over them is able to check accurately the distance to the runway threshold. He also knows the ideal height above the runway threshold at these points and can thus check positively on his position.
14. Localiser The localiser directs a radio beam along the centre line of the runway indicating to the pilot the path along which he should fly to touch down on the runway. It indicates whether the aircraft is left or right of this path and enables the pilot to correctly align the aircraft for landing. In the case of the north-south runway at Sydney the localiser is to be installed south of the extended runway on the end of the area of reclamation now being carried out in Botany Bay.
15. Glide Path Equipment This provides a radio beam along the glide path down which the aircraft should fly to touch down at the ideal place on the runway. The beam is at a pre-set angle from the horizontal,  $2\frac{3}{4}$  degrees in this case, and leads the aircraft over the threshold of the runway at a height of 50 feet to a touch-down point 1000 feet along the runway. The pilot knows whether the aircraft is above or below the correct glide path and can take action to position the aircraft for a good landing. The equipment is located clear of the runway adjacent to the touch-down point.

16. The localiser and glide path equipment thus give the pilot a path in the air space along which and down which he should fly to land at the ideal point on the runway.

17. The I.L.S. now widely used in Australia and overseas permits an aircraft to operate safely in conditions down to a cloud ceiling of 200 feet and visibility of half a mile. However, in some circumstances, such as where the terrain adjacent to the airport is unfavourable, higher operational figures are adopted. At Sydney, operations are allowed with a cloud ceiling of 390 feet and visibility of one mile

18. The Committee were told that there is now a general tendency to operate in lower visibilities, such as with a cloud ceiling of 100 feet and visibility of a quarter of a mile, and in some circumstances, in "zero-zero" conditions. There is also a move to provide better I.L.S. guidance for large high speed aircraft and to reduce the pilot work-load by increasing reliance on automatic systems in conditions of good as well as low visibility.

#### THE NEED FOR A NEW I.L.S.

19. Sydney airport is not affected to any great extent by fogs and adverse weather conditions. The number of occasions when the cloud ceiling is below the existing allowable minimum of 390 feet, and when the visibility is less than one mile, is comparatively small. However, diversion of an aircraft to another airport is expensive and inconvenient and the proposed I.L.S. should make it possible to reduce the number of such occasions.

20. The principal benefit of the new I.L.S. guidance will, however, be an improvement of the existing system to provide better assistance to pilots during landings. International aircraft operating into Sydney will have the airborne equipment to make full use of the improved I.L.S. installations.

21. The north-south runway at Sydney is at present being extended to a length of 8,500 feet and when this work is completed will become the primary runway at the airport. It is therefore essential to have

an I.L.S. of the appropriate quality. In order that Sydney may retain its place as a major airport in the international network, the Committee believe that an improved instrument landing system at the northern end of the 16/34 runway is necessary.

DIVERSION OF ALEXANDRA CANAL

22. For an instrument landing the radio guidance given must be accurate and reliable. The beam from the localiser must not vary from the precise direction, and the radio beam from the glide path equipment must not vary from the exact glide path to be flown by the aircraft. This accuracy is achieved, not only by the quality of the equipment itself, but by the quality of the ground areas adjacent to the installations, since the radio waves are reflected by the ground surface.

23. In the case of the glide path installation, the radio glide path in space is formed by the inter-action of radio waves, some directly transmitted from the antenna and others reflected from the ground in front of the installation. If the terrain is uneven, irregularities will be produced in the glide path. Thus the reflecting area must have a level or almost level surface and be of sufficient length for an acceptable glide path quality to be achieved.

24. The length of ground area required can vary from airport to airport, according to the site and the surrounding topography. Calculations and flight tests using mobile glide path equipment, indicate that on the north-south runway a length of reflecting surface in front of the equipment of the order of 2,400 feet is necessary.

25. In order to provide the required clear smooth area of ground, 2,400 feet long and 800 feet wide, it is proposed to divert portion of Alexandra Canal immediately north of the runway. The diversion of the canal as proposed will gain 800 feet of the length required for the I.L.S. This would not be available with the canal in its present position without incurring heavy expenditure in moving the runway south.



26. Advantages The relocation of the canal is required basically for the ground preparation associated with the I.L.S. However, there are also some other significant advantages including a better alignment of the departmental perimeter road and of the public road between the existing and future terminal areas.

27. Of the additional land which would come within the airport boundary as a result of the diversion, 15 acres would be available as a valuable addition to the building and apron area in the north-west.

28. Diversion of the canal may also make possible a minor extension of the runway to the north. We noted that surveys and tests are being made to determine whether any significant extension is possible.

29. Land Areas Involved The area between the existing south bank of the canal and the proposed new north bank is 46 acres, including an area of 12 acres required for the new diversion channel. The net increase in area, south of the new canal and included in the airport boundary, would therefore be 34 acres.

30. All of the 46 acres of the land and water area is vested in the New South Wales government, except for one acre which is part of a recreation reserve within the jurisdiction of Marrickville Council. The State lands are zoned as "open-space" and both these and the acre of recreation reserve have been used by the Marrickville Council over a period of years as a garbage dump. The Commonwealth expects that there will be some costs associated with the acquisition of this land, but as yet it has not entered into detailed negotiations with the State on the matter of compensation. The estimate does not include any funds for this purpose.

31. It is difficult to place any figure on the value of the land areas concerned. However, the Commonwealth has 10 acres of land, north of the diverted canal, which could be transferred to the State if it has a requirement for it in its future road plans in the area. Although smaller in area than the land required for the diversion, it is better land and we were told that it is valued more highly.

32. The State Planning Authority of New South Wales has no objection to the diversion of the canal provided it does not adversely affect the proposed southern and south-western expressways or the interchange facilities to be built north and west of the airport. We were also advised that the N.S.W. Department of Lands would agree, in principle, to the diversion subject to satisfactory negotiation of detail.

33. The Department of Main Roads, which is interested in the State and Council land between Alexandra Canal and the Princes Highway for the establishment in the future of the expressways and related interchanges, advised the Committee that while the canal diversion may cause minor design difficulties by limiting the area of land otherwise available, their expected requirements can be co-ordinated with the proposal.

34. Movement of the canal in a northerly direction will alter the Marrickville Municipal boundary. The land involved on the northern side of the existing canal, is at present used by Marrickville Council as a garbage dump. The life of the dump will be reduced both by the diversion of the canal and the construction of the expressways.

35. Construction of the Diversion The existing canal, which is the responsibility of the N.S.W. Public Works Department, is approximately 200 feet wide and its depth varies from 10 feet to 13 feet below mean sea level. The construction of the diversion has been discussed with State authorities and as a result it is proposed to provide a channel 150 feet wide having a depth of six feet below mean sea level. The Maritime Services Board which controls navigation on the canal, has indicated that it may require the Commonwealth to widen the diversion to 200 feet and deepen it by a further three feet should this ever become necessary for navigation purposes. Any future widening of the canal would encroach on State land.

36. Excavation for the canal diversion and access road will involve removal of 250,000 cubic yards of rubbish and 150,000 cubic yards of soil. Rubbish will only be removed from the area between the new and existing canals where it is within the landing strip of the north-south runway.

All the soil and 40,000 cubic yards of rubbish will be used as filling for the existing canal and the glide path equipment area. The balance of the rubbish will be disposed of outside the airport.

37. In order to complete the filling of the existing canal, 200,000 cubic yards of sand fill is required. This will be obtained from Botary Bay in conjunction with the site preparation of the north-west building area.

38. Alternatives Among the alternatives to the diversion of the canal considered by the Committee during its investigations, were piping or bridging the canal. We were told that piping the canal would interfere with its function as a substantial waterway draining a large area north-east of the airport. If the canal was covered with a concrete sheet for a width of 1000 feet for runway and flight strip purposes, the costs would exceed by a substantial margin the costs of diversion.

39. We also examined the possibility of moving the whole runway 600 feet south by extension further into Botany Bay, so eliminating the need to divert the canal. However, we found that such a movement would require either major earthworks to raise the glide path area to the level of the taxiway which would then cross it, or the construction of a new taxiway south of the glide path indicator. It was stated that the cost of moving the runway south is higher than that of diverting Alexandra Canal.

40. On consideration of the proposal and the alternatives, we are satisfied that the best and most economical way of handling the problem is to divert the canal. We therefore recommend the diversion of Alexandra Canal as proposed.

41. The Canal Banks The existing banks of the canal are protected with coursed sandstone blocks varying from 15" to 30" long, 9" to 12" wide and 12" deep. The State Public Works Department requires the banks of the diversion channel to be protected with a layer of cement grouted stone fill three feet thick on a filter bed one foot deep.

42. It was submitted to the Committee that a less elaborate but satisfactory bank protection equivalent in standard to that existing, is possible at lower cost. The figure of £140,000 in the estimates for bank protection is based on work of a standard considered satisfactory by the Commonwealth. We believe that bank protection as requested by the State could increase costs by £30,000. However, the Committee were told that further discussions are taking place between the Commonwealth and the State in order to reach a satisfactory agreement on this matter.

#### MOVEMENT OF LANDING THRESHOLD

43. Improvement of Northern Approach The normal obstruction-free approach to runway equipped with an I.L.S. is at a slope of 1 in 50 from a point 200 feet before the runway threshold. To achieve this on the north-south runway the landing threshold would have to be moved 600 feet to the south. The relatively short length of the existing runway - 5,500 feet - has prevented this movement of the threshold as the effective landing length would have been reduced to 4,900 feet.

44. The reclamation of Botany Bay and extension of the runway will, however, allow this approach to be improved. The lengthened runway, with a landing threshold 600 feet south of its present position, will have the desirable 1 in 50 obstruction-free plane for an aircraft landing from the north.

45. This movement of the landing threshold will fit in well with the requirements of the glide path equipment and diversion of the canal. With the glide path equipment properly located in relation to the new landing threshold, the required clear, level area between the equipment and the access road will be available.

46. Landing Length Although the landing threshold will be moved 600 feet to the south, the pavement length available for landing will still be 8,500 feet since the type of localiser equipment to be installed will permit the pavement at the southern end of the runway to be extended. Previously the monitor of the I.L.S. system had to be 950 feet from the

localiser and this length had been allowed in the runway extension. The more modern equipment now available will reduce this requirement to 350 feet, thus permitting an increase of 600 feet in landing, or stopway, length at the southern end of the runway. The whole of the 8,500 feet available for landing will, in effect, be moved 600 feet to the south.

47. Take-off Length The available take-off length will commence at the existing northern end of the runway and will be 8,500 feet. The end of the take-off will be at the point where the 1 in 50 clearance over the antenna of the localiser meets the runway, and it remains unaltered.

48. Improvement of the northern approach is desirable and the Committee agree that the landing threshold of the 16/34 runway should be moved 600 feet to the south.

#### PREPARATION OF GLIDE PATH EQUIPMENT AREA

49. As already mentioned, the ground surface in front of the glide path equipment must be level and smooth. For the north-south runway at Sydney a reflecting surface 2,400 feet by 800 feet is required. This area is to be uniformly graded to a plane surface, except across the north-eastern taxiway and adjacent to the runway where no alteration to existing levels is required.

50. Sand filling will be used for preparing the area within the 1000 feet wide flight strip of the runway and its prolongation to the perimeter road around the southern bank of the canal diversion. Over the remainder of the area filling will be material from the canal diversion. To prepare the area to the required standard, 40,000 cubic yards of refuse from the canal diversion and 30,000 cubic yards of sand will be required. The surface is to be top dressed with soil from the diversion and grassed.

51. The Committee recommend the site preparation of the glide path equipment area as proposed.

#### EXTENSION OF PAVEMENT

52. In order to retain the desirable landing length of 8,500 feet on the 16/34 runway, it is proposed to extend by 600 feet the runway pavement on the reclamation being constructed in Botany Bay for the

reasons discussed in paragraphs 46 to 48. The pavement extension will be used only as stopway for aircraft landing from the north as aircraft taking off from the north will still have to leave the runway at the present take-off point in order to clear the localiser antenna. The overall pavement length will thus be 9,100 feet but landing and take-off lengths each will remain at 8,500 feet to meet glide path and clearance requirements at either end of the runway.

53. The pavement of the 600 feet of stopway will be the same strength as the runway extension. It will comprise a crushed stone base over which will be laid a 10 inch thickness of fine crushed rock surfaced with two inches of bituminous concrete.

54. The Committee recommend construction of 600 feet of stopway pavement at the southern end of the 16/34 runway.

#### RELOCATION OF ACCESS AND PERIMETER ROADS

55. In the reference on the site preparation of the north-west building area is a proposal for a public access road between the north-east area and the new terminal area along the southern bank of the existing Alexandra Canal. The airport perimeter road at present runs along this route. Surfacing of these roads is included in that reference.

56. After the diversion of the canal as proposed in this reference, it is intended to relocate both these roads along the new southern bank and clear of the northern end of the runway and the glide path equipment area. This will require removal of the rubbish from under the road alignment prior to filling and surcharging with sand.

57. During our investigations we considered the possibility of placing these roads underground. However, having regard to the advantages to be gained, the Committee are satisfied that the large expenditure involved is not warranted. We therefore recommend relocation of the airport perimeter road and proposed public access road from the existing terminals to the north-west building area as proposed.

CONSTRUCTION TIME

58. It is estimated that five months will be required after an approval to proceed is given, to complete drawings and tender documents, call tenders and let a contract. Completion of the various phases of the construction work is expected to be spread over a period of 12 to 18 months after a contract is signed. The work required to allow operation of the I.L.S. concurrently with the lengthened runway is to be completed by mid-1967.

COSTS


59. The estimated cost of the proposals referred to the Committee is £850,000 made up as follows:

	£	£
Alexandra Canal diversion		
Excavation of diversion including disposal of material and removal of rubbish	300,000	
Sand filling	165,000	
Bank protection	140,000	
Temporary bridge and construction roads	55,000	660,000
Preparation of glide path area		
Sand filling	20,000	
Grade surface, top dress and grass	40,000	
Drainage	10,000	70,000
Site preparation for relocated roads		60,000
Extension of stopway pavement		60,000
		<u>850,000</u>

RECOMMENDATIONS AND CONCLUSIONS

60. The summary of the Committee's recommendations and conclusions is set out below. Alongside each is shown the paragraph in the report to which it refers.

	<u>Paragraph</u>
1. THE COMMITTEE BELIEVE THAT AN IMPROVED INSTRUMENT LANDING SYSTEM AT THE NORTHERN END OF THE 16/34 RUNWAY IS NECESSARY.	21
2. DIVERSION OF ALEXANDRA CANAL AS PROPOSED IS RECOMMENDED.	40
3. THE LANDING THRESHOLD OF THE 16/34 RUNWAY SHOULD BE MOVED 600 FEET TO THE SOUTH.	48
4. GROUND PREPARATION OF THE GLIDE PATH EQUIPMENT AREA AS PROPOSED IS RECOMMENDED.	51
5. CONSTRUCTION OF 600 FEET OF STOPWAY PAVEMENT AT THE SOUTHERN END OF THE 16/34 RUNWAY IS RECOMMENDED.	54
6. RELOCATION OF THE AIRPORT PERIMETER ROAD AND PROPOSED PUBLIC ACCESS ROAD FROM THE EXISTING TERMINALS TO THE NORTH-WEST BUILDING AREA AS PROPOSED IS RECOMMENDED.	57
7. THE ESTIMATED COST OF THE PROPOSED WORKS IS £850,000.	59

  
W. J. Brimblecombe  
Chairman.

Parliamentary Standing Committee  
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14th September, 1965.