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1916.



COMMONWEALTH OF AUSTRALIA

C. R. Boydell  
Clerk of the Senate  
1-9-16.

PARLIAMENTARY STANDING COMMITTEE ON  
PUBLIC WORKS.

REPORT

TOGETHER WITH

MINUTES OF EVIDENCE

RELATING TO THE PROPOSED

WATER SUPPLY SCHEME FOR THE  
FLINDERS NAVAL BASE.

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MEMBERS OF THE PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS.

(First Committee.)

EDWARD RILEY, ESQUIRE, M.P., Chairman.

*Senate.*

Senator the Honorable John Henry Keating  
Senator Patrick Joseph Lynch (Vice-  
Chairman)  
Senator William Harrison Story.

*House of Representatives.*

James Edward Fenton, Esquire, M.P.  
William Fyfe Finlayson, Esquire, M.P.  
The Honorable Henry Gregory, M.P.  
Sydney Sampson, Esquire, M.P.  
William Henry Laird Smith, Esquire, M.P.

EXTRACT FROM THE VOTES AND PROCEEDINGS OF THE HOUSE OF REPRESENTATIVES.

No. 26 of 17th DECEMBER, 1914.

5. PUBLIC WORKS COMMITTEE—WORKS REFERRED TO.—Mr. Fisher, for Mr. Archibald, moved, pursuant to notice, That the following works be referred to the Parliamentary Standing Committee on Public Works in accordance with provisions of *Commonwealth Public Works Committee Act 1913*, viz. :—

1. Flinders Naval Base—Works under control of Department of Home Affairs, including supply of water, . . . . .

Debate ensued.

Question—put and passed.

PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS.

FLINDERS NAVAL BASE—  
WATER SUPPLY.

REPORT.

THE PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS, to which the House of Representatives referred for investigation and report the question of a Water Supply for the Flinders Naval Base, has the honour to report as follows :—

INTRODUCTORY.

1. It was laid down by Admiral Sir Reginald Henderson, K.C.B., in his report on the general administration, organization, distribution, &c., of the Naval Forces of the Commonwealth, that the Flinders Naval Base was intended as a sub-base for torpedo boats, destroyers, and submarines, and as such buildings are being erected for the housing and training of about 78 chief petty officers and petty officers, and about 684 men as the first complement to be located there.

2. As the scheme of Naval defence develops the strength of the establishment will be increased to 4,000, so that, including women and children in married quarters and residences, it will be necessary by the end of 30 or 40 years to cater for a supply of water to a population of approximately 10,000.

3. To provide an efficient water supply for this maximum population, and at the same time to have such a volume at hand as may be necessary to supply any visiting warships in addition to those allotted to the Base, makes it an essential feature in the consideration of any scheme that the quality of the water for all purposes be unquestioned, and the amount available sufficient to meet all requirements that can possibly be foreseen.

ALTERNATIVE PROPOSALS.

4. At the outset of its inquiry the Committee was informed that, as a result of inspections of the locality and investigations which had been made, four main sources of supply had received consideration, viz. :—

- (a) Borings in the vicinity of the site.
- (b) Local catchment area (Flinders Range).
- (c) Melbourne and Metropolitan Board of Works.
- (d) Monbulk and Cardinia Creek (Dandenong Ranges).

(a) BORINGS IN THE VICINITY OF THE SITE.

5. The possibility of obtaining water from borings received early consideration, and was the subject of inquiry and discussion between the departmental officers and the geologists of the Mines Department of Victoria. Information obtained did not point to a satisfactory supply being obtained by this method, but some borings were made to test the matter. The samples of water obtained from the bores were, however, declared by the analyst to be unfit for human consumption.

(b) LOCAL CATCHMENT AREA (FLINDERS RANGE).

6. Investigations made by the Department of Home Affairs showed that it would be possible to obtain a supply of water from a catchment area of 3,530 acres in the Flinders Range sufficient to meet requirements at the Naval Base, but the scheme was open to certain objections.

F.11127.

INDEX.

	Page.
Report ... ..	v
Minutes of Evidence...	1

LIST OF WITNESSES.

Cattinach, William, Chairman, State Rivers and Water Supply Commission, Victoria ...	50
Creswell, Rear-Admiral Sir William R., First Naval Member of the Naval Board...	11
Fanstone, Herbert Herbert, Director of Naval Works ... ..	7
Hill, Thomas, Engineer, Department of Home Affairs .. ...	35, 38, 44, 49
Hunter, Stanley Burrell, Engineer for Boring, Mines Department, Victoria ...	23
Murray, Thomas, Engineer, State Rivers and Water Supply Commission, Victoria ...	21, 29
Oliver, Calder Edkins, Engineer-in-Chief, Melbourne and Metropolitan Board of Works ...	27
Owen, Percy Thomas, Director-General of Works, Department of Home Affairs ...	1, 41
Riddell, Walter John Carre, Chairman, Melbourne and Metropolitan Board of Works ...	25
Sambell, Albert Keaston Trenavin, Civil and Hydraulic Engineer, Melbourne ...	14
Shaw, Ebenezer, Commissioner of State Rivers and Water Supply Commission, Victoria ...	46

7. In the first place, although the engineering difficulties of obtaining a supply were not very great, analyses had shown that the water would not be fit for human consumption.

8. In the second place many of the seaside towns on the Mornington Peninsula are endeavouring to obtain a water supply, and it is not considered advisable that the Commonwealth should spend any large sum on a scheme which would bring the pipe line in the vicinity of these towns without supplying them with water. It is considered that if the Commonwealth is to spend a large sum of money for a water supply for the Naval Base it would be preferable, if possible, to add it to an amount raised by the shires interested, or spend it in conjunction with the Melbourne and Metropolitan Board of Works in a scheme which would confer a benefit on the residents of the districts through which the supply would be conveyed.

(c) MELBOURNE AND METROPOLITAN BOARD OF WORKS.

9. Correspondence which had taken place with the Melbourne and Metropolitan Board of Works showed that that body was willing to provide a supply of water from the Notting Hill Reservoir for the Base, the maximum requirement being 120,000 gallons a day on the following conditions:—

- (i) That a meter approved by the Board be fixed at the point of offtake and maintained to the Board's satisfaction;
- (ii) That all pipes be laid and maintained by the Department to the satisfaction of the Engineer-in-Chief of the Board;
- (iii) That payment at the rate of 9d. per 1,000 gallons be made for all water supplied;
- (iv) That no extension from the main supply pipe be made unless the Board's consent shall first have been obtained; and
- (v) That the arrangement be embodied in a formal agreement to be prepared at the expense of the Department.

(d) MONBULK AND CARDINIA CREEK (DANDENONG RANGES).

10. Representations had been made to the Department of Home Affairs by the engineers to several of the shires on the Peninsula with the object of obtaining a joint supply of water sufficient to satisfy requirements of the Naval Base and the seaside towns.

11. It was stated that from an available catchment area of about 5,350 acres in the Dandenong Ranges it would be possible to convey sufficient water to provide for a present population of 10,200 people with a subsequent increase to 19,300 in 20 years, and a further possible increase to 37,500 in 50 years, and it was asked that the Commonwealth join with the shires concerned in moving the State Government to constitute a water trust to carry out the scheme.

ESTIMATED COST.

12. The estimated cost of installing an exclusive service for the Naval Base from the Flinders Range was set down at £58,000, which would insure a flow of 133,000,000 gallons per annum, or about 365,000 gallons per diem.

13. The estimated cost of obtaining water from the Melbourne and Metropolitan Board's Reservoir at Notting Hill was set down at £61,000, in addition to which the Commonwealth would have to pay at the rate of 9d. per 1,000 gallons for all water consumed.

The total annual cost under this scheme, using 9-in. cast-iron pipes and providing for interest and sinking funds, depreciation, maintenance, &c., would be—for a supply of 30,000 gallons per day, £4,171; for a supply of 60,000 gallons per day, £4,582; and for a supply of 120,000 gallons per day, £5,404.

14. In the case of the combined scheme from the Dandenong Range, usually referred to as the "Monbulk scheme," it was stipulated that the Commonwealth should pay for a minimum consumption of 120,000 gallons per day at the rate of 1s. 6d. per 1,000 gallons, or £3,285 per annum.

COMMITTEE'S INVESTIGATIONS.

15. The Committee visited the Flinders Naval Base and inspected the catchment areas which would be availed of on the Flinders Range for a separate local scheme, examined the country which would be traversed by the pipe line from the Notting Hill Reservoir, and made itself acquainted with the catchment area and sources of supply suggested in the case of the Monbulk scheme.

16. Inquiries showed the necessity for an adequate water supply to the Naval Base as no suitable water is available locally, and at the present time water is being obtained from the end of the Board of Works's scheme at Mordialloc, and is taken to the Base in trucks at a cost of 20s. to 25s. per 1,000 gallons.

17. Evidence given by the Engineer for Boring, Mines Department, Victoria, satisfied the Committee that the idea of supplying the Base by artesian water should be abandoned, and after some deliberation it was also agreed to pass over the suggestion for the separate scheme from Flinders Range in view of the facts that the catchment area was limited, that the surrounding country was of a saline nature, and that the settlement in the district precluded a perfectly pure supply except at some cost for filtration.

18. At this stage the two schemes under serious consideration were the Notting Hill and the Monbulk schemes. It was then suggested that it might be possible to obtain a suitable supply from the Bunyip River at Koo-wee-rup, and investigations were undertaken by the Engineer, Department of Home Affairs, and later by the engineers of the State Rivers and Water Supply Commission.

19. The Committee visited this district and was satisfied that an adequate supply of water was available if it could be obtained from such a position as to insure absolute purity and, if possible, a gravitation scheme to the Naval Base.

20. Suggestions to take a supply from the Koo-wee-rup Canal with the offtake at the 40 feet level, and from the Bunyip River at the 167 feet level, and at the 330 feet level, as well as a separate supply from the Toomue Creek at the 400 feet level received consideration. But at a conference which the Committee arranged and at which were present the members of the Committee, the three members of the State Rivers and Water Supply Commission, the Engineer of the Commission, the Director-General of Works, and the Engineer, Department of Home Affairs, it was decided that the State Rivers and Water Supply Commission should make a detailed examination of the district with a view to reporting to the Committee the best point of offtake and the most advisable route for a joint scheme to supply water to the seaside towns on the Mornington Peninsula, as well as the Flinders Naval Base, with full details as to cost, &c.

21. On the 20th May, 1916, Mr. Shaw, one of the Commissioners of the State Rivers and Water Supply Commission, submitted to the Committee the promised report in which it was stated that, after careful investigation and examination of the country, a scheme had been arrived at which it was thought would be satisfactory in every respect.

BUNYIP SCHEME.

22. Under this scheme supply would be drawn from the main stream of the Bunyip River at a point just below "The Falls," distant some 48 miles from Frankston by the supply route, and it would be possible to supply the towns of Mornington, Frankston, Seaford, Chelsea, Aspendale, Somerville, Hastings, Tyabb, Crib Point, Pakenham, Benconfield, Berwick, Cranbourne, Garfield, Bunyip, as well as the Naval Base.

23. The level of the river bed at the offtake is 375 R.L., but on account of the rocky nature of the bed and banks at this point the draw-off level can be raised to 410 R.L. at a low cost. This will be a sufficient working head for the scheme.

24. The area of the river catchment tapped at this point is about 18,560 acres. It is practically all virgin country under the control of the State, and could be strictly reserved for water supply purposes. The Committee suggests that this area should be permanently reserved from settlement.

25. The rainfall is good, averaging about 50 inches per annum, so that there should be ample water without storage for the required purpose in the driest years. The whole of the stream would be available, there being no compensating flows of any

kind necessary, as just below the offtake other good streams join the river. During March and April, when the stream at "The Falls" was as low as ever known, the estimated volume passing was 10 cubic feet per second, approximately 5,385,000 gallons per day, or nearly five times the volume required under the scheme, namely, 1,250,000 gallons per day.

26. As shown by analysis the water is of excellent quality, equal to that of the metropolitan supply.

27. In estimating the population of the district to be served, liberal allowance must be made for material increases in the near future, especially as regards the floating population. In dealing with the question of supply to those towns within the scope of what is known as the "Mornington Peninsula scheme," including provision for the Naval Base, it would be unwise to make provision for a less population than 15,000 during the winter, and 45,000 during the summer months, say from December to March inclusive, or the equivalent of a fixed population of 25,000, using an average of 50 gallons per head per day throughout the year, that is an average daily consumption of 1,250,000 gallons.

28. The feeding main from the source of supply is designed to deliver steadily 1,250,000 gallons daily. During periods of low consumption, the excess goes into two storage reservoirs established at selected suitable sites, the larger about a mile south-east of Frankston and the smaller about 4 miles north of the Naval Base. The combined capacity of these reservoirs will be 257,000,000 gallons, or rather more than six months' average consumption.

29. The distributing mains from the reservoirs will be of sufficient size to distribute through the various reticulations this stored water, as well as that brought in by the constantly running supply main, so as to meet the full summer demands of the 45,000 people for which provision is made.

30. All proper safeguards to avoid pollution can easily be secured and the scheme is gravitation throughout.

31. From the 80,000,000-gallon reservoir, 4 miles north of the Naval Base, supply will be drawn to feed a service basin of 1,000,000 gallons capacity, which will be under the control of the Naval authorities, and be placed at a suitable location near the north boundary of the Naval Base area. This provision by reservoirs gives absolute security against any shortage of supply, even should anything happen to put the main out of action temporarily, while under ordinary circumstances the works are on such a scale that they could supply three times the present requirements without extra cost, so that as the demand increases it will be possible to put the scheme on a better paying basis.

32. The estimated cost of the scheme is set down at £156,000. It is considered that under favorable circumstances water can be delivered to the Naval Base in twelve months from date of commencement of the work.

33. The whole of the work will be carried out by and remain under the control of the State Rivers and Water Supply Commission, the Commonwealth being charged for the water delivered, while rates will be levied on the various towns to cover interest and sinking fund, &c.

34. The service reservoir at the Naval Base will be constructed as part of the general scheme, but from that point the responsibility of taking the water into the Base, together with such reticulation as may be necessary, will devolve upon the Commonwealth.

35. For this water delivered into the reservoir the Commonwealth will be charged at the rate of 1s. per 1,000 gallons, but it is stipulated that the Commonwealth should agree to a minimum payment of £4,000 per annum for the first three years, then a payment of £3,500 per annum for the next three years. After the second period of three years the service to be continued in operation for a minimum payment by the Commonwealth of £3,000 per annum, with a further proviso that should a reduction in charges be made to the general public in the various towns and districts served as a result of the development and increase in population in these areas a corresponding reduction should be made to the Commonwealth on the basis of the contributions provided for under the scheme as now proposed.

## COMPARISON OF THE VARIOUS SCHEMES.

36. Comparing the various schemes investigated, it will be seen that the cost to the Commonwealth would be as follows:—

	Gallons per day.	Capital Cost. £	Annual Out to the Commonwealth.	£
<i>Naval Base only—</i>				
Blinders Range	365,000	58,000	Interest, and Sinking Fund, and Depreciation, at 6 per cent. . . . .	3,480
Notting Hill	.. .. .	61,000	Interest and Sinking Fund, and Depreciation, at 6 per cent. . . . . Maintenance and Manage- ment .. .. .	3,600 100
			plus cost of water supplied at 9d. per 1,000 gallons— if 20,000 gallons per day=£411 + £3,760 =	4,171
			if 60,000 gallons per day=£822 + £3,760 =	4,582
			if 120,000 gallons per day=£1,644 + £3,760 =	5,404
Bunyip No. 1	120,000	57,500	Interest and Sinking Fund at 5½ per cent. . . . . Depreciation—according to material .. .. . Maintenance and Manage- ment .. .. . Pumping .. .. .	3,102 1,930 218 700 6,060
<i>Joint Schemes—</i>				
Monbulk	120,000	Nil	1s. 6d. per 1,000 gallons for a minimum of 120,000 gallons per day .. .. .	3,285
Bunyip No. 2	210,000	Nil	1s. per 1,000 gallons with a minimum of £4,000 per annum for first three years, £3,500 per annum for second three years, then £3,000 per annum, with a possible further reduction.	

37. After careful consideration of the question in all its aspects, the Committee is satisfied that the Bunyip River scheme submitted is the most advantageous to the Commonwealth, as well as conferring a much needed benefit upon the seaside towns, and recommends that an agreement be entered into between the Commonwealth and the Victorian State Rivers and Water Supply Commission so that the work may be put in hand at the earliest possible moment—such agreement to provide that the Commonwealth have priority of claim on the supply for Naval purposes.

38. The decision arrived at by the Committee is shown in the following extract from its Minutes of Proceedings:—

Mr. Finlayson moved—That the Committee approves of the scheme for the supply of water to the Flinders Naval Base, submitted by the Victorian State Rivers and Water Supply Commission. Seconded by Senator Story. Carried unanimously.

*Edward Riley*

Chairman.

Office of the Parliamentary Standing Committee on Public Works,  
120 King-street,  
Melbourne, 21st August, 1916.

## MINUTES OF EVIDENCE.

(Taken at Melbourne.)

THURSDAY, 25th FEBRUARY, 1916.

Present:

Mr. RILEY, Chairman;	
Senator Keating;	Mr. Finlayson.
Senator Lynch;	Mr. Gregory;
Senator Story;	Mr. Sanson.
Mr. Fenton.	Mr. Laird Smith.

Percy Thomas Owen, Director-General of Works, Department of Home Affairs, sworn and examined.

1. To the Chairman.—In connexion with works proposed at Flinders Naval Base, working drawings of a certain number of buildings have been prepared, but not of all. The notes which I have prepared for the information of the Committee up to the present refer entirely to the water supply, as I have regarded that as a dominating factor in relation to the whole project. It must, for instance, affect the general reticulation, and also the sewage system. If it were eventually decided for the water carriage sewage to use salt water that would affect very materially the necessary reticulation, and the fittings used for the buildings. The water supply must have an important bearing upon the whole project, though it may not materially affect the design of the buildings at the Base. I understood that the matter which the Committee wished primarily to consider was the water supply, and I submit the following notes as setting out as completely as possible all that has taken place in regard to the water supply up to the present time:—

### NOTES REGARDING WATER SUPPLY, FLINDERS BASE.

I. The first reference to this Department for construction of works at Flinders Base was in November, 1912, and Mr. Thomas Hill, who was acting on the staff of the Director-General of Works in charge of civil engineering, made a report on the 22nd of that month regarding preliminary investigations which had been conducted as to various sources of supply. As a result of inspections of the locality, and investigations from that time until the present, there have been four main schemes under consideration, viz.:—

- I. Local catchment area (Flinders Range);
- II. Springs in the vicinity of the site;
- III. Monbulk and Cardinia Creek;
- IV. Melbourne and Metropolitan Board of Works.

2. The schemes I., III., and IV. are shown by green, blue and red lines respectively on accompanying plan.

3. Summarizing the position, the dominating question at the present time is the supply from Monbulk and Cardinia catchment areas, now under consideration by the State Rivers and Water Supply Commission, because—

- (a) The Shires have prompted its consideration;
- (b) A Commonwealth scheme for supply to only the Flinders Base from the Metropolitan ranges would not properly meet public needs, and would entail another supply system in course of time (for Shires);
- (c) The only way to get a comprehensive supply would be by concerted movement of all concerned;
- (d) Concerted movement is not at present feasible unless the Monbulk-Cardinia scheme is put on one side.

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4. A serious aspect of the matter is that until it is known what will be the source of supply and when the supply can be effected, the erection of buildings and works might result in a dépd, the proper and full occupation of which would have to await water supply. The time which would be occupied in laying mains, &c., would, from the time decision is arrived at, be about eighteen months or two years, and as matters appear at present it may be several months before a decision as between respective schemes can be arrived at. In the meantime there are many pressing reasons why the dépd at Flinders Base should be begun as soon as practicable.

5. In the following notes it is briefly stated what action has been taken in respect to each of the schemes mentioned in paragraph 1.

### 6. I. Local Catchment Area (Flinders Range).

Mr. Hill's report of the 22nd November brought under notice a proposal for supplying water from Stony Creek at a point near Shoroham, and he was instructed to, and made further investigations. His report was as follows:—

"Melbourne, 22nd November, 1912.

Memorandum to the Director-General of Works. In the matter of requisite water supply at the Royal Australian Naval Depot at Westernport, I desire to report that rough preliminary observations and inquiries have been conducted as to various sources of supply, including the Dandenong Waterworks' Front, and the accompanying plan and section indicate what is considered to be the most economical and satisfactory scheme.

The proposal provides for:—

1. The conveyance of water from Stony Creek at a point near Shoroham having an elevation of 320 feet above sea-level.
2. The construction of a concrete dam on a suitable site—particular location yet to be determined.
3. The acquisition of a waterled area, as approximately hatched in blue on plan.
4. An assessment for a small portion of the pipe line where levels necessitate deviation from the road.

5. The acquisition of a site for a service reservoir. The rainfall on the main Flinders Range is very good, and an ample water supply for 2,000 men seems assured. The estimated cost—approximately only in the absence of the data which final exploration will furnish—is from £20,000 to £25,000. Subject to your instruction, I shall institute further investigation.

THOMAS HILL,  
Works Director, Victoria."

Samples of water were taken from several catchment areas in the vicinity, and submitted to the Federal Analyst for report, and in view of the results of analyses, Mr. Hill made the following report on 22nd July, 1913, in which three catchment areas were discussed, and the approximate cost, including acquisition of lands and construction of pipe lines, was estimated:—

"Memorandum to the Director-General of Works.

In the matter of water supply to Flinders Naval Base, I beg to report that, in accordance with your instructions, I have had a reconnaissance survey made of the Flinders Peninsula and Range, and submit herewith a plan and estimates of cost.

The areas numbered respectively 1, 2, and 3, and shown on the plan, are the only portions of the range from which the provision of the water supply is at all practicable, both by reason of their elevation and location. The soil varies from a rich chocolate loamy clay to a sandy loam, and the country is mostly freehold, its richer portions being devoted to orcharding, strawberry, and vegetable growing, some of the poorer to grazing, while the residue is uncleared. The rainfall is fairly good, the district being favoured by generous coastal rains, and may be taken as from 25 to 40 inches annually. The volume quoted and the estimated annual discharge are based upon 2 inches of the rainfall being discharged throughout the year. Two schemes are

submitted for consideration, one shown as areas 1 and 2, combined, and the other as area 3. It will be noticed that the cost of the purchase of land for 3 is very heavy, so much of it being under cultivation. A large proportion of areas 1 and 2 is in the native state, comprising peppercorn and stringy-bark country and sandy loam. The rough estimates are appended:—

#### Watersheds 1 and 2 combined—A.

	£	s.	d.
(1) 20 acres orchard, £30	000	0	0
150 acres crop, £10	1,500	0	0
72 acres cleared land, £9	648	0	0
160 acres timber, rung and partially cleared, £7	1,050	0	0
10 acres vegetable, £10	100	0	0
1,217 acres uncleared land, £5	6,085	0	0
Total area, 1,610 acres			
4½ miles 4-inch C.I. pipe, laid complete, 23,700 feet, 2s. 6d. per foot.	2,970	0	0
12 miles 6-inch C.I. pipe, laid complete, 63,300 feet, 3s. 3d. per foot.	10,236	0	0
Annual flow, 66,000,000 gallons.			
Main reservoir, earthen wall, concrete core, capacity 120,000,000 gallons	7,000	0	0
Service reservoir	3,000	0	0

(2) 20 acres orchard, £30	000	0	0
35 acres crop, £10	350	0	0
108 acres cleared land, £9	972	0	0
16 acres timber, rung and partially cleared, £7	105	0	0
Total area, 1,011 acres.			
1,701 acres uncleared land, £5	8,765	0	0
Reservoir, earthen wall, concrete core, capacity 120,000,000 gallons.	7,000	0	0
Annual flow, 67,000,000 gallons.			
4 miles 6¼-inch C.I. pipe, 21,120 feet, 3s. 3d.	3,432	0	0
800 feet tunnel, £2	1,600	0	0
Summary.			
Purchase of land (areas 1 and 2)	20,225	0	0
Main reservoir, 1 and 2 (210,000,000 gallons)	14,000	0	0
Service reservoir	3,000	0	0
Pipe line complete	20,238	0	0
Total cost	67,923	0	0

	£	s.	d.
Say	68,000	0	0
Total area watersheds (1 and 2 combined)—3,520 acres.			
Estimated annual flow (1 and 2 combined) on discharge, 133,000,000 gallons.			

#### Watershed No. 3—B.

	£	s.	d.
108 acres orchard, £30	3,240	0	0
258 acres crop, £10	2,580	0	0
350 acres cleared land, £9	3,150	0	0
252 acres timber, rung and partially cleared, £7	1,764	0	0
6 acres strawberries, £25	150	0	0
800 acres uncleared land, £5	4,000	0	0
Total area, 1,863 acres.			
Main reservoir, concrete core and earth, capacity 160,000,000 gallons	15,000	0	0
11 miles 6-inch C.I. pipe, 68,080 feet, 3s. 3d.	9,438	0	0
Service reservoir, 1,600,000 gallons	3,000	0	0
Summary.			
Purchase of land	17,620	0	0
Main reservoir, 160,000,000 gallons	15,000	0	0
Service reservoir, 1,600,000 gallons	3,000	0	0
Pipe line	5,438	0	0
Total cost	44,997	0	0

Say	45,000	0	0
Total area of watershed, 1,863 acres.			
Estimated annual flow on 2-inch discharges, 82,000,000 gallons.			

Samples of water have been obtained, and analyses made by the Federal Analyst have been forwarded to you. The results in case watershed No. 3 are of consideration. When taken into conjunction with the high cost of obtaining the land, and the relative small area of its watershed as compared with areas 1 and 2, and the fact that its discharge is similarly small, and the analyses of the water of areas 1 and 2 are considerably

better, and unless the further investigations now being made in connexion with the supply of water by the Dandenong Trust Supply, in company with other shires in the Mornington Peninsula, result in a more extensive scheme being evolved, it would appear that further close consideration and estimate of cost should be undertaken, as the water, while not of the best quality, and suitable for boiler purposes, while the estimated cost of such a scheme, £58,000, is not unduly high. It will be noticed that an estimate has been made in respect of watershed 1 and 2 for a considerable deviation of the main, together with the construction of about 800 feet of tunnel. This course is necessary to effect a crossing over a high spur known as the Main Ridge road, separating the watersheds from the Naval Base. The extra length is roughly 4 miles, representing some £7,000, but the increased cost insures the advantage of a gravity scheme against a pumping scheme.

The matter is submitted for consideration, and the favour of instruction as to whether, in the light of the facts presented, an investigation should be made of the creeks discharging from the Dandenong Range adjacent to the Dandenong water supply—this is the only one being examined by Mr. Sambell, in touch with the State Rivers and Water Supply Department. This course is strongly urged.

THOMAS HILL,  
Works Director, Victoria."

He submitted the matter for consideration and instructions as to whether, in the light of the facts presented, an investigation should be made of the creeks discharging from the Dandenong Range, adjacent to the Dandenong water supply—this is the only one being examined by Mr. Sambell, in touch with the State Rivers and Water Supply Department. This course is strongly urged.

When Mr. Hill's reports reached this stage he submitted that an investigation should be made of the Moubuk scheme. His investigations were then merged into those of the engineers of the Mornington Peninsular Shires, *vide* scheme III—Moubuk and Cardinia Creek.

**II. Borings in the Vicinity of the Site.**  
8. The possibility of obtaining water from borings required early consideration, and was the subject of inquiry and discussion with geologists of the Geological Department of Victoria. The information obtained did not point to a satisfactory supply, and it was by this method. However, the Naval authorities considered it advisable to thoroughly probe the question, and Sir William Creswell communicated with the Professor of Geology, Melbourne University. Subsequently, borings were made, and the results were, it is understood, unsatisfactory. The information is held by the Royal Australian Naval authorities.

I have in my possession information received from the Naval authorities, but I suggest that the officer who conducted the borings might later be examined by the Committee.

#### III. Moubuk and Cardinia Creek.

9. The scheme was considered by the Department and brought into prominence by letters during December, 1912, from Mr. Thomas Walker Fowler, C.E., engineer in charge of the Shires of Mornington and Hastings to the Home Affairs, for a scheme from Cardinia Creek, and Mr. Sambell, civil and hydraulic engineer (at that time Shire Engineer at Frankston) and subsequently Secretary for Defence. The latter communication was referred to the Minister for Home Affairs, and subsequently a meeting was arranged with Mr. Sambell.

10. The source of supply (in the Dandenong Range) is the next nearest available catchment (after Flinders Range) and the object of the representations by the Shire engineers was to obtain a water supply for the Mornington Peninsular Shires and for the Flinders base.

11. It was understood at the time that the Shire Council had been investigating all possibilities of local supply, but had been discouraged by the presence of a rhinoceros matter in the water obtained from the local catchments.

12. Consultations were held with the Director of Naval Works and Mr. Sambell, and it was considered that the matter could not be further dealt with except in direct touch with the State Rivers and Water Supply Commission.

13. A communication was sent to the Premier of Victoria requesting that the Commission should interview the Shire engineers and subsequently confer with Commonwealth officers. With the concurrence of the Victorian Government, Mr. T. Murray, of the State Rivers and

Water Supply Commission, was instructed to make inquiries, and a consultation was held, the notes of which are as follows:—

#### Water from Dandenong Supply.

Notes Made—Consultation with Mr. T. Murray, 22nd April, 1913.

Mr. Murray drew attention to a letter from the Prime Minister to the Premier, dated 17th March, 1913, under which the question was raised as to water supply for Mornington, Frankston, and Dandenong shires, that being the subject on which he was attending the meeting. He stated that if the Commonwealth would put forward any scheme the Rivers and Water Supply Commission would consider the diversion of portion of the supply from catchment.

Colonel Owen pointed out, however, that there is difficulty in the Commonwealth Department putting forward a scheme in which the Dandenong shire would participate, in that they are unable to make any selection in the absence of knowledge of what would be the requirements for the shire.

On the other hand it was mentioned also that during a meeting with Mr. Sambell he had stated that he could not submit a scheme to the Rivers and Water Supply Commission unless the Commonwealth would join in (to take water).

Mr. Murray stated that the Commission had not under its notice any scheme from either Mr. Fowler or Mr. Sambell.

In respect to the possible supply from Dandenong the next steps appear therefore to be—

(a) that the Commonwealth should prepare data as to its requirements and other dominating conditions for Flinders Base, and forward that information to the Rivers and Water Supply Commission in furtherance of the proposal made in the Prime Minister's letter.

(b) that the Commission also be informed that, with a view to ascertaining what are the possibilities of water supply from that source, the Commonwealth would be prepared to contribute a sum of £150 towards the cost of such preliminary investigations and plans as are necessary for the Commission to determine the matter, subject to such investigation being put before the Commission within six months.

(c) also, subject to the shires interested determining on one scheme to which they would all agree, and which they would be prepared to put before the Commission;

(d) that the payment be conditional on a notification to be received from the Commission that they have received information sufficient for them to deal with the matter, and on further condition that the Commonwealth should be afforded all information (plans, data, and estimates) to give final consideration;

(e) that the Commission be advised also that, as brought under the notice of Mr. Murray personally, the Commonwealth is making investigations regarding another source of supply for the sole purpose of Flinders Base.

(f) that notwithstanding the contribution of £150 the Commonwealth reserves the right to reject or adopt the scheme for its own purposes as it may deem fit.

14. The following communication was addressed to Mr. Sambell, stating that the Commonwealth would contribute £150 towards such preliminary expenses as would be incurred by the shires in preparing and submitting to the State Rivers and Water Supply Commission the scheme proposed by him:—

"Moubuk Creek Catchment Area and Proposed Reservoir in Dandenong Range."

14th May, 1913.

DEAR SIR,  
It is understood that the above scheme suggested by you at an interview on the 29th October, 1912, has not yet been prepared in sufficient detail for placing before the State Rivers and Water Supply Commission for their investigation.

If such be the case, the Commonwealth would be willing to contribute towards the preliminary expenses in preparing the scheme in order to have the data available at an early date when finally considering which source of water supply should be adopted for the Flinders Naval Base.

It is not possible for the Department to consider any proposal unless which the Commonwealth would be given water supply under a shire's scheme without knowing what would be the water supply requirements for the shires concerned, and the actual quantity of water that will be available for distribution.

It is now proposed by this Department to contribute £150 towards the preliminary expenses which would be incurred by the shires concerned in preparing and submitting this scheme to the State Rivers and Water Supply Commission, on conditions as follows:—

(a) That the shires interested determine on one scheme to which they would all agree, and which they would be prepared to put before the State Rivers and Water Supply Commission.

(b) That the scheme would be submitted to the Commission within six months from the date, and that it be sufficiently complete in detail for the Commission to deal with the scheme before the payment of the Commonwealth's contribution of £150 be made.

(c) That the Commonwealth be given copies of all plans, data, and estimates for their consideration.

(d) That, notwithstanding this contribution of £150, the Commonwealth reserves the right to reject or adopt the scheme for its own purposes, as it may deem fit.

I wish to emphasize the fact that, in making a contribution towards the preparation of this water supply scheme, the Commonwealth is endeavouring to obtain a definite offer for consideration; other sources for supplying water to the Flinders Naval Base are under consideration.

The Commonwealth has received a communication from the Engineer of the Mornington shire, and a reply similar to the above is being sent to him.

Yours faithfully,

THOMAS HILL,  
Director-General of Works."

15. A communication to the same effect was addressed to Mr. T. Walker Fowler, shire engineer, Mornington, in continuation of the matter raised in his letter of December, 1912.

16. Mr. Sambell replied saying that he had been requested by the shires of Dandenong, Frankston, and Hastings to prepare a scheme of water supply for Flinders Base, and to include the Naval Base if required to do so by the Department. Further, that a committee appointed from the council had agreed to submit the Moubuk scheme to the State Government, and that he could accept the offer of £150 subject to the conditions of the letter of 14th May, 1913.

17. Accordingly, Ministerial approval was given to contribute £150 towards the cost of Mr. Sambell's report.

18. During May, Mr. Thomas Walker Fowler writing stating that he had been appointed to the position of Engineer-in-Chief for Tasmania.

19. A communication was addressed to the Secretary of the State Rivers and Water Supply Commission, stating the basis of requirements of water for Naval Base, also that a letter had been written to Mr. Sambell proposing that the Government should contribute £150 towards the preliminary expenses of preparing and submitting a scheme for the consideration of the Commission. A copy of the letter to Mr. Sambell was sent to the Secretary of the Commission, together with (at the Secretary's request) a copy of Mr. Sambell's reply.

20. On the 20th June, 1913, Mr. Anderson wrote for the State Rivers and Water Supply Commission, saying that Mr. Murray intended to visit Mornington on the 11th July for the purpose of discussing with the engineers of Mornington, Hastings, Frankston, and Dandenong the question of a joint scheme.

21. An officer of the Department attended the meeting, and reported that the shires intended to ask the Commonwealth to contribute £300 instead of £150 towards the expenses. Subsequently the Minister for Home Affairs stated that he considered £150 was a liberal contribution.

22. Mr. Sambell then took in hand the investigations and preparation of a report, and from time to time inquiries were made as to progress. It was asked in March, 1914, what was the position in regard to his scheme, and informed that, unless the Moubuk Creek data were made available, that source of supply could not receive further consideration. His reply was that the councils concerned were then dealing with rating proposals under the scheme proposed by him.

It was understood from that that he had completed his part of the work as engineer, and that the councils were dealing generally with the question of ratings.

23. In April, 1914, Mr. Sambell forwarded to the Department a copy of a report of the Special Committee of the Peninsular Water Supply Conference (shires), which





6. To Senator Lynch.—I believe that whatever scheme were adopted public pressure would be brought to bear upon the Commonwealth authorities to supply the people in the districts through which the pipe main would pass. If the Commonwealth laid down a pipe only big enough for its own purposes, it could not afford supply, and it would then be said that it was a lack of foresight not to have provided for the local demand. The alternative for the Commonwealth is an impossible one, namely, that it should lay down a big enough pipe to supply every one in the localities through which it would go. Therefore, my suggestion to the Melbourne and Metropolitan Board of Works was that they should arrange for a scheme towards the expense of which the Commonwealth and the shires interested might contribute, big enough to meet the demands of the Commonwealth and the shires. I believe that in that way, for a given expenditure of money, the best results will be obtained by all parties. When you suggest that the Commonwealth Government may not have local power to supply more than the Naval Base, I would say that if that be so, it should not be difficult to obtain the necessary power. There is no comparison between the watersheds of the different schemes. The supply from the O'Shanassy River is the one which should be drawn upon. I understand from Mr. Murray that some gauging indicates that the flow from the Monbulk and Cardinia schemes has been very small within the last few months. Personally I am most apprehensive of the success of attempting to obtain a big water supply from a small catchment area. Although the first scheme—to obtain the supply from the local catchment area—might be sufficient for the Naval Base, it would not meet the requirements that would be made on the water. I do not think that there need be any fear that the necessary supply for the Naval Base would be subordinated to the requirements of Melbourne if the fourth scheme were adopted. We should not have a separate catchment area, because our supply would be drawn from the O'Shanassy scheme, but we would take off at the Notting Hill reservoir, and we need not contemplate that the supply for the Flinders Naval Base would be actually cut off.

7. To Mr. Fenton.—It would cost the Commonwealth £52,000 for the mains if steel pipes were laid, and it would cost us about £8,000 a year for water rates at 1s. per 1,000 gallons, but I do not think there would be the full consumption every day.

8. To Mr. Laird Smith.—The charge of 1s. per 1,000 gallons is very high.

9. To Mr. Sampson.—The present proposition of the Board of Works is that we should spend £50,000 odd to put in the pipe line, and also pay 1s. per 1,000 gallons afterwards, but I do not think that is equitable. My idea is that we should contribute to the cost of the pipe line, and then have an equitable rate arranged. The Board might well review the matter, and reduce the rate. It has not yet been proposed to the Board that they should pay the cost of construction and that we should guarantee them a certain consumption per annum. The matter has been held in abeyance from week to week, pending a settlement about the Monbulk and Cardinia catchment. Until that matter has been settled with Mr. Murray, I do not think that the Commonwealth should enter into any final arrangement with the Board.

10. To the Chairman.—If no arrangement is come to with the Board, and the Committee cannot see their way to recommend the spending of money on the Notting Hill scheme, I could not say what would be the best alternative scheme until I saw the reports of the shire engineer, and heard what the State Rivers Commission had to say. I am inclined at present to think that under such circumstances the best would be our own self-contained scheme.

11. To Mr. Finlayson.—The quotations given for the cost of various kinds of pipe in the reports produced include cost of laying.

12. To Senator Keating.—I have not absolutely abandoned the local catchment area scheme, but if scheme No. 4 can be carried out on an equitable basis, in conjunction with the Metropolitan Board, I prefer that. I have been told that the borings in the vicinity of the site are unsatisfactory. My opinion in regard to the Monbulk and Cardinia scheme is open to be changed, but I have all along held that that scheme is too small to allow of a water pipe being taken down over the whole of the Mornington Peninsula, with the Commonwealth requirements at the far end of it, although the catchment area would be large enough for the Naval Base requirements alone. The shires, however, have really put the scheme forward, and I doubt whether the catchment area would be sufficient to supply them and us too, eventually. The line from the Metropolitan Board of Works reservoir in scheme No. 4 would be 42 miles in length. It would require at least a 9-inch pipe to do the thing properly, while if the shires come in it ought to be more than 9-inch. I suppose a 6-inch pipe would be just about sufficient for the requirements of the Naval Base alone. With a service reservoir, it would do it easily. A 9-inch pipe would be sufficient to supply the Naval Base and adjoining communities, but to do the thing properly, and supply all the adjacent communities, there should be a 12-inch pipe. The estimates I have submitted as to the cost of 6-inch and 9-inch mains cover the whole 42 miles. I think pressures would be rather high for the use of wooden pipes, and I would be a little scared of using them on the job. For instance, there is a drop to the north of Cranbourne. Wooden pipes are extensively used around Sydney, and in some of the New South Wales country water supply schemes, but I have heard of cases where they have suffered from white ants, but generally I believe they are satisfactory. Of course, there is no corrosion. If No. 4 scheme were entered upon, it would take two years to complete it from the time we set to work. The reference in my report to the discovery by the local councils of alkaline matter in the waters obtained from the local catchment is based on what I heard a long time ago. The people at Mornington are very anxious to get water on the western watershed, but I have been told that, wherever they went, they got saline matter in solution. It is not from borings, but in surface water, due, I think, to the nature of the soil. With reference to Mr. Hill's statement in his report of 26th July, that the cost of the purchase of land for scheme No. 3 would be very heavy, so much of the land being under cultivation, and the fact that, in the detailed estimates, the purchase of land for scheme No. 3 is put down at £17,550, and for schemes Nos. 1 and 2 combined at £20,425, it must be remembered that there is a very much larger catchment area in schemes 1 and 2. What is meant is that the cost would be proportionately heavier. The costs I

have given can be called a general preliminary estimate. Mr. Hill, in his letter to me of 19th December, 1913, says, "The route will present no difficulties, being along main roads, and entailing easy excavation." The pipes would be laid at a depth of about 3 feet. If it were afterwards found that larger pipes were required, the pipe already put in would be left there, but, of course, a certain amount of excavation would have to be done for the new pipes. It is suggested that the service reservoir should be situated at a level of 120 feet. The highest level in the Naval Base is under 50 feet. There are some sites which are going to be occupied along the inlet, of which I do not know the level, but it will be under 50 feet. A height of 120 feet will be adequate for the service reservoir anywhere. The water from the O'Shanassy scheme has been available for the last month or two. The maintenance charge of the pipe line would be very small. Although the Board propose that the Department should lay and maintain the pipes, the maintenance is not a very expensive matter. If they gave us water at a rate that would cover maintenance, I do not think they would make any charge for maintenance. If it were agreed that the Department should "lay and maintain" the pipe, it would mean, broadly, that it would be our pipe and our main, whereas if the Board laid and maintained it, it would be their pipe, and they would be responsible, but in any case the charge for maintenance is inconsiderable. It is the Board's policy to retain possession of the mains. They charge 1s. per 1,000 gallons for water as a general rule, allowing free a certain quantity, based on the rateable value of the property served.

#### FLINDERS NAVAL BASE.

Rainfall, Mornington—  
Worst years 1895, 23 inches,  
1896, 28 inches.

#### WATER SUPPLY.

Minimum estimated supply for all purposes, 150,000 gallons per day.  
Maximum estimated supply for all purposes, 250,000 gallons per day, allows for all possible eventual requirements.  
Allowing a basis of 55 gallons per head per day at Naval Base with a population of 2,000, the daily consumption would be 110,000 gallons.

#### WATER CONSUMPTION OF TYPICAL TOWNS IN VICTORIA.

	GALLONS PER HEAD.			Reserved.
	Per Day.	Per Annum.	Cost per Thousand Gallons.	
Melbourne .. .. .	55	20,000	Yes	
Wentzell .. .. .	44	10,000	No	
Tochester .. .. .	39	14,000	No	

#### SCHEME SUBMITTED TO WATER SUPPLY COMMISSION FOR CONSIDERATION.

Proposed Source of Supply for Naval Base.	Instigator.	Daily Quantity Available.	Total Cost.	Cost per Thousand Gallons.	Quality.
Monbulk ..	Shires of Frankston and Hastings, Dandenong, Mornington	1,250,000	With Naval Base, £125,000; Without Naval Base, £100,000	s. d. 1 5½	First
Notting Hill ..	Metropolitan Water Board	200,000	£25,000 and royalty, 1s. per 1,000	2 5	First
Stony Creek, 1 ..	Home Affairs .. .. .	180,000	£28,000 ..	1 7	Potable but not first class
Stony Creek, 2 ..	Home Affairs .. .. .	180,000			
Artesian at Base, 3 No. Bore	Navy Board .. .. .	Ample for 55 gallons per head per day purposes	Flow of 8,400 gallons per day	Ample for 55 gallons per head per day purposes	Not potable

N.B.—Cost per 1,000 gallons is based on a consumption of 120,000 gallons per day. Greater consumption than this would reduce the cost per thousand.

(Taken at Melbourne.)

TUESDAY, 23rd MARCH, 1914.

Present:

Mr. RILEY, Chairman;  
Senator Keating, Mr. Finlayson,  
Senator Lynch, Mr. Gregory,  
Senator Storey, Mr. Sampson,  
Mr. Fenton.

Herbert Herbert Fanstone, Director of Naval Works, sworn and examined.

13. To the Chairman.—In my official capacity the investigation and research work of a water supply scheme for the Westernport Naval Base has been entirely under my direction. I reported on it first in August, 1911. Consequently I am thoroughly familiar with the plans now before the Committee. All the research work in this connexion has been done under a Naval Civil engineer. It has been a very extensive work, covering a great area in and around the Naval Base. We have also thoroughly examined all the creeks in the vicinity and also the formations from the stand-point of a catchment area and of an artesian supply. Briefly stated, the results of our investigations have been of a negative character. All the samples of water from No. 1 sample, which was reported upon by Mr. Marcus Bell, the analyst, onwards, have been condemned as unfit for human consumption. This remark applies, not only to the surface water, but to the sub-artesian supply. The results of these analyses are shown in the following tabulated statements:—

FLINDERS NAVAL BASE.

TABULATION OF SAMPLES OF WATER.

Sample No.	Reference.	Date of Analysis.	Locality and description of sample.	PART PER 100,000.										Remarks.				
				Arsenic and Sulphur.	Ammonia.	Aluminium.	Organic Matter in Filtrate.	Chlorine.	Sulphate Salts.	Magnesia.	Calcium.	Iron.	Temp.		Sodium Chloride.	Boiling.	Turbidity.	Sulphates.
2	V. 31 D. 2092	10.0.13	Research's Bore, 1 1/2 miles west of Hastings Railway Station	0.075	0.027	0.303	11.1											Sample taken, 15th August, 1912. Bore 160 feet deep. Analyt. Mr. Marcus Bell. Sample slightly discolored. On standing to pump water was quite clear, after pumping fifteen minutes the water was clear. Weather very dry at time sample was taken (see table for Mr. Research's bore after continuous pumping). Unit for human consumption. (Unit) K. C. 6th November, 1912. Iron and sulphates, 2.5 per cent. Mr. Marcus Bell, Chemical Analyst. Unit for human consumption.
21	V. 31 D. 4340	13.11.13	Sample taken from Mr. Research's Bore	0.012	0.001	0.026	58.8	116.8	5.8	2.8								Sample taken, 4th July, 1913, before pumping. Depth of water below surface, 21 feet. Mr. Marcus Bell, Analyst. Salt of water below surface 100 feet. Sample taken, 4th July, 1913, after pumping about half-an-hour. Depth of water below surface 21 feet. Mr. Marcus Bell, Analyst. Iron salts a trace. Unit for human consumption. 1913, after pumping 700 gallons continuously at the rate of 300 gallons per hour. No reduction in supply of water observed. Mr. Marcus Bell, Analyst. Unit for human consumption. Sample taken from Stacey's Bore, p.m., 18th October, 1913, after pumping 200 gallons per hour; pump section 100 feet below surface level. Mr. Marcus Bell, Analyst.
3	V. 31	21.8.13	Sample from Stacey's Bore								16.3							Sample taken, 4th July, 1913, before pumping. Depth of water below surface, 21 feet. Mr. Marcus Bell, Analyst. Salt of water below surface 100 feet. Sample taken, 4th July, 1913, after pumping about half-an-hour. Depth of water below surface 21 feet. Mr. Marcus Bell, Analyst. Iron salts a trace. Unit for human consumption. 1913, after pumping 700 gallons continuously at the rate of 300 gallons per hour. No reduction in supply of water observed. Mr. Marcus Bell, Analyst. Unit for human consumption. Sample taken from Stacey's Bore, p.m., 18th October, 1913, after pumping 200 gallons per hour; pump section 100 feet below surface level. Mr. Marcus Bell, Analyst.
4	V. 31	21.8.13	Sample from Stacey's Bore								15.9							Sample taken, 4th July, 1913, after pumping about half-an-hour. Depth of water below surface 21 feet. Mr. Marcus Bell, Analyst. Iron salts a trace. Unit for human consumption. 1913, after pumping 700 gallons continuously at the rate of 300 gallons per hour. No reduction in supply of water observed. Mr. Marcus Bell, Analyst. Unit for human consumption. Sample taken from Stacey's Bore, p.m., 18th October, 1913, after pumping 200 gallons per hour; pump section 100 feet below surface level. Mr. Marcus Bell, Analyst.
5	V. 31	22.10.13	Sample from Stacey's Bore	0.015	0.003	0.083	41.8		1.5	5.7								Sample taken, 4th July, 1913, before pumping. Depth of water below surface, 21 feet. Mr. Marcus Bell, Analyst. Salt of water below surface 100 feet. Sample taken, 4th July, 1913, after pumping about half-an-hour. Depth of water below surface 21 feet. Mr. Marcus Bell, Analyst. Iron salts a trace. Unit for human consumption. 1913, after pumping 700 gallons continuously at the rate of 300 gallons per hour. No reduction in supply of water observed. Mr. Marcus Bell, Analyst. Unit for human consumption. Sample taken from Stacey's Bore, p.m., 18th October, 1913, after pumping 200 gallons per hour; pump section 100 feet below surface level. Mr. Marcus Bell, Analyst.
6	V. 31	22.10.13	Sample from Stacey's Bore	0.016	0.001	0.062	61.4		3.0	13.3								Sample taken, 4th July, 1913, before pumping. Depth of water below surface, 21 feet. Mr. Marcus Bell, Analyst. Salt of water below surface 100 feet. Sample taken, 4th July, 1913, after pumping about half-an-hour. Depth of water below surface 21 feet. Mr. Marcus Bell, Analyst. Iron salts a trace. Unit for human consumption. 1913, after pumping 700 gallons continuously at the rate of 300 gallons per hour. No reduction in supply of water observed. Mr. Marcus Bell, Analyst. Unit for human consumption. Sample taken from Stacey's Bore, p.m., 18th October, 1913, after pumping 200 gallons per hour; pump section 100 feet below surface level. Mr. Marcus Bell, Analyst.
8	V. 31 C. 5351	15.10.13	Sample taken from dam ..	0.010	0.012	0.086	81.7	181.0	17.3									Sample taken, 6th October, 1913. This water is not suitable for human consumption. Mr. Marcus Bell, Analyst.
7	V. 31 E. 137641	30.0.13	Sample taken from Bore No. 2	0.0008	0.0014	0.128	53.4		18.7									Sample taken, 10 a.m., 27th August, 1912, after half-an-hour standing. On standing to pump water was quite clear, after pumping fifteen minutes the water was clear. Weather very dry at time sample was taken (see table for Mr. Research's bore after continuous pumping). Unit for human consumption. (Unit) K. C. 6th November, 1912. Iron and sulphates, 2.5 per cent. Mr. Marcus Bell, Chemical Analyst. Unit for human consumption.
18	V. 31 E. 4246	30.10.13	Sample taken from Bore No. 2	0.012	Trace	XII	115.0	210.8	6.8	7.4								Reaction neutral. Sediment slight reddish brown on settling. On standing to pump water was quite clear, after pumping fifteen minutes the water was clear. Weather very dry at time sample was taken (see table for Mr. Research's bore after continuous pumping). Unit for human consumption. (Unit) K. C. 6th November, 1912. Iron and sulphates, 2.5 per cent. Mr. Marcus Bell, Chemical Analyst. Unit for human consumption.
19	V. 31 E. 4326	11.11.13	Sample taken from Bore No. 2	0.007	0.001	0.031	114.4	201.0	6.3	4.0								Reaction neutral. Sediment slight reddish brown on settling. On standing to pump water was quite clear, after pumping fifteen minutes the water was clear. Weather very dry at time sample was taken (see table for Mr. Research's bore after continuous pumping). Unit for human consumption. (Unit) K. C. 6th November, 1912. Iron and sulphates, 2.5 per cent. Mr. Marcus Bell, Chemical Analyst. Unit for human consumption.
20	V. 31 E. 4326	11.11.13	Sample taken from Bore No. 2	0.003	Trace only	0.014	113.0	202.6	NH	4.4								Reaction neutral. Sediment slight reddish brown. On settling water is clear and colorless. On standing to pump water was quite clear, after pumping fifteen minutes the water was clear. Weather very dry at time sample was taken (see table for Mr. Research's bore after continuous pumping). Unit for human consumption. (Unit) K. C. 6th November, 1912. Iron and sulphates, 2.5 per cent. Mr. Marcus Bell, Chemical Analyst. Unit for human consumption.
9	V. 31 A. 127256	10.3.12	Sample taken from Stony Creek	0.016	0.004	1.26	70.1						1.07	70.1	84	17.2	2.0	Result of analysis forwarded by Col. Owen, D.G.W. Sample moderately hard water, suitable either for potable or boiler purposes. Clear, pH. Reaction, faintly acid; sample taken for boiler purposes. Result of analysis forwarded by Col. Owen, D.G.W. Sample moderately hard water, suitable either for potable or boiler purposes. Clear, pH. Reaction, faintly acid; sample taken for boiler purposes. Result of analysis forwarded by Col. Owen, D.G.W. Sample moderately hard water, but not so soft as sample 9 and 10, taken in dry weather. Mr. Percy Wilkinson, Analyst. Result of analysis forwarded by Col. Owen, D.G.W. Sample passes a reasonable standard for boiler purposes. Sample taken after heavy rain. Mr. Percy Wilkinson, Federal Analyst. Result of analysis forwarded by Col. Owen, D.G.W. Sample passes a reasonable standard for boiler purposes. Sample taken after heavy rain. Mr. Percy Wilkinson, Federal Analyst. Result of analysis forwarded by Col. Owen, D.G.W. Sample passes a reasonable standard for boiler purposes. Sample taken after heavy rain. Mr. Percy Wilkinson, Federal Analyst.
10	V. 31 A. 2072	10.3.13	Sample taken from Stony Creek	0.01	0.03	2.04	74.8						1.4	74.8	90.0	17.2	3.42	Result of analysis forwarded by Col. Owen, D.G.W. Sample moderately hard water, suitable either for potable or boiler purposes. Clear, pH. Reaction, faintly acid; sample taken for boiler purposes. Result of analysis forwarded by Col. Owen, D.G.W. Sample moderately hard water, but not so soft as sample 9 and 10, taken in dry weather. Mr. Percy Wilkinson, Analyst. Result of analysis forwarded by Col. Owen, D.G.W. Sample passes a reasonable standard for boiler purposes. Sample taken after heavy rain. Mr. Percy Wilkinson, Federal Analyst. Result of analysis forwarded by Col. Owen, D.G.W. Sample passes a reasonable standard for boiler purposes. Sample taken after heavy rain. Mr. Percy Wilkinson, Federal Analyst.
11	V. 31 A.	10.3.13	Sample taken from Stony Creek	0.006	0.014	1.2	121.7						2.29	121.7	148.0	45.27	1.8	Result of analysis forwarded by Col. Owen, D.G.W. Sample moderately hard water, suitable either for potable or boiler purposes. Clear, pH. Reaction, faintly acid; sample taken for boiler purposes. Result of analysis forwarded by Col. Owen, D.G.W. Sample moderately hard water, but not so soft as sample 9 and 10, taken in dry weather. Mr. Percy Wilkinson, Analyst. Result of analysis forwarded by Col. Owen, D.G.W. Sample passes a reasonable standard for boiler purposes. Sample taken after heavy rain. Mr. Percy Wilkinson, Federal Analyst. Result of analysis forwarded by Col. Owen, D.G.W. Sample passes a reasonable standard for boiler purposes. Sample taken after heavy rain. Mr. Percy Wilkinson, Federal Analyst.
12	V. 31 A. 13	10.3.13	Sample taken from Stony Creek	0.01	0.012	0.44	67.1						2	57.1	69	15.2	1.0	Result of analysis forwarded by Col. Owen, D.G.W. Sample moderately hard water, suitable either for potable or boiler purposes. Clear, pH. Reaction, faintly acid; sample taken for boiler purposes. Result of analysis forwarded by Col. Owen, D.G.W. Sample moderately hard water, but not so soft as sample 9 and 10, taken in dry weather. Mr. Percy Wilkinson, Analyst. Result of analysis forwarded by Col. Owen, D.G.W. Sample passes a reasonable standard for boiler purposes. Sample taken after heavy rain. Mr. Percy Wilkinson, Federal Analyst. Result of analysis forwarded by Col. Owen, D.G.W. Sample passes a reasonable standard for boiler purposes. Sample taken after heavy rain. Mr. Percy Wilkinson, Federal Analyst.
13	V. 31 A. 137416	10.3.13	Sample taken from Stony Creek	0.008	0.014	0.92	91.3						5.1	91.3	101.7	31.7	1.5	Result of analysis forwarded by Col. Owen, D.G.W. Sample moderately hard water, suitable either for potable or boiler purposes. Clear, pH. Reaction, faintly acid; sample taken for boiler purposes. Result of analysis forwarded by Col. Owen, D.G.W. Sample moderately hard water, but not so soft as sample 9 and 10, taken in dry weather. Mr. Percy Wilkinson, Analyst. Result of analysis forwarded by Col. Owen, D.G.W. Sample passes a reasonable standard for boiler purposes. Sample taken after heavy rain. Mr. Percy Wilkinson, Federal Analyst. Result of analysis forwarded by Col. Owen, D.G.W. Sample passes a reasonable standard for boiler purposes. Sample taken after heavy rain. Mr. Percy Wilkinson, Federal Analyst.
14	V. 31 A. 157416	10.3.13	Sample taken from Stony Creek	0.006	0.008	0.40	120.7						7.1	120.7	165	35.2	0.827	Result of analysis forwarded by Col. Owen, D.G.W. Sample moderately hard water, suitable either for potable or boiler purposes. Clear, pH. Reaction, faintly acid; sample taken for boiler purposes. Result of analysis forwarded by Col. Owen, D.G.W. Sample moderately hard water, but not so soft as sample 9 and 10, taken in dry weather. Mr. Percy Wilkinson, Analyst. Result of analysis forwarded by Col. Owen, D.G.W. Sample passes a reasonable standard for boiler purposes. Sample taken after heavy rain. Mr. Percy Wilkinson, Federal Analyst. Result of analysis forwarded by Col. Owen, D.G.W. Sample passes a reasonable standard for boiler purposes. Sample taken after heavy rain. Mr. Percy Wilkinson, Federal Analyst.
15	V. 31 A. 127256	25.9.12	Sample taken from bed of stream about 1/2 mile down from summit of ridge				16.02											Not suitable for drinking purposes. Mr. Marcus Bell, Defence Chemist. Not suitable for drinking purposes. Mr. Marcus Bell, Defence Chemist.
16	V. 31 A. 25.9.12	25.9.12	Sample taken from bed of stream, about 3/4 mile down from summit of ridge				64.5											Not suitable for drinking purposes. Mr. Marcus Bell, Defence Chemist. Not suitable for drinking purposes. Mr. Marcus Bell, Defence Chemist.
17	V. 31 A. 127256	25.9.12	Sample taken from bed of stream, about 3/4 mile down from summit of ridge															Not suitable for drinking purposes. Mr. Marcus Bell, Defence Chemist. Not suitable for drinking purposes. Mr. Marcus Bell, Defence Chemist.
			Sample taken from main road to end of Naval Base															Not suitable for drinking purposes. Mr. Marcus Bell, Defence Chemist. Not suitable for drinking purposes. Mr. Marcus Bell, Defence Chemist.

MARKS'S CREEK.

The Westernport Naval Base is situated at the end of Hann's Inlet, as shown on drawing E13 G1/P38. References to plan will show the position of the proposed buildings for the Naval Training Depot, which consist of barracks and quarters for the officers, the warrant officers, the chief petty officers, and seamen, and sites set aside for the dockyard and workshops for repairing ships, also the Naval Store Department for dealing with the ships of the Fleet later if so required. The victualling Store Department which later deals with the victualling of the Fleet, as well as the establishment and base and the central block of administrative offices. The following buildings, forming part of the training establishment, such as the large drill hall, the gunnery school, the torpedo sub-depot, the submarine sub-depot, the wireless station, and the several buildings in connexion with the naval training scheme. The Westernport Base is unique in this regard; that the site as so planned and laid out, in my opinion, second to none, and forms one of the finest training bases of its kind in the world; complete with recreation ground and parade ground, which altogether form one large review ground. Admiral Henderson, in his historical report, laid it down that Flinders Naval Base was intended as a sub-base for torpedo boats, destroyers, and submarines, and should be pushed to completion as rapidly as possible. We have splendid deep water at entrance to Hann's Inlet, ranging from 8 to 12 and 10 fathoms. The flagship *Australian*, I may remark, draws only about 5 fathoms, and later on we may hope to see the Fleet lying off at anchorage in Westernport Bay, and small craft using the proposed channel way, which will have to be dredged up to the wharfs at the base. The first portion of this dredging will soon be in hand, and then we shall have to proceed with the second portion of the dredging scheme. The length of the channel to be dredged is about 2½ miles. But we must bear in mind that, at the present time, it is only intended to be used by submarines and destroyers and small craft. There is, however, every possibility of any vessel being able to proceed to the base, provided that the channel is dredged deep enough.

14. *To Senator Keating.*—This channel varies in depth at the present time from 2½ fathoms at the mouth of Hann's Inlet to nothing at low water. We are taking out the first cut of this channel to a width of 125 feet, and as destroyers are only 25 feet wide, there should be plenty of room. Our endeavour is to develop this naval scheme so as to provide, not only for the present, but future requirements. Consequently we are proceeding upon safe lines which will permit of easy future expansion. Later on, if it should be deemed necessary, there is ample room to establish a floating dock. By means of a suction dredge we intend to reclaim 1,000 acres of land—an asset which should amply repay for the cost of dredging. It is proposed to establish a general hospital on the south of Hann's Inlet. The hospital will be equipped with an operating theatre, and there will be an isolation hospital and wards, as well as surgical and medical wards. Near Cribb Point railway station will be erected the residential quarters of the officers stationed at the base. Altogether there are some 4,000 acres included in the area of the base. Coming to the matter immediately before the Committee, namely, the water supply, in this connexion we have investi-

gated from a point about 1½ miles from Hastings, and for a distance of 8 miles up Stony Creek, and within this area several samples of water have been taken and all analyzed. The whole of the surface waters within this catchment area have been condemned as unfit for human consumption. Next we took up the question of an artesian supply, and with this end in view put down bores. We were assisted a good deal by a bore which had been sunk about 1½ miles from Hastings. We further put down a bore at the base to a distance of 60 feet, and discovered in the strata deposits of sand which were water carrying, but the samples taken from this sand, however, also proved upon analysis to be unfit for human consumption. Before this property came into our hands a prospector had sunk a bore to a depth of 610 feet, and I was fortunate enough to be able to secure particulars of the strata and borings through which it passed, but I was unable to discover any indications of an artesian supply which could be used by a community of 4,000 people, such as we anticipate will be settled at the base later. I then recommended that a water supply scheme should be taken up in conjunction with the Department of Home Affairs.

15. *To Mr. Fenton.*—When I say that all the water samples which were analyzed were unfit for human consumption I mean that they were highly mineralized. A suggestion has been made that we should obtain an adequate supply for domestic purposes from the Metropolitan Board of Works, Melbourne, and that we should utilize the water that can be obtained in the sub-soil for sanitary and washing-down purposes. If that suggestion were adopted, we should have a supply for domestic use, and a separate supply for sanitary, fire, and other general purposes.

16. *To Senator Lynch.*—Various townships along the sea front are anxious to tap any main which may be laid down with a view to supply the Naval Base. Should effect be given to their wishes it would be necessary to construct a reservoir at the base for our own protection; otherwise, in exceptionally dry periods, the inhabitants of these places might practically draw off the whole available supply and deprive us of water. Two schemes have been put forward in this connexion—one by the Metropolitan Board of Works to bring the water from Notting Hill; and the other, a private scheme, known as the Monbulk scheme. Of the borings put down at the base, No. 2 bore is situated close to the site of the barracks, and No. 1 bore is located 100 feet west of that.

17. *To Mr. Finlayson.*—The deep bore was sunk to investigate for coal before the Commonwealth acquired the property. The idea prevailed that the Wonthaggi vein ran in this direction. As a matter of fact, the previous owner of the property obtained coal, but not in any great quantity. Although I do not think we should ever obtain a supply of water from a catchment area sufficient for all purposes for the Naval Base, there would be a fair supply for ordinary sanitary and fire uses. We have, however, to seriously consider, not merely the requirements of the base, but also those of the Fleet, which is an unknown quantity.

18. *To Mr. Fenton.*—The water now used for works at the base has been analyzed and has caused a small incrustation on our boilers when used for steaming purposes, but nothing to speak

19. *To Senator Lynch.*—I cannot say how long it will be before a population of 4,000 is settled at the base. At present there are 320 men working there. The works at present consist of general engineering, Naval works, wharfs, reconstructions, and embankments on the southern side of Hann's Inlet. I do not expect the base to be used commercially.

20. *To the Chairman.*—Provision has been made for housing 2,000 seamen in the barracks, and in addition there will eventually be a complement of men for the dockyard and for training purposes. I cannot say when the dockyard will be established.

21. *To Mr. Finlayson.*—It is only a question of £ a day—in other words of dredging—to enable the ships of the Fleet to reach the site of the base or dockyard later. The working strength of the establishment when the barracks are finished will be between 3,000 and 4,000 persons, including women and children in the married quarters and residences.

22. *To Senator Lynch.*—I should think that within the next thirty or forty years the population would not exceed 10,000. That would be an outside estimate. The development of Jervis Bay should have no effect whatever upon the Flinders Base, which is intended to be a sub-base. It is part of the chain of sub-bases which includes Fremantle, Port Lincoln, Hobart, Launceston, Port Stephens, Brisbane, Townsville, Rockhampton, and Port Darwin, recommended by Admiral Henderson in his report. The fleet primary base at Cockburn Sound (the western base) is an entirely different proposition. Sydney is the eastern base. Where shipbuilding is undertaken at Cockburn Island, and at Garden Island, barracks have been provided, and in addition repair and fitting shops and naval storehouses with stores for the fleet.

23. *To Mr. Fenton.*—Sydney and Cockburn Sound are regarded as fleet primary bases, and all the other places I have enumerated are regarded as sub-bases. Everything centres at the fleet primary bases, from whence directions are given.

24. *To Mr. Finlayson.*—The last conference with the Department of Home Affairs in regard to a water supply for the Flinders Naval Base had reference to a supply by the Metropolitan Board of Works. I am quite in sympathy with the desire of the inhabitants of the several townships along the sea front to tap our pipe line to the Naval Base in order to meet all requirements if possible. At that conference I raised the question of why we should be called upon to pay the cost of laying down a pipe line if we are to be charged 1s. or 1s. 6d. per 1,000 gallons for the water which we consume, and the inhabitants of the townships on the route charged a similar rate.

25. *To Senator Lynch.*—It is only a few weeks ago that we had a conference on that matter.

26. *To Mr. Fenton.*—The Metropolitan Board of Works have been most generous in their treatment of us in considering our application.

27. *To Mr. Finlayson.*—Sufficient data is not available, at present, to warrant us in assuming that the Monbulk scheme would provide us with an adequate supply. On the other hand, the Metropolitan Board of Works offer us a good supply, and one which can almost be termed unlimited. If the scheme of the Metropolitan Board of Works cannot provide for the requirements of the townships

on the sea front we shall be driven to make the best terms possible. To supply a population of 4,000—assuming that the consumption is 40 gallons per head per day—would involve an expenditure of £3,000 annually. The pipe line would cost £50,000. This supply should be used only for human consumption, and all other services should be provided for by means of water from the sub-soil. That would reduce the expenditure enormously. Our rainfall is a good one. It averages about 30 inches per annum, but I am afraid that we have not sufficient roof space to provide all the water required for human consumption. Consequently we must obtain a supply by other means. At present, for the works, we have to bring water from Langwarrin. We have no enclosures from roofs worth talking about at present.

28. *To Senator Lynch.*—The water supplied by the Metropolitan Board of Works has been pronounced of good quality for all purposes. So long as we are close to the sea we do not trouble much about our boilers, if a condensing plant is available.

29. *To Mr. Sampson.*—Condensed water is a satisfactory water for steam purposes.

30. *To Mr. Gregory.*—Flinders is a sub-base for destroyers and submarines, and also provides a large training establishment. A dockyard, with room for expansion, is contemplated. In the bore which was sunk to a depth of 600 feet no artesian supply was met. Sub-artesian water was obtained about 7½ feet from the surface. The basic rock appears in the lower strata which the bore pierced. Other bores were put down about 1½ miles from Hastings to a depth of 100 feet, in undulating country. We have samples of the rock which these bores passed through.

(Taken at Melbourne.)

WEDNESDAY, 17th MARCH, 1915.

Present:

	Mr. RILEY, Chairman;
Senator Keating,	Mr. Finlayson,
Senator Lynch,	Mr. Gregory,
Senator Storey,	Mr. Sampson,
Mr. Fenton,	Mr. Laird Smith.

Rear-Admiral Sir William R. Creswell, first naval member of the Naval Board, sworn and examined.

31. *To the Chairman.*—The water supply at Westernport comes under my consideration amongst various other matters, and it has presented a very big problem. I have my own opinion as to the best method of obtaining a permanent water supply for the Naval Base at Westernport, but that opinion is not a strictly professional one. I know that there are two schemes proposed (1) to place a catchment at the extreme end of the Melbourne water supply, and (2) to tap a fresh supply in the direction of Monbulk, and carry the water through the intervening country to the Naval Base. I am inclined to favour the latter project. Apart from any question of expense, I think that for a great establishment such as the Naval Base with eventually be, and having regard to the enormous

expansion that is continually taking place in Melbourne, we would stand a better chance of obtaining all the water that may be required at the Base if we had a new and separate scheme. Melbourne is extending very rapidly, particularly in the direction of the sea beaches, and it is impossible to place a limit to the demand that may be made upon the present system for supplying the city with water. Of course, we shall not be ready for our war ships at Westport for a considerable time, but we shall probably require water for ships other than those which would come to the Base through the dredged channel. It was proposed by Admiral Henderson that Westport should be the meeting place, and summer exercising area of the Fleet pending the completion of Cockburn Sound. When Westport is put to that use we shall want a great deal of water, and I think our reservoir would be best met by having a local source. When a fleet takes water it requires a very big supply, and it would be necessary to be able to have a good reserve available. In that respect the water supply for a naval base differs from the ordinary daily consumption of town.

If we had only a comparatively small flow from Mornhill we could still arrange to have a sufficient quantity in reserve to meet the requirements of the Fleet. In connexion with any scheme of water supply for the Naval Base we should require a reservoir with a storage capacity sufficient to cope with the demands of the ships. At present our ships obtain their water at Williamstown from the Melbourne system, and so far we have not had any difficulty in obtaining an abundant supply. Admiral Henderson has laid down a basis of nine submarines; these would have a complement of 25 men each. There may be periods when we shall have the whole Fleet at Westport, the large ships and the destroyers as well as the submarines. Such an event is not probable, but we would be likely to have quite a large number of vessels there at times. At present there are in commission or in course of construction six destroyers, and if all of them were present at Westport at one time they would represent about 300 men, comprising the crews and others attending the vessels. I regard a plentiful water supply as a most important necessity in connexion with the Naval Base. We have not had any reason, that I am aware of, to find fault with the Yau Yau water on account of any corrosive effect upon the boilers. The general tendency of surface water is to be rather beneficial to boilers. I know that the Murray River water is celebrated for keeping boilers particularly clean. The brackish water this is obtainable at Westport would not be suitable for boiler purposes.

32. To Mr. Fenton.—I estimate that within the next two years there will be about 1,000 naval men at the Naval Base, including the crews of any destroyers which might be at Westport. The destroyers would not require to visit the channel is completely dredged before making use of the Base; they could come there as soon as the channel was created. I think that if we were to calculate that a water supply would be required for 1,000 men at the Base within the next two years we would be well on the safe side.

33. To Senator Story.—I do not think we will have the main Fleet at the Base for a few years. It peace were to be declared, say, at the end of this month, and the development of our Navy

were allowed to proceed as proposed by Admiral Henderson, and if Parliament were to allow us sufficient funds for our purposes, I should consider that I had made sufficient provision of water at the Base if I had a scheme capable of getting a daily supply for 1,000 men. Of course, we are anxious to get the Base in operation as soon as possible.

34. To Mr. Sampson.—The 1,000 men I speak of would be those who were in training, reserve men to make good any shortages in the Fleet, instructors, officers, and the whole of the permanent staff, and also the different artisans and mechanical ratings required for the workshops. I think there is a prospect of developing the Base 20 years as he estimated. Of course, the present war may bring about a great many changes, and suggest some modifications in the scheme which has been laid down. Admiral Henderson noted that possibility, and expected that as advances were made in naval science modifications of his scheme would be introduced.

35. To Mr. Gregory.—I have not estimated the development of the Base much further than the completing of the present establishment. Of course, the rate at which it would develop would depend on the rate at which the Government would let us have the necessary money. We would take the Base over before the channels were dredged; in fact, the dredging would be done by the Naval Department. We would be prepared to take over the scheme as soon as the water was in it. I should think that within the next two or three years we should have the Base completed sufficiently for current requirements.

36. To Mr. Laird Smith.—The 1,000 men which I estimate to be at the Base at the end of two years comprise only the naval portion of the establishment. Provision would have to be made to supply the labourers and civil population in addition to that number.

37. To the Chairman.—I have not formed any estimate as to what it would cost the Naval Department to convey water by rail to Westport in sufficient quantities to meet the requirements of the population there.

38. To Senator Lynch.—When the programme now under contemplation for the development of the Naval Base at Westport is completed there will be about 4,000 men at the Base, of whom about 2,000 will be quartered there. Admiral Henderson estimated that the completion of the Base, according to the programme he laid down, would occupy about 23 years, so that this number should be provided for at the end of 20 years. On the basis of Melbourne's daily consumption, namely, 71 gallons per head, the proposal for a water service capable of supplying 120,000 gallons per day to Westport would provide for only 1,700 people. That daily supply is estimated to come from a 6-inch service; a 9-inch service would deliver 288,000 gallons per day. On the basis of Melbourne's present consumption the 4,000 men whom I estimate to be at Westport at the end of 20 years would require 280,000 gallons per day. However, I think that the men at the Naval Base will consume rather less per head per day than do the people of Melbourne. I should say that 60 gallons per head per day would be an ample allowance for the Naval Base. Of course, there would be at the Naval Base much more shipping in proportion to population than

there is at Melbourne, and that would necessarily raise the average consumption. My estimate of 4,000 men does not take into account the civil population that may be in the district. I am calculating only the furthest possible limit of naval ratings. We propose to transfer to Westport the men at present domiciled at Williamstown. This will be done as soon as possible. As to the men at Williamstown, they are located on present rights, making a mixed tenure with certain rights and certain rights there that it is difficult to get at the bottom of the matter, and so we have promised to vacate the property as soon as we possibly can, as the State is anxious to extend its shipping yards. We occupy the site where they wish to establish a dry dock. The transfer from Williamstown to Westport will be a convenience and an advantage to us even before the dredging has been completed, so long as there is sufficient room to enable small craft such as destroyers to proceed up the channel, and even prior to that. We propose to shift about 400 men. Of course, any increase over that number will depend upon the rate of increase in the size of the Fleet. Really, more than launch water, we only require little sufficient water to give us free boat communication between the Base and the open water outside. That will be all that we need at present as a beginning. To shift the men as soon as possible will be a matter of economy and advantage to the Department. I cannot give the opinion of a chemist or a professional engineer upon the proposals of Sir Maurice Fitzmaurice to use salt-water for sanitary purposes at the Naval Base, but I can see no reason why salt water should not be used. I understand that there is an immense system outside New York where it is used very largely. Certainly from a departmental point of view I have no objection to the proposal. It is purely a matter of pounds, shillings, and pence. The suggestion of Sir R. Henderson that Westport might be used as a regular station has been the subject of much consideration from myself, and has entered into my calculations in estimating a population of 4,000 people; but the repairs that would be undertaken at Westport would not be big undertakings; they would simply be little more than minor fitting shop repairs. The Commonwealth Dock at Cockatoo Island being available for larger repairs, the duplication of this establishment, having similar works at Westport would be absurd. As to the feature of Westport being a commercial centre or important seaport, that the place did not become a commercial centre in the early days and gradually increase in importance seems strange to me. There is a magnificent port there, which can be entered at all times, and its distance from Melbourne is not great. However, I suppose that the scarcity of water supply prevented the locality in the early days from coming forward as a commercial centre. This has been to an extent fortunate for us from a naval point of view, because the land not having been taken up we have been left a perfectly free hand to establish our Base. I am not aware that we intend to obstruct the extension of commerce. The road up the arm of the gulf is perfectly clear up to a site above ours. It should the place at any time become a seaport. We have not pre-empted the whole of the frontage. I cannot speak from personal observation as to whether Westport is likely to become a seaport of importance, but I have heard that a

certain steamship company proposes to run a line of steamers from that point to Tasmania, and thus save a number of hours in the sea passage. This is only hearsay, and I merely mention the matter in order to show that Westport is favorably situated for a seaport. The spot from which the shipping company would start would be about 2 or 3 miles north of the Naval Base. I have heard nothing beyond this to lead me to believe that the place will become a commercial centre, but from a maritime point of view Westport has all the advantages of an important seaport. No one can forecast what will or will not be a good port as Australia generally is concerned, the inlet that has been found by a seaman to be a good port has usually been discarded or neglected, and the point on the coast discovered by the mining prospector or the settler or squatter, the nearest water capable of floating anything, has become a permanent port. It is usually restricted and land from a shipping point of view, but hampers on its own disadvantages, because the expenditure of the large sums of public money which are required to develop it attracts population there. Thus, like a snowball, it goes on gathering greater population, while the other place, no matter how favorably situated and good the conditions, languishes. In Australia you will generally find that where the first bullock dray goes down to the creek and meets the first flat-bottomed boat putting in from a ketch, other ketches go, and the place looks very promising, but certainly when the first public house and the first store are erected they take root, and are ineradicable. Take the case of Rockhampton. There we have a most curious place. It is 40 miles up a river, and there is a watershed as large as England, without Wales, and there is a small community there attempting to keep the river clear—and believing that they are doing it—for a population of 10,000 or 15,000, while 60 miles away is Gladstone, with a port that will accommodate a whole fleet, and with deep water right to the water's edge. Townsville and Bowen are other cases on exactly the same lines. We shall require very little fresh water for submarines; the main requirement will be water for our big ships. Engineers always like to have a free run of the purest water because of the saving of coal consumption in condensing; they fit their tanks to supply what they call "make-up water," and I cannot give the exact tonnage that each ship will require, but I can supply the information later on. No doubt for the present the large ships will go to Port Phillip for water, but assuming that we have available at Westport a supply equal in quantity and quality to that obtainable at Williamstown, there will be no reason for the larger ships coming into Port Phillip for water, except for the slight advantage that the smaller vessels can get right alongside the wharves in Port Phillip. A considerable time must elapse before we have a dredged sufficiently to enable the light cruisers to come up to the Base—that is not at present proposed—but when they can do so the engineers prefer to go alongside the wharf, and turn the water on rather than pump it from a tank alongside. That is the advantage that Williamstown has over Westport. There is no need for the water to be pumped except in the case of very big ships. For instance, the *Australia* cannot go alongside any wharf in Port Phillip, and she could just as easily be supplied from a tank alongside in

Westernport. As to the disposal of sewage and the recommendation of Sir Maurice Fitzmaurice that it should be discharged at Sandy Point instead of Stony Point, I prefer the Sandy Point site, because it is further from the Base, and there is a considerable tide which will make it sure that the sewage is swept away.

39. To Mr. Fenton.—The discharge of the sewage at Sandy Point would remove any objection to utilizing Stony Point for residential purposes. Sandy Point is not likely to become a residential quarter. It is within our reserve.

40. To Senator Lynch.—The safest point for the discharge of the sewage is Sandy Point, because then it will be swept out to sea.

41. To Mr. Finlayson.—The number of men who will be transferred from Williamstown to Westernport as soon as accommodation is provided will be the whole of the establishment, that is 400 men, which will be quite sufficient to give us a good start. I have not had any personal experience of the use of sea water for sewerage purposes, but, having in view the strength of the tide by the discharge of the sewage at Sandy Point, there will be less danger of the excreta passing up the gulf. The rate of tide varies, but I have been told that at spring tides it runs up to 3 or 4 knots. I believe that it will be preferable to store the discharge until the ebb of the tide, but I do not know that it is proposed to do so, though I should think that the necessity for doing that would apply more to a large city than to our Naval Base. The increase in the number of men for whom we would require accommodation would entirely depend on the growth of the Navy, and that growth, which I have estimated at 4,000 in 20 years, is according to the programme laid down in the Henderson report. I cannot say whether, in view of the altered circumstances that will probably follow the war, that programme will be necessary. I would be very glad if I could answer the question. The chances are that we shall achieve greater security in Australia, not only by carrying out the present programme, but also by adding to it. The present idea is to go on gradually extending the Navy, thereby increasing the number of men who will be required at Westernport.

42. To Mr. Sampson.—The dredging of the channel with one dredge will take two years, but the work can be done by two dredges in one year. At present we are taking the work in sections or by degrees. If I remember correctly the estimate made by Sir Maurice Fitzmaurice was for a channel 15 feet deep and 130 feet wide. We propose to use suction dredges that will discharge to the shore inside walls, and enable reclamation work to go on, not because we need the reclamation, but because this method provides the cheapest way of getting rid of the spoil. Engineers tell me that it is about one-sixth of the cost of discharging the material into barges and taking it out to sea. In this way we shall be able to bring up the destroyers to the Base in a very much shorter time than anticipated by Sir Maurice Fitzmaurice, and we propose to use the present tidal channel by straightening it a little, thus shortening our dredging and cheapening the work we have to do. We thus hope to be able to get into the deeper channel in about six months from date of beginning the dredging. I think by taking advantage of the tide that we will be in a position to bring in a submarine within six months from starting the dredging. There will be sufficient wharfs ready by then.

(Taken at Melbourne.)

THURSDAY, 18th MARCH, 1916.

Present:

Mr. RILEY, Chairman;	
Senator Keating,	Mr. Finlayson,
Senator Lynch,	Mr. Gregory,
Senator Story,	Mr. Sampson,
Mr. Fenton,	Mr. Laird Smith.

Albert Keaton Trenavin Sambell, Civil and Hydraulic Engineer, sworn and examined.

43. To the Chairman.—I am consulting engineer to the three shires which are promoting the Mornington Peninsula water supply scheme from the Moulbuk catchment area. The three bodies held a Conference and appointed me consulting engineer. Various schemes have been considered for supplying the Peninsula lying between Port Phillip below Frankston and Westernport, but the Moulbuk scheme has been adopted by the three shires. I am the regular consulting engineer to the Frankston-Hastings Shire Council and the Mornington Shire Council, and I have been engineer to the Dandenong Water Trust for some years. In the first place the Frankston-Hastings Shire Council asked me to prepare a water supply scheme for Frankston. I investigated local sources because there is a considerable area of country at a sufficiently high level to give a gravitation scheme for Frankston, and there are suitable storage sites. However, all the samples of water obtained proved by analysis to be absolutely bad. The same remarks apply to a local supply for Mornington. The Mornington Shire Council made independent inquiries with similar results in regard to the samples of water taken. Finally, the State Government Analyst said that he thought we were wasting time in looking for sites on the Mornington Peninsula, because all the samples he had analysed from that area were unsound and unfit for human consumption, and the cost of treatment to render the water suitable would be out of all proportion. I had then to look for some other source of supply, and I waited upon the chief engineer to the Metropolitan Board of Works.

44. To Senator Lynch.—The water proposed for the Mornington Shire Council's supply was to be collected from the Flinders Range. Dunn's Creek was one source of supply investigated, but the water was condemned. Dalcombe's Creek, which also drains from the high land round Arthur's Seat, was also condemned by Mr. Scott, the Government Analyst, because before it could be used for human consumption it would have to be submitted to special treatment. The practice is for the State Rivers and Water Supply Commission to find the money for town water supplies, but before they provide any money the Engineer for Water Supply, Mr. Thos. Murray, investigates each scheme in detail and reports for or against it. He insists on having reports from the Government Analyst upon the quality of the water, and numbers of samples are taken. Thus samples have been taken from most of the creeks in the Mornington Peninsula and analysed by the Government Analyst, but all have been turned down. When Mr. Thomas Walker Fowler, who is now Chief Engineer for Works in Tasmania, was acting for the Mornington Council some years ago, he investigated sources of water supply for Mornington, but, although he had carried out a great deal of

work, and although from an engineering point of view the matter was fairly simple, he reported against any supply from the creeks in the Peninsula. The Mornington people would have carried out a scheme for a supply from these creeks, but for the report of the analyst upon the quality of the water. The Government Analyst has turned down any scheme for the supply of water from that particular district.

45. To the Chairman.—Near the Naval Base we have not discovered any water that is suitable for human consumption, either from streams running throughout the year or from streams running through the winter only. One would naturally expect fairly good water from the latter streams, because, while the regular flow from streams might contain salt and other minerals, one would think that, perhaps, during the winter the water might be much better. I therefore selected one or two sites for the storage of winter water, practically off I collected samples and submitted them for analysis, but they were practically similar to the samples previously sent in from streams running throughout the year. As a result of those investigations I decided that any scheme for supplying water from these streams was absolutely hopeless, and Mr. Thos. Walker Fowler, who submitted some reports to his council, came to the same decision. Speaking of Dunn's Creek he says, in one report: "This creek was followed up to an altitude of about 500 feet, and a sample of water taken from Allotment 22b, parish of Kangerong, but unfortunately it proved brackish, and unfit for human consumption. Dunn's Creek has its source on the north-eastern slope of Arthur's Seat Range. I have not tested the water in Main Creek, which commences on the south-west slope. While Mr. Fowler paid particular attention to that district, because it was nearer to Mornington, I paid particular attention to the Mount Eliza country, near Frankston, because to go to Arthur's Seat for a scheme for Frankston would mean going almost as far as to the Dandenong Ranges. In view of the reports of the analyst I would not give any consideration to any source within the Peninsula catchment for a water supply for Westernport."

46. To Mr. Laird Smith.—If no other scheme were available it would be better to take the water from the metropolitan scheme, but I think that a better and a cheaper scheme is available for supplying Westernport.

47. To the Chairman.—Reverting to the history of this matter, I have got as far as approaching the Metropolitan Board of Works for a supply for the district from Mordinloc to Frankston direct from the Nolling Hill Reservoir in the hills that matter very closely. A rate of 1s. 6d. per 1,000 gallons for the supply to the Naval Base would bring in a revenue of £3,200 per annum. It has been suggested that this is rather higher in ratio to the charge made upon the other consumers in the towns, but I consider it very fair and equitable. The Carrum and Frankston people could get their water at a rate of 1s. 6d. in the £1 without having the Naval Base included in the scheme.

48. To Mr. Gregory.—The Trust would provide the main to Westernport, and the reservoir there, but they would not provide the actual reticulation at the Base. The reservoir, which would hold three months' supply, would be 100 feet above sea level, and as the Naval Base is about 30 feet above sea level there would be an ample head of water. It would be about 3 miles from the Naval Base.

There are two sources of supply, Moulbuk Creek and Cardinia Creek. The Moulbuk Creek is capable of supplying 12,000 people. At present the population is about 4,000, including Naval Base, 2,000; Mornington, 1,000; Frankston, 1,000; Chelsea, Carrum, and Aspendale, 1,000. As present there is an ample supply, providing that storage basins are put in at each place. If in the future the population should increase to 30,000 or 40,000 they might have to provide water from some other source, but there are other creeks in the Dandenong Ranges which, I am led to believe, can be utilized to increase the supply, and there ought to be an abundance of water available if large reservoirs are provided.

At that Conference it was decided to have this scheme investigated fully, and as a result of that decision my report of last year was published. The scheme provided for will supply ample water for all the towns in the area, and for the Naval Base; under a rate of 1s. 6d. in the £1 for Aspendale, Chelsea, Carrum, and Frankston, a rate of 2s. in the £1 for the Mornington area, and a charge of 1s. 6d. per 1,000 gallons for water delivered at the Naval Base with a minimum supply of 120,000 gallons, which the Naval authorities at that time said would be about their requirement. If the Naval authorities obtain water from any other source the carrying out of the scheme will not be affected so far as the scheme to Frankston is concerned, because there would still be a rate of only 1s. 6d. at Frankston, but Mornington would probably be affected to a slight extent, as the rate might have to be increased to 2s. 3d. or 2s. 6d. in the £1 there. But I have not got the figures that matter very closely. A rate of 1s. 6d. per 1,000 gallons for the supply to the Naval Base would bring in a revenue of £3,200 per annum. It has been suggested that this is rather higher in ratio to the charge made upon the other consumers in the towns, but I consider it very fair and equitable. The Carrum and Frankston people could get their water at a rate of 1s. 6d. in the £1 without having the Naval Base included in the scheme.

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40. *To the Chairman.*—We propose to commence with a 14-inch main for 7 miles from the off-take. Then there would be a 12-inch main to Carrum. Beyond this there would be a 10-inch main to Frankston with a 7-inch branch from Frankston to the Naval Base, which would be capable of discharging about 250,000 gallons every twenty-four hours. There would be about 17 miles of 7-inch pipe. At Langwarrin, where there is a point 320 feet above sea level, we propose to put in a balancing basin capable of holding 100,000 gallons. It will relieve the main which will discharge into it of very high pressure, but at the same time it will be to some extent a small storage reservoir. The water in the Monbulk catchment area is of good quality. Speaking in regard to the quality of the water, I may say that the area embraces 2,600 acres, a good deal of which is reserved from occupation. In my scheme allowance has been made for the sum of £8,000 to be spent on the resumption of the balance of the area in order that the whole 2,600 acres may be absolutely reserved from occupation. The quality of the water should then be as perfect as water in natural streams can be. The reports from the analysis are very favorable, and the water has been used by the Dandenong Council for twenty-five years. By observation and by tasting, and by all methods, the water is good. It is also the nearest source of supply, being only 19 miles from Carrum, the closest point of consumption, where we propose to put in an elevated tank. As far as I am available I have never had any doubt. We may get even lower rainfalls than during last year, but the previous lowest rainfall was in 1908, namely 33.5 inches, over the catchment area, whereas last year it was only 30.8 inches. I estimated that in 1908 when there was a rainfall of 33.5 inches, there would be a run-off of 485,000 gallons, which I considered a conservative estimate for the Monbulk and Menzies Creeks, and not including the Ferny Creek; but last year with a rainfall of 30.8 inches the actual run-off was 635,000 gallons, proving that my estimate for the previous lowest rainfall was very conservative, and there was a 50 per cent. bigger discharge last year with a lower rainfall. Sometimes there is a rainfall of 50 inches in that area, but in making these estimates it is necessary to be conservative. Prices may be over-estimated, but quantities of water available should not be over-estimated. We had no stream gaugings in 1908, but we had rainfall gaugings. I under-estimated the run-off, because the actual run-off in a drier year has been greater. The present requirements, including the supply for Dandenong, is 204,000 gallons per annum, whereas the discharge last year was 635,000 gallons. To fix what the population will be twenty years hence is difficult. I allow for an increase of 80 per cent. in twenty years, and calculate that the requirements then will be 363,000 gallons per annum.

50. *To Senator Story.*—I allow for a consumption of 60 to 80 gallons per head per day in the summer, and about 35 gallons in the winter. Of course, the consumption varies a good deal in different towns in proportion to the amount of supervision. In some towns there are masters, and inspectors, and other means of checking waste, but other places have no such means, and the consumption per head goes up enormously as is likely to be the case where taps and hose are allowed to run almost continuously during dry periods. I think that the average consumption per head per day is about 60 gallons in Melbourne, including sewerage and water supply for engines, &c.

51. *To Mr. Finlayson.*—In my report I did estimate that the consumption would be 398,000,000 gallons in fifteen years; whereas I now estimate the consumption at 363,000,000 gallons in twenty years, but between Mordialloc and Frankston there is an enormous number of small townships some of them being merely tents, and at the time I framed my report I did not know the actual population in which I may term the holiday area. Since then I have made a house-to-house count during the busy season in January, and obtained the numbers of the people in residence and the numbers of those who spend the week end in the district. By this method I arrived at the basis of 2,000 odd people living there throughout the year, and 6,000 people visiting at week ends. On that basis, which is reliable, I have calculated the actual quantity of water which I think will be required as the years go on. When I submitted my report I did not have the opportunity of checking the population. The Government Statist gave me his latest figures, but they were three years old, and the population had increased to some extent. However, as far as the quantity is concerned, I think that there is an ample supply for the present and future requirements. I estimated in my report that in fifty years from now there would be a population of 3,000 at the Naval Base. I may have under-estimated this, but it must be understood that, once the establishment is complete and in order, an increase of 500 men will not increase the consumption of water in the same ratio, because as the men will probably be in barracks they will not have the same domestic requirements. We are allowing for a domestic supply which, in my opinion, will be ample for the Naval Base for some time to come. I do not see how the consumption can be 60 gallons per head per day. When Sir Maurice Fitzmaurice asked me to go into the matter with him he made mention of a particular point. I cannot supply in detail the available supply from the various creeks, but the run-off from the Monbulk area was 635,000,000 gallons last year. I have with me a graph showing the present requirements from month to month ascending during the dry weather and declining during the winter months; also the requirements for twenty years, the estimated run-off for 1908, the rainfall for last year, the rainfall for 1908, and the actual discharge last year. It shows that without storage each month's demands would have been met last year, but it is proposed to store 200,000,000 gallons at Monbulk, while there will be other storages along the main with a reservoir holding 10,500,000 gallons at the Naval Base, which will be equal to three months' requirements at the rate of 120,000 gallons per day.

52. *To Senator Lynch.*—The run-off last year of 635,000,000 gallons does not represent the total run-off from the whole of the watershed. I am taking for the present the two Menzies' and the Menzies' Creek as the most economical supplies to develop. There are also the Ferny and Cardinia Creeks which can be brought in later if necessary, though perhaps the storage on the Cardinia Creek would be too low for the Naval Base, as it is only 450 feet above sea-level, and would not give sufficient head for anything but a working discharge over Langwarrin; but the scheme will be so arranged that the Naval Base supply will probably be sent along during the winter. As the main will be capable of discharging about twice the quantity of water actually required during the winter season, during those months, send down to the Naval Base the full requirements for the year. We are providing mains from the off-

take to Carrum capable of supplying the whole of the demand to that place during the hours of daylight, which means that for some hours the mains will remain to some extent idle. The full summer supply is much greater than the winter supply when the consumption goes down to 30 gallons per head per day in some towns, and thus we can send down to the Naval Base in the winter double the 120,000 gallons required. In other words, the Naval Base can get 240,000 gallons per day, and by an additional expenditure of about £3,000 the reservoir above the Naval Base can be increased to a capacity of 21,000,000 gallons which would give six months' supply. Thus the Naval Base can get its supply during the winter, so that there should be no cause of anxiety during the summer. The water can be stored very economically at the point 3 miles from the Base. I have tested the formation. There is good clay-holding ground. The Dandenong Trust has provided storage of 4,000,000 gallons for about £1,600, and the facilities are even better at the Naval Base.

53. *To Mr. Gregory.*—I do not think that there will be any danger of the water in the reservoir becoming salt by being stored there any length of time. The depth would be 12 feet, and as the bottom would be lined with broken stones the water would not be in contact with the soil, and I do not think that there would be any danger of contamination or anything of that kind. The matter of enlarging the reservoir is worthy of close attention in passing, because it has been claimed that the requirements of the Naval Base should have the first call and be absolutely guaranteed. I think we all concede that the requirements of the Naval Base are paramount, and in the way I have suggested they can be secured. The mains will be big enough to carry down the full supply during the winter months when otherwise they would be half the time idle. Our investigations show conclusively that there is ample supply available within reasonable distance. The only other source of supply that I can see is the O'Shannassy scheme—that is, the Notting Hill reservoir—which would mean 80 miles of mains and works in order to convey the water to the Naval Base.

54. *To Mr. Sampson.*—The Dandenong people will be supplied from the 635,000,000 gallons to which I have referred as the run-off from the area during last year, but their requirements will not be interfered with by this scheme. The riparian rights for the people on the Dandenong Creek will be about 100,000 gallons per day. The present population of Dandenong is 2,500 people. I estimate that the population will be 5,000 in 1923, and perhaps 10,000 in fifty years. The Dandenong people take about 45 gallons per head per day, and that is provided for in the scheme. I think that they have a first claim on the Monbulk water. I have allowed for the present Dandenong consumption about 45,000,000 gallons per annum, and I have allowed for 100,000 gallons for the people along the creek, but I think that the latter will be provided for below our off-take. The catchment below our off-take should supply the creek, and we need only provide that for about six months. At any rate, it would mean 20,000,000 gallons per annum for the riparian rights, or, in other words, about 60,000,000 gallons for the Dandenong township and the Dandenong Creek riparian rights. I do not think that there is any Statute giving the Dandenong people a prior claim, but, as they have had their works established for twenty years, we regard it as beyond question that they have a first call on the

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Monbulk Creek. They have no call on the Menzies' Creek catchment, which alone would supply the whole of our scheme.

55. *To the Chairman.*—We have no power to enter into an agreement with the Commonwealth to supply this water, but the councils concerned will ask the State Government to constitute a water trust which will carry out the scheme. I suppose that the Commonwealth will have representatives on the trust. Even in the event of the Commonwealth not entering into the scheme, it will mature so far as Frankston is concerned, but it is probable that the cost to Mornington will be slightly increased. There will be trouble from the townships if there is any delay in getting the scheme under way. They are getting very anxious. Water is now conveyed to Mornington by train for supplying hotels. It is impossible to get baths in the houses or water for flushing street channels there. If the Commonwealth agree to the scheme matters will be facilitated and eased, especially so far as the Mornington end is concerned, because the more people who enter into a scheme of this kind the cheaper it is likely to be for all parties concerned. We are now prepared to carry out the scheme on a minimum rate for the water at the Naval Base on a minimum consumption basis. As we are obliged to make provision for the discharge of a maximum quantity, we must stipulate for a minimum consumption. We have to meet the interest on the money borrowed for the construction of works of a maximum size, and if the Councils consider the requirements of the Naval Base should have the first call and be absolutely guaranteed, the annual charges on the undertaking will not be affected, because the size of the main cannot be reduced to any extent. A reduction from a 7-inch to 6-inch main would not reduce the cost very much, and, therefore, the annual charge for the water would not be materially reduced, even if the requirements were considerably reduced; but as the works are capable of supplying about double what the Commonwealth will require, if they agree to take a larger quantity a reduction in the charge could be arranged very simply. I do not know what the councils concerned would say, but so far as I can see, they could very well afford to reduce the charge if larger quantities were consumed, but it must be borne in mind that water trusts throughout Victoria supply the Railway Department with large quantities of water within townships at varying rates up to 1s., whereas we propose to supply water 43 miles from the off-take at the rate of 1s. 6d. per 1,000 gallons. This does not consider the proposition a very reasonable one—and I cannot help thinking that it is—and the best proposition available. Speaking with regard to the quantity of water available, the Melbourne supply has 6.27 people per acre of catchment, whereas we propose to supply 2.50 people per acre of catchment. Thus we have, proportionately, double the area from which to supply our customers, and the rainfall is very similar. For instance, the O'Shannassy catchment area of 37,000 acres gives a discharge of about 13,000,000 gallons per day, equal to about 220,000 gallons per square mile per day, whereas a square mile on the Menzies' Creek catchment area is now giving 355,000 gallons per day. These figures give an idea as to the charge from the Menzies Creek catchment area, even at the end of a very dry period, as compared with the discharge from the best stream within the Melbourne and Metropolitan Board of Works catchment area, which has to supply 6.27 people per acre, as compared with less than three people in our case. These facts go to show that there

need be no doubt as to the quantity of water available. It may be said that the whole area should be purchased right out to preserve the quality of the water. Though we propose to purchase the whole of the Monbulk area, we have made no estimate as to what the purchase of the Menzies Catchment area will cost, but it will probably take another £8,000 or £10,000. The question is whether this will be necessary. I do not know that it is absolutely essential to buy out the landholders. I think that the only case in Victoria where the catchment is absolutely reserved from occupation is that of the Melbourne supply. Nearly all the towns of Victoria have settlements within their catchment areas. Reserving all the catchment areas from occupation would very materially affect the welfare of the State, and I do not know that it is essential in our case. Analyses show that the Dandenong people have as good water as comes from the Yan Yean; it is of first-class quality; however, if purchase is necessary in order to supply the Naval Base from a reserved catchment area, it can be done. It is quite possible without this to send water during the winter months, thus giving six months' storage, but if we re-purchase land we can increase the storage within the reserve. If we do not re-purchase about £8,000 will be saved, though in some cases the objection may be raised that the water will be contaminated.

56. *To Mr. Innes Smith.*—I think the various Health Acts and Water Acts provide that if any nuisance is created, or is likely to be created, by the erection of dwellings or piggeries within a given distance from a creek, steps can be taken to prevent it, and in these circumstances I do not think water in any creek would be contaminated. Mr. Murray and I are going to-morrow to make another inspection of the Cardinia storage site. There are a few matters which Mr. Murray is now clearing up with a view to preparing his report, and when it is available, which should be at a very early date, the various councils interested will meet. If it should be favorable they are determined to proceed as fast as possible with carrying out the scheme. I have made inquiries from the various manufacturers of material, and if the scheme is to be carried out in its entirety all the material used will be of Australian manufacture. Portions of the main will be of cast iron, and another portion will probably be of wood pipe. The manufacturers undertake to deliver material for the whole of the mains within six to nine months, so that we can commence laying the mains as soon as the first batch of pipes comes to hand. The whole of the main to the Naval Base can be laid within twelve months from the time the work commences.

57. *To Mr. Gregory.*—Before the war commenced I was approached with regard to the supply of steel pipes made in Germany, but I would not recommend German stuff. I quoted for Glasgow pipes supplied by Stewart and Lloyds, because they were much cheaper than cast-iron pipes for sections of the main, but since the outbreak of the war the rates for steel pipes have gone up 30 per cent., and having gone into the matter again, I find that, in view of the fact that the production of pig iron in Australia has come about, the manufacturers of cast-iron pipes can supply on a basis which is on a level with the cost of steel pipes. Cast-iron pipes are more reliable, and give a more durable job all round.

58. *To Senator Story.*—We are not in a position in Victoria, or probably in Australia, to give a definite opinion in regard to wood pipes.

59. *To Mr. Gregory.*—A big contract for Broken Hill for wood pipes was let two years ago, but the Broken Hill climate, which is dry, and the matter of railway freights would affect any decision in a matter of that kind. Where we are close to the manufacturers I do not think it is advisable to use material such as you might use at a distance from the manufacturers. Cast-iron pipes have been taken up after being in use from twenty-five to thirty years, and have been found quite equal to new pipes.

60. *To Mr. Finlayson.*—In my report I estimated that cast-iron pipes would cost £2,500 per mile; wood pipes £1,700, and steel pipes £1,624, but it is impossible to employ wood pipes throughout on a main of this kind and sustain a pressure of a 600-feet head. Steel pipes have gone up about 30 per cent. since my estimate was made, while cast-iron pipes are a shade easier. The manufacturers have told me that they can get ample supplies of Australian pig iron at a reasonable cost. Another fact to be taken into consideration is that in works such as this steel pipes and wood pipes have to carry a depreciation fund of 2½ per cent. per annum; that is to say, we must make provision to renew them in about twenty years, whereas cast-iron pipes have been known to serve up to 100 years—I have taken them up after twenty-five or thirty years, and sold them equal to new pipes—and a depreciation fund of ¼ per cent. only is required on them. The water trusts have been paying 4½ per cent. to embrace interest and sinking fund, but as that does not give sufficient for the sinking fund the Commission have added ¼ per cent. for cast-iron pipes, and 2½ per cent. for steel pipes and wood pipes. In considering the use of cast-iron pipes as against steel pipes we must bear in mind the annual charges to the consumers to maintain interest on capital cost and depreciation fund. We can afford to spend more on cast-iron pipes, and thus have less annual cost. I would feel inclined to give steel pipes a little longer life than twenty years, as they are now manufactured, but the State Rivers and Water Supply Commission, who find the money for the trusts, fix the rates of depreciation. I have suggested that there should be two styles of pipes used. As the pressure of a 7-inch pipe increases it will be found cheaper to use steel, because, if we employed wood, the steel winding would be almost in contact under a heavy pressure, and there would be practically as much metal in the wood pipe as in the steel pipe. Thus I prefer steel pipes to wood for the higher pressures, but I prefer cast-iron pipe to all other pipes. I estimated the annual charges at £135,674, but it may be necessary to alter the figure to about £140,000. However, though the capital cost would be increased, the annual charges would be less. I propose to cut out the steel pipes which carry a depreciation of 2½ per cent., and replace them with cast-iron pipes which carry only ¼ per cent. I would increase the capital cost by £5,000 or £6,000, and decrease the annual charge by removing the liability to pay 2½ per cent. depreciation fund on a good deal of the capital cost. I have gone into the matter of the cost very fully. Within the last few days I have received estimates from the manufacturers of wood pipes, and they are practically the same to-day as they were fifteen months ago. The cast-iron pipe manufacturers tell me that their quotes are a shade easier than when I submitted my report. The 7-inch main will go right into the Naval Base. No provision is made for the reticulation of the Base. Mr. Fanshawe, the Naval Works Director, told me to run the main right into the Naval Base, and the

Naval authorities would do what else was required, and put in a small tank. In my report I provide for service basins, relief basin, and storage basin for Naval Reserve at a cost of £8,000. The storage basin for the Naval Base would hold 10,000,000 gallons, but for an extra £3,000 it could be made to hold more supply. The amount of £8,000 provided for the purchase of land does not apply to land required for storage basins, it applies to the re-purchase of 800 acres in the catchment area on the east branch of the Monbulk Creek. At present we have about 1,700 acres reserved, but re-purchasing the land alienated would have the whole catchment of 2,500 acres free from occupation. However, I do not think that settlement on the catchment area will seriously interfere with the water, and perhaps it may not be necessary to re-purchase all the land, though within a short distance of the railway line, where there may be close settlement, such, for instance, as week-end settlements, it may be necessary to acquire about 100 acres. I cannot give in detail the supply available from the two Monbulk creeks, the Ferry Creek, the Menzies' Creek, and the Cardinia Creek. My books will show the gaugings throughout the year, and I can arrive at the information very easily and supply it to the committee later.

61. *To Senator Lynch.*—As to the number of people the watershed will supply, I mentioned in my report—

Under the present scheme it is proposed to provide for the present population of 10,000 people, with a subsequent increase to 10,000 people in twenty years, with a further possible increase to 37,000 in fifty years.

Then I went on to say that in all probability the Monbulk Creek might be fully utilized in about twenty years. That supply includes the water from the east and west branches, which junction at Belgrave, but, in addition, there are the Ferry and Menzies' Creeks, and the latter is giving a bigger discharge than the east branch of the Monbulk. Further, we have the Cardinia Creek which, although at a lower level, is capable of supplying three-fourths of the requirements. The run-off in the Menzies' Creek is better than that in the Monbulk. The Cardinia Creek is practically dry in the summer, owing to the geological formation. On the Monbulk Creek the soil is deep and of good quality, and is clothed with all kinds of vegetation, so that there is very little evaporation and every facility is given for the water to remain well down, emerging in deep-seated springs. In the Cardinia Creek country there is a rocky bottom, and the water runs straight away during the winter, so that there is very little flow during the summer. There are riparian rights on the Monbulk Creek, but they could be met by keeping the main fairly well down the centre of the valley, and connecting up with troughs by 4-inch pipes. It would be an economical method, especially leading to the saving of water during the summer, as compared with sending 100,000 gallons down the stream. The total catchment area for the Monbulk is 2,500 acres, which I said in my report would be used up in twenty years. In addition the areas from the three other creeks would be—Ferry Creek, 950 acres; Cardinia Creek, 1,250 acres, and Menzies' Creek, 650 acres. But these are not the only available sources that have been considered in connexion with this scheme. They are the only sources mentioned, because the works to be provided would not carry any more water, but if further sources are required it will be necessary to provide a duplicate set of mains, and we would probably go along the range to the next nearest source. The limit

of the range is not confined to the country extending from Monbulk to Cardinia. Different creeks run down to the coast from the hills which continue right along to the east. There are fine streams all the way along and fine catchment areas. According to my report the whole of the catchment area mentioned in the report will be drawn upon and used up in fifty years, but my report has now to be modified in view of the fact that the actual discharge of the streams as measured is greater than what I estimated. My report was based on what I considered would probably be the lowest discharge in the driest year previously—that is, 1903, but in view of the actual measurements of the discharge in 1914, which was the year with the lowest rainfall known, the available supply must increase by 50 per cent. on the estimate mentioned in my report. I thought that the discharge would be 485,000,000 gallons, but the actual discharge last year, with a lower rainfall, was 635,000,000 gallons. To provide water for irrigation purposes would not be possible in schemes such as this, the authorities exercise very close control over the consumption; it is based on supply for domestic purposes only, and we could not supply water for irrigation purposes from a main of the length proposed. People could not irrigate with the water at the coast. Mornington, with a branch main of 8 miles, would pay a rate of 2s. in the £1, with an additional charge of 1s. 6d. per 1,000 gallons for water used for domestic purposes in excess, so that Mornington will be paying the same for water measured as will be paid at the Naval Base at the end of a branch main of 17 miles. I do not think that it will be absolutely necessary to clear the catchment area of all settlements, but the opinion of the Commonwealth was of the opinion that, in any case, provision should be made for the resumption of the whole of the area, and the matter could be settled later on. They wanted the estimate of the cost of purchase to be included, so that they could see whether it would be worth while effecting the purchase. In arriving at my final estimate as to the price at which the water can be supplied everything has been included; but if the cost of re-purchase is deducted an annual saving of about £240 will be effected. Other countries do not remove all settlement from catchment areas. Where necessary they purify the water by treating it. In nearly all countries population is increasing to such an extent that they utilize water from settled catchment areas and purify it by removing bacteria or earth, or anything objectionable. This is done in the case of the London water supply. A suggestion has been made to employ 6-inch pipes to carry 93,000 gallons per day, and 8-inch pipes to carry 285,000 gallons, as against my 7-inch pipes to carry 950,000 gallons; but the other suggestion applies to the Notting Hill scheme, where you start from an elevation of 320 feet, and have a length of 30 miles over which to distribute the water, which reduces the head to a very low amount, and Sir Maurice Fitzmaurice, in discussing the scheme with me, said that if the Naval authorities utilized the water from the Melbourne and Metropolitan Board of Works' scheme they would probably have to pump the water. On the other hand, in our scheme we start off at an elevation of 630 feet. Outside the area controlled by the Naval authorities at Westborough the water would probably be sold under special agreement to people requiring it. There would probably be a minimum charge to cover the cost of supervision, perhaps £2 or £3 per annum, and a certain amount of water would be allowed



at the rate of 2s. per 1,000 gallons as a set-off against that charge. I do not think there would be any water rate except, perhaps, at a town like Hastings, where a small area might be rated. The price of 1s. 6d. per 1,000 gallons would cover the whole cost of supplying water to the Naval Base.

**62. To Mr. Sampson.**—I have estimated that the present requirement would be 204,000,000 gallons per annum. Of this, about 42,000,000 gallons would be consumed at the Naval Base, or, roughly, about one-fifth of the total consumption. I have also estimated that of the total annual revenue of £9,554, the proportion to be paid by the Naval authorities for a minimum consumption of 120,000 gallons per day would be £3,285, or, roundly, about one-third of the total revenue. But we must take into consideration the fact that we have to provide the Naval Base with the maximum quantity that may be taken. As the Naval authorities say that they must have a minimum supply per day, we must make our works capable of supplying it, whether it is used or not. It would appear that we are asked to supply the Naval Base with one-fifth of the run-off from the catchment area, while we obtain a third of our revenue from it, but we must first of all consider the proportion absorbed by Dandenong, which reduces the quantity to 143,000,000 gallons, and Dandenong is not included in the scheme so far as contributing towards its cost is concerned, though it has first call. We estimate that the towns may require a certain quantity, but in practice they will not use that quantity. I allow a conservative estimate of about 60,000 gallons per day for Mornington, as against the 120,000 gallons for the Naval Base. It is proposed to charge Mornington £1,157. We have to show to the State Rivers and Water Supply Commission our estimates of revenue well on the conservative side, and our estimates of quantity to be consumed well on the other side; but from the experience I have gained in other places, I consider that the consumption at Mornington will be much less than 60,000 gallons per day throughout the year, while the revenue will be very much in excess of £1,050. If Mornington were taking 120,000 gallons a day, on the basis of the charge for the Naval Base, it would be paying £2,314 per annum at the end of an 8-mile branch, whereas the Naval Base will be paying the same at the end of a 17-mile branch, and, in addition, will have a fairly large storage. At the measured rate the cost per 1,000 gallons to the residents of Mornington on a minimum quantity would be about 1s. 2d. or 1s. 3d. The cost of carrying the extra pipe to the Naval Base from Frankston is about £20,000. The additional annual charge on that would be made up in this way: Allowing 2d. per cent. depreciation on £13,000, which represents £300, and 5 per cent. on the balance, which would be £1,000, and £200 for maintenance and management, we arrive at the sum of £1,500 per annum. If the Naval authorities take their water at Frankston at a charge of 1s. per 1,000 gallons, the Trust would probably be better off, because they would get about £2,000 a year, while their annual cost on the whole scheme would be reduced by £1,500—this would represent £3,500; whereas under the present scheme it would get £3,200 from the Commonwealth. The additional cost of supplying the Naval Base, as compared with the cost of supplying the other portions of the area, is about 8d. per 1,000 gallons. Of course, we refer to the other schemes. I have no doubt that Carrum, Chelsea, Aspendale, and Frankton can be supplied at the rate of 1s. 6d. in the £1 without the Naval Base requirements being considered, but the Naval

authorities are not contributing an unfair proportion as compared with Frankton, because without the Naval Base being in the scheme the rate at Frankton would still remain 1s. 6d. It is not easy to estimate what a rate of 1s. 6d. in the £1 means in a measured quantity of water. Town supplies are very rarely measured, except when the water is used for other than domestic purposes, and I do not know of any town in the State getting its supply through a meter which we could easily check, but I should say that the rate of 1s. 6d. in the £1 corresponds to a charge of about 1s. per 1,000 gallons. If the Naval authorities obtained water at Frankton at 1s. per 1,000 gallons, and provided their own main to the Naval Base, they would pay more for the water than they would do under the scheme. A charge of 1s. per 1,000 gallons would include the cost of reclamation in the centres of population; but when the claim is made that this must be considered as a set-off against the construction and maintenance of the additional pipe from Frankton to the Naval Base, we must realize that in the principal portions of the towns supplied the main itself is the reclamation. However, I shall work it out the comparison and supply it to the Committee. If the Naval authorities get the water at 1s. in Frankton and provide the extension, they will pay more than 1s. 6d. at the other end. In other words, the cost of conveying the water would be more than 6d. per 1,000 gallons.

**63. To Mr. Gregory.**—The report from the State Rivers and Water Supply Commission should be available within a month. If the State Parliament bring in a Loan Appropriation Bill, gradually—and I notice that in reply to a deputation the Premier has stated that such a Bill will be brought in very early—there is no reason why the money should not be provided and the work undertaken in a very few months. From that time, twelve months will lay the main to the Naval Base. We would do the work in sections, east-on or west-on pipes being laid simultaneously. The materials would be supplied in from six to nine months, and twelve months would enable us to put the main right through. I do not think I have mentioned anything in my report about the time that will be occupied in carrying out the scheme, but I have gone into the matter since, because at present the work will give employment to many hundreds of men, and because we need it very urgently for the towns. Besides, if it is to go to the Naval Base, time will be a consideration. The analysis of the water have made no mention of magnesia. Where streams carry magnesia the country is noted for it. The Western District carries a great percentage of magnesia, and it is difficult to get good water there.

**64. To Mr. Laird Smith.**—I do not anticipate trouble from electrolysis through the extension of the electric railway system. The main will not be close to the railway anywhere. Several sections of pipes have had to be taken up in Melbourne on this account, but as the trams go right over the pipes the current finds its way to the nearest metal.

**65. To Mr. Fenton.**—In the present circumstances the State Government and the State Parliament would be more inclined to push through a Loan Appropriation Bill. It is a fact that where schemes have been in existence for some years it has been possible to reduce charges. It was said that the Traralgon water supply could not be provided at the rate of 1s. 6d. per 1,000 gallons by me, but the rate is now reduced to

1s. 3d. With the increase of population likely to take place in our area, the rate will be reduced. The works are capable of supplying double the population. If we have an 80 per cent. increase in population, we should have about that increase in revenue, which will give the Trust more money to work with, and make possible a reduction of the rate all round. Such reduction would also apply to the Naval Base.

**Thomas Murray, Engineer of the Victorian State Rivers and Water Supply Commission, sworn and examined.**

**66. To the Chairman.**—The subject of providing a water supply for Westernport Naval Base and the Mornington Peninsula generally is in the investigation stage at the present time. The Commission has had various reports prepared, but the investigations are not complete. I have no complete report in regard to the supply from the districts which I visited with the members of this Committee. Until we get all the facts from the promoters of the scheme I cannot say anything definite about that report. I was especially commissioned by the Government in 1903 to report on the improvement of the Melbourne water supply. I personally visited the various catchments and waterworks about Melbourne in company with the Engineer-in-Charge, Mr. E. G. Ritchie, and I prepared a report, and gave evidence before an Inquiry Board, which subsequently reported on a scheme of improvements. The scheme which has been put forward to supply the people at Westernport is, I understand, based on the idea that the Metropolitan Board shall charge 1s. per 1,000 gallons for the water supplied. I should say that there is a possibility of getting a water supply at less cost from other sources. I mean the water from Notting Hill. What I mean is that water could be brought to that point at possibly less cost than 1s. per 1,000 gallons. Of course, there would then be the additional expense of conveying it to the Naval Base. I think it better not to express a definite opinion as to which is the better scheme until further reports are available. The State Rivers and Water Supply Commission has not yet received all the facts from the Mornington Peninsula Conference, and I should say that from the time we do get the facts it will take me about two months to prepare my report. As to the proposal to give the shire councils the right to construct a separate scheme to supply the Westernport district, including the Naval Base, assuming that all the facts are obtained, that the investigations are completed, and that that proves to be the source from which a sufficient supply of good water could be obtained at the lowest cost, and with the least annual charges, and assuming also that the scheme is within the means of the residents, and they are prepared to undertake it, I believe that that scheme might be recommended for the approval of the Commission and the Governor in Council. If the Monbulk proposal complies with those conditions, then it is the best scheme. So far as I know, the only two schemes under consideration are the Monbulk-Menzies' Creeks supply, and the extension of the Metropolitan Board's scheme. In connection with all suggested local schemes there is a great difficulty in regard to the quality of the water. Certainly, if it had not been for the poor quality of the water, I would have made strenuous efforts to obtain in the vicinity an adequate supply of water for the Naval Base and other towns. The nearer the source the supply is to the town, the better the scheme, but owing to the difficulty of getting suitable water we had to practically abandon the local

sources altogether. At the same time, the Monbulk scheme involves a long carriage of water for a scheme the size of that proposed for the Mornington peninsula. All the local supplies near Westernport are brackish, I believe. The State Rivers and Water Supply Commission had analysed made of samples taken in the district, and I shall endeavour to have that information and all particulars in the possession of the Commission in regard to analyses of water in that district made available to the Committee. It will be necessary to look outside the Naval Base area for water suitable for boilers.

**67. To Mr. Fenton.**—Realizing the urgency of providing a water supply for the people at Westernport, I shall personally give the matter all possible expedition.

**68. To Mr. Sampson.**—There is a certain amount of spring flow in the Mornington Peninsula, and that water comes from underground sources. I shall ask the Commission to send all the analyst's reports to the Committee.

**69. To Senator Lynch.**—I have not made calculations in regard to the possibility of getting water to Notting Hill from other sources at a cheaper rate than that at which it is proposed that the Metropolitan Board should supply water, but the indications point to that conclusion. The State Rivers and Water Supply Commission has not yet come to any decision in regard to the project for supplying the shire councils from the Dandenong Ranges.

**70. To Mr. Sampson.**—There is power vested in the Government to resume a certain area of land on both sides of a stream or creek in a catchment. If a waterworks trust were formed the Government would have power to include by Order in Council a strip of land within the boundaries of the trust, and when that inclusion was gazetted there would be power under section 282 of the Water Act of 1905 to deal with the resumption of the land. I think there is power to resume whatever land is necessary in the interests of a scheme.

**71. To Mr. Fenton.**—With regard to settlement in a catchment area, I think that some properties near reservoirs should be bought outright; other properties that are away from reservoirs and creeks should be allowed to remain in private hands, subject to Government control of the landowner in order to prevent pollution of the supply. There is power under the Victorian statutes to deal with the question of polluting water supplies; generally the action lies with the municipal councils and the health authorities.

**72. To Mr. Finlayson.**—I think that a strip of land along the creeks in the reservoir area and adjoining frontages should be resumed. As to whether the catchment area so resumed should be kept entirely idle and unoccupied, that depends on circumstances. There was an instance the other day where valuable cocksfoot grass was growing in a catchment area, and we gave permission for the cutting of that grass. In a case like that the catchment area could be used, but I would not allow indiscriminate grazing. I would keep the stock off the water frontages; otherwise the land could be used, but not for cultivation. The extent to which the water from a catchment area used for grazing or cultivation should be subjected to some process of filtration or purification depends on the character of the catchment. Menzies' Creek has a particularly favorable catchment. It has a deep porous red soil, in which all the flow except in flood is underground, and if the streams themselves were protected against



pollution that would be sufficient precaution. Where, however, there is a hard-running catchment there is likely to be pollution due to the drainage of the road, and means would have to be taken to settle the water and purify it. I should say that with a reservoir having a storage capacity of 10,000,000 gallons to supply the Naval Base in the Westernport district, there would be about eighty days' sedimentation, and in a reservoir of 20,000,000 gallons, 160 days' sedimentation. Judging from the quality of the water in the catchment I should think that either 10,000,000 gallons or 20,000,000 represented liberal provision for sedimentation, and that you would get practically pure water. Such a reservoir would be useful, both as a storage basin and as a sedimentation tank. It is well to have a reservoir of water at the end of a long line of main.

73. *To Mr. Sampson.*—I do not know of any investigation having been made of the quality of water running from the head of the basin from Koo-wee-rup and Derwick. I am not intimately acquainted with the whole of that country, but the water in such catchment is mostly good. A large portion of the country is granite, and granite always gives good water. Any scheme to utilize the water from the Koo-wee-rup drain would involve the expense of pumping. I saw a good flow of water there about a month ago, although that was at a period when the flow would be at its minimum. I have never known the streams there to cease running.

74. *To Senator Lynch.*—I have made no calculations as to what population these watersheds would supply. I can arrive at a rough approximation on the basis of the Melbourne figures. The Melbourne water supply has catchments very similar to the catchments at Monbulk and Menzies' Creeks as regards the run-off of water. Approximately Melbourne catchments have a drainage area of about 170 square miles, and the water impounded there supplies about 600,000 people. That represents 1 square mile of catchment to every 3,500 people. It must be remembered, however, that the Melbourne water supply is not wholly dependent on the water from the catchment; it has a considerable storage in addition. The Yan Yean reservoir holds 6,500,000,000 gallons, of which only 5,500,000,000 gallons are effective. Then there are various minor reservoirs impounding about 200,000,000 gallons extra. This works out at about 4,000,000,000 of effective water supply distributed over a population of 600,000, or about 10,000 gallons of storage per head of population. There are two important questions involved in any water scheme, namely, the sufficiency of catchment and the sufficiency of storage. In his proposal to cost £135,000, Mr. Sambell has not given any estimate for the diversion of Menzies' Creek, but, including that creek, there is in the Monbulk catchment about 54 square miles; that comprises the Ferry Creek and the two branches of the Monbulk Creek, and the Menzies' Creek. Therefore, with a storage capacity on the same basis as that of Melbourne at the present time you would have in connexion with the Monbulk scheme a supply for about 22,000 people. Melbourne, however, has not exhausted its catchment. The Metropolitan Board has in contemplation the building of a reservoir on the Marondah watershed, and the chances are that, with this extra reservoir, there will be a supply available for a considerably greater number of people. At periods during the winter there is a considerable run-off or waste from Melbourne's 170 square miles of catchment area. The key to

the capacity of a scheme is the provision of sufficient storage. More than 22,000 people could be supplied by the Monbulk scheme, but that would involve the question of money, and of the provision of adequate storage. The Metropolitan Board cannot be said to have impounded all the water available in their catchment area. There is a likelihood of getting more water by constructing additional reservoirs. On the basis of the Melbourne figures, the Monbulk watershed of 2,500 acres, without Ferry and Menzies' Creeks, would have very little more than enough water for 14,000 people. The Melbourne supply has no storage in the Watt's River valley, or along the Gracemuir River, nor is there any storage on the O'Shanassy. A vast quantity of unregulated water thus runs away to the sea in the winter time. Roughly speaking, two-thirds of the Melbourne catchment has practically no storage provision. Mr. Sambell states that the total area of the Mornington Peninsula watershed is 6,360 acres, and with the same proportion of storage as Melbourne has at the present time, the four streams in that catchment would supply only about 30,000 people. I have pointed out, however, that the Melbourne catchment could be better utilized by the provision of more storage, and that the limit to the usefulness of the Monbulk and other catchments will be determined by the reservoir accommodation. In regard to the proposed scheme for the Mornington peninsula it is for the Federal Government to come to an agreement with the State Government as to what price the former will pay for the supply for the Naval Base. Personally, I desire to see an arrangement arrived at which will be fair to all parties, to the State Government, the shire councils, and the Federal Government alike. It will be necessary to know also the quantities of water to be supplied to the various contingencies, and also the amount of the annual charges, and to then apportion the annual cost. An understanding between the State Government and the Federal Government is a necessary preliminary to any scheme. The State Government will require to be assured that sufficient money has been provided in any proposal put before them, so that the scheme may be carried out within the estimate. When the cost is ascertained the Federal Government will be in a position to know fairly accurately what contribution they will be expected to pay. My report to the Commission will deal with all phases of the scheme, the engineering problems, the capital and annual charges, and the likely revenue. In the event of the Federal Government deciding not to participate in this scheme, it will be necessary for the Mornington Peninsula Conference to go in for a reduced scheme. Personally, I think there should be one scheme to supply the State and Federal Governments and the municipalities. Instead of the Federal Government coming in as a partner and sharing with the other authorities the cost of construction and management, I think it would be better for a trust to carry out and manage the scheme, but it would be necessary to have an understanding beforehand as to the charge to be paid by the Federal Government. The State Government would require to have that matter settled. Considering the magnitude of the project and the large expenditure involved—estimated by Mr. Sambell at £135,000—it should be understood that the Federal Government would make a certain contribution for which it would be entitled to a certain quantity of water. I see no objection to the Federal authority being represented on the trust. I think there would be a certain moral obligation on the Federal Government, as

one of the biggest customers, to contribute a certain sum every year. The local authorities would be always pegging away to see that the Federal Government paid their share. At Seymour railway station the Railway Department purchases water from the Seymour Waterworks Trust, and pays that body from £1,300 to £1,600 per annum, but the Department has no representation on the trust. The State Government has a certain control, but it is difficult to vary the payments once the amount has been fixed, because there are certain annual charges, such as the interest on the bill, which cannot be reduced unless by a depreciation fund, a sinking fund, or some other means of writing the cost down.

75. *To the Chairman.*—In my report I shall endeavour to estimate how, under certain conditions, certain municipalities and other consumers will be supplied with a certain quantity of water at a certain price, and I shall also show what, in my opinion, will be a fair proportion of the cost for each body to pay. The State Government will require to know as exactly as possible what the cost of the scheme is to be, so that there may be no extras introduced after the original estimate has been approved. As soon as we are in possession of that information, we shall be able to estimate what the various charges will be.

76. *To Senator Lynch.*—The participation of the Federal Government as a partner in the scheme instead of merely as a customer would depend on the extent of representation that the Federal authority would require.

77. *To Mr. Sampson.*—My function is to report on the scheme put forward by the shire councils to the State Rivers and Water Supply Commission. Thereupon the Commission will inquire into the matter, and if the report is concurred in by it a copy will be sent to the Home Affairs Department, and another copy to the secretary of the Mornington Peninsula Conference. If there then remain any points in dispute between the various parties the most expeditious method of settlement will be the calling of a conference of representatives of each. My report to the Commission will be in the nature of a criticism or approval of Mr. Sambell's scheme or the recommendation of some other scheme. If I thought his scheme unworkable I should go to a certain length with preliminary investigations to show that a less costly or more efficient scheme might be undertaken, and the Commission would then require that proposal to be investigated. I have a free hand to make any suggestions that may facilitate a settlement.

78. *To the Chairman.*—The date of my report being available will depend on the receipt of certain information from Mr. Sambell. If he lets us have the further information for which we have asked in, say, a couple of weeks, I should probably take two months from that date to prepare my report. I estimate that after the matter is made available to the Parliament for whatever scheme is adopted, it will take about two years to get the water to Westport.

79. *To Senator Lynch.*—After the scheme has been agreed to by the Federal Government and by the Mornington Peninsula Conference, the next step will be for the State Government to make provision in the Loan Estimates for the year following upon that, the Mornington Waterworks Trust will be constituted by order of the Governor in Council, and then the works can be proceeded with. I should say that the final stage in the adoption of the scheme is the provision of the money by Parliament. Of course, the State Cabinet would require to be satisfied with the project

before they would consent to make the necessary provision in the Loan Bill. If the State Rivers and Water Supply Commission recommends to Cabinet a satisfactory scheme, and the necessary funds for carrying it out are available, such a recommendation is not, as a rule, rejected by the Government. One scheme was turned down for the time being, because the State Government was short of funds, but such a thing has not happened for some years.

80. *To Mr. Fenton.*—The expediting of work of the character would depend on parliamentary approval. In the ordinary course the Loan Bill comes before the State Parliament in November or December.

81. *To Mr. Finlayson.*—I would not care to say off hand which would be the best piping to use, or the cost per mile of any particular class of piping. Some pipes may be used in one situation and not in another. Speaking generally, wood pipes of large diameter are very suitable where they are under pressure of water all the time, and under a low head, but the competition of cast-iron and wrought-iron pipes would operate in connexion with smaller pipes. The time to decide as to the use of thick wrought-iron pipes, cast-iron pipes, or wooden pipes, is when the tenders have been received. As a rule, I would use the cast-iron pipes where there is a heavy pressure. I would not use wooden pipes for a greater head than 350 feet.

(Taken at Melbourne.)

FRIDAY, 19th MARCH, 1915

Present:

Mr. RILEY, Chairman;

Senator Keating,	Mr. Finlayson,
Senator Lynch,	Mr. Gregory,
Senator Storr,	Mr. Sampson,
Mr. Fenton,	Mr. Laird Smith.

Stanley Burrell Hunter, Engineer for Boring, Mines Department, Victoria, sworn and examined.

82. *To the Chairman.*—Boring in the Westernport district generally has been done under my supervision, but not in the immediate neighbourhood of the Naval Base. A private bore, however, was put down near Bittern about 1912, and at a depth of about 550 feet passed through basaltic rock and a little gravel and clay, and tapped a limited supply of very brackish water. Below that depth the bore passed into slates and sandstones, and it is unlikely that any potable water will be found in such rocks there. At Flinders I supervised the sinking of a bore 1,500 feet in basaltic rock and clay, and obtained a very limited supply of brackish water. At Main Creek, close to the road, a bore was sunk to a depth of a little over 800 feet, and was still in hard basaltic rock; no water worth speaking of was obtained. At Sorrento, under my supervision, another bore was sunk to 1,700 feet, and the whole depth was in tortory clays, sands, and mud. There was a fair supply of water in the bore-hole, but it was slightly brackish and not artesian; it did not rise to the surface. When the boring was finished, the water was stationary at from 40 to 60 feet from the surface. The chance of getting a quantity of water anywhere on the western coast inside Westport Bay is remote. On the Dromann side of

the Peninsula, however, there are fairly good supplies of fresh to brackish water, and towards Carrum it is possible to get an unlimited supply in ground of tertiary formation. One man down there is going into the question of irrigating a large area from a bore, and I have told him that nothing less than a bore of 10-inch diameter will suit, but that with such a bore he will, with the aid of a big pump, get a very large volume of water. The Carrum water is quite potable, and good enough for irrigation. The bulk of the water that comes from Carrum Swamp is off the granite area, and water from a granite watershed is nearly always fresh. The salts detrimental to drinking water do not exist in the granite to the same extent as in many other rocks. In the tertiary area, marked yellow on the map, there is fairly good water at from 10 to 15 feet from the surface, but that area is a long way from the Naval Base. At Lang Lang, about 13 miles from the township, I supervised a bore some years ago, and at about 700 feet obtained a flow of 54,000 gallons per day; that was a pure artesian flow of good quality. The shire council wrote into the Department urging that the casing should be left in the bore-hole. An offer was made to allow the council to have the casing for the benefit of the travelling public for about £20; but the council would not pay that amount. We, therefore, drew the casing, and the hole became choked, and thus was lost a magnificent supply of water for the district, a supply which would have been of special value having regard to the fact that there is a large butter factory there. The bore, I have mentioned, comprises the whole of the Government boring in that district.

83. *To Mr. Gregory.*—The Lang Lang artesian supply does not extend to Sale; there is an interruption in the basin. We know approximately where we can get artesian waters, but there has been no survey sufficiently comprehensive to enable us to speak definitely. It is quite possible that nearer to the Naval Base than Lang Lang you may get artesian water, but that could only be settled by actual boring. The Lang Lang water is particularly good for human consumption, but both Lang Lang and Carrum are somewhat distant from the Naval Base.

84. *To the Chairman.*—The consumption of 120,000 gallons per day, the minimum which you require for the Naval Base, is equivalent to a flow of 5,000 gallons per hour. By pumping, that quantity could be obtained at Carrum, but, in order to convey it to the Base, it would be necessary to raise it over a ridge about 200 feet high. The water would require to be pumped up to the top of the ridge, and then allowed to run by gravitation. That would be a costly scheme. The actual raising of the water from the bore would not be costly, because the water being so near the surface, large quantities could be pumped with low power.

85. *To Senator Lynch.*—You could have a reservoir at the Base in which to store water, but otherwise there could be no advantage from storage in connexion with the bore. I know the Mornington Peninsula fairly well, and I have always been of the opinion that to insure a large water supply an artificial reservoir would be required somewhere. Carrum and Lang Lang are the only two places, so far as I know, where you could rely on getting a big quantity of water from underground.

86. *To the Chairman.*—I cannot give you much definite information as to where you may get an underground supply of water for the Naval

Base; I can give only negative evidence. I can tell the Committee that a good supply of water cannot be obtained on the eastern portion of the Peninsula. Through that eastern portion there has been an enormous fault; the ground has subsided more than 1,300 feet, as we proved by the fact that, after boring to that depth, we were still in basaltic material that had filled up a great trough. There is a remote possibility that if you bored through that stratum of basaltic rock and clay you would get water, but how far it would be necessary to go to penetrate that stratum I cannot say. If it were decided to bottom that trough with a view to finding an artesian supply it would be a simple work to clean out the 1,500 feet bore hole, and continue the sinking from that depth. The bore was put down near the beach not far from the old Flinders Cable Office.

87. *To Senator Lynch.*—The deepest bore in the district is that at Sorrento, and the water there is slightly brackish, although stock could drink it.

88. *To Mr. Fenton.*—There are a number of places in the district where, by sinking wells, a small local supply may be obtained. That is due to a depression in the original surface having formed a water lodgment, and the recent strata in such depression having become waterlogged. I have some knowledge of the Bunyip River, and I have seen the flow reduced to a very small stream in summer. The Koo-wee-rup waters probably form portion of an artesian supply, probably the same as that I tapped at Lang Lang, because the country is similar all the way through. We passed through nearly 700 feet of basaltic rock before we reached any large quantity of water at Lang Lang.

89. *To Mr. Gregory.*—The water at Lang Lang was a true artesian supply. It rose well above the surface, and gave a magnificent flow, but, of course, immediately we pulled the casing the hole became blocked with sand, and the flow ceased. The Department is always requiring casing, and at that time we could not afford to leave 700 feet of casing in the hole, although we did offer it to the shire council for about £20. The boring at that spot cost about 10s. to 12s. per foot, I think. It might be done at a cheaper rate now with the more up-to-date plant we possess. A 5-inch bore was used in sinking that hole.

90. *To Senator Lynch.*—I am inclined to think that the flow at Lang Lang could be maintained for years to come. It is the general experience that the original flow is fairly well maintained until the hole becomes choked. At Werribee we have put down several artesian bores, and the only reason for any one of them ceasing to flow was due to the choking of the hole. Of course, when the supply is first tapped the flow is stronger than at a later stage. Even in Queensland the supply from the artesian bores is greatly diminishing. That may be due to the fact that so many bore holes were left unplugged when they were abandoned. In the United States they have introduced very strict legislation on this subject in connexion with the oil fields. If a bore is sunk which proves a duffer it must be absolutely secured against the leakage of gases, because it is a recognised fact that it is the pressure of the gases which drives the oil out of the producing wells. Of course, gas pressure does not usually apply to artesian water, but by leaving open abandoned bores so that the water gradually drains away, the artesian pressure is relieved, and there is in consequence a diminished flow from the working bores.

91. *To Senator Lynch.*—A water supply from artesian sources has the drawback that no storage can be provided unless it be between the source of supply and the distribution. Assuming the Carrum bore to be equal to supplying the required 120,000 gallons per day, the pumps would need to be worked throughout the twenty-four hours in order to produce that supply. Of course, you might be able to increase the supply by providing additional bores. I believe that the Carrum area would be equal to the strain of quite a large number of bore holes, and the installation of fairly large pumps. There is such an enormous storage in the Carrum basin that you could go on pumping almost indefinitely without making much difference. It is true that that is a "pocket," but it is a very large one. In the Loddon Valley district four mines were pumping 19,000,000 gallons per day for eighteen months, at the end of which period they had only commenced to make a slight reduction in the flow. Even in a new district like Ararat, where something like 2,600,000 gallons per day is being pumped from one mine, they were only recently able to reduce the pressure sufficiently to allow them to get into the wash and examine it in a limited way. The supply in the Carrum basin is probably greater than in the Loddon Valley.

92. *To Mr. Gregory.*—As to the possibility of the Carrum water becoming odorous when stored in a large reservoir, there is a large amount of humus in the soil, and it is quite likely that there are organic acids in the water, but that is a question for chemical analysis. There would be a risk of the growth of algae, and even with water which has come from 400 feet below the surface through clean drift, a fine green growth commences after it has been running a few weeks. There may be a risk of contamination from the drainage at Carrum, because there is a good deal of settlement there.

93. *To Senator Lynch.*—The suitability of the Carrum water for ships' boilers is a question to be determined by analysis. If the water is rich in organic acids it will commence to corrode the plates. So far as I know, no analysis of the water in the Carrum basin has been made. No analysis has been made in the laboratory of the Mines Department. I think it would be a good idea to get at least a dozen samples of water from different localities within the Carrum area and have them tested. There are plenty of wells and bores in the district. Now that the bore at Lang Lang is closed up there is no means of obtaining a sample of that water unless the hole is cleaned out. That would involve a cost of £40 or £50 for transport charges to get a drill to and from the bore; the cleaning of the hole should not cost more than 3s. or 4s. per foot. If casing were to be put in 700 feet would be required at a cost of 4s. 6d. per foot.

94. *To the Chairman.*—The Lang Lang water was cold and clear and showed no sediment. We did not have any analysis of it made.

95. *To Senator Lynch.*—There is no hope of getting an increased pressure by deepening the bore because we reached bedrock.

96. *To the Chairman.*—I feel confident that at Lang Lang a supply of a quarter of a million gallons per day could be obtained with a larger bore. I do not know what the evaporation is in the district, but I think that in a reservoir it would be at least 4 feet per annum.

97. *To Senator Lynch.*—It was a 5-inch bore that produced the 54,000 gallons per day at Lang Lang. The casing for that bore should last seven or eight years, possibly ten years, be-

cause there is in the water no sulphuretted hydrogen, or any other acids which attack steel or iron. The cost of 10s. to 12s. per foot represented the complete cost of the boring, with the exception of the transport charges. In making any test of the Lang Lang area the easiest method would be to clean out the old bore hole; otherwise there would be a lot of boring through basalt to be done. I am almost certain that the Mines Department has no record of any analysis of the Lang Lang water. From my recollection the water was so good that analysis was not thought of. No water is running from that bore now, because the hole is choked. I should say that for about £100 the bore could be cleaned out and tested. Then there would be the additional cost of casing.

98. *To Mr. Gregory.*—After boring through the basalt the drill entered drift country.

99. *To Senator Lynch.*—Sale is the only town in Victoria that is supplied with water from an artesian source. When that bore was first opened the quantity of drift that came from it was so great that the hole had to be shut down. I put down a 7-inch bore, and in the first twenty-four hours of the flow 600 dray loads of sandy soil came out of the hole. In a very few hours the sand was 3 feet deep around the hole. It was subsequently carted away and used by the shire council for street works. The water from that bore was used only for street flushing, and for filling an artificial lake which had been made out of an old swamp close to the town. The water was not used for domestic purposes.

100. *To the Chairman.*—In considering the possibility of supplying the Naval Base from artesian sources, I think the first thing to be ascertained is the probable cost of taking the water from the bore hole to the Base in the event of there being a sufficient supply. It might be found that the cost of carrying the water would be greater than that of building a big reservoir in one of the adjacent catchments. I remember that when the small Talbot water supply was installed, it cost a little over £100 per mile to carry it to the point of distribution.

101. *To Mr. Gregory.*—The Carrum people may have asked to be connected with the proposed scheme for supplying the district with water, but there is plenty of sub-artesian water in that locality, and if I had a block at Carrum I would have within a week enough water to irrigate it. Another test that might be carried out in the district is the continuation of the 1,300 feet bore at Flinders in order to ascertain what is in the big trough which I described earlier.

102. *To the Chairman.*—If the bore at Lang Lang were successful a greater supply than what is required for the Naval Base could be obtained, but it must be remembered that the water would have to be carried about 30 miles. I will let the Committee have any analyses of Lang Lang water that there may be in the Mines Department.

Water John Carrs Riddell, Chairman of the Melbourne and Metropolitan Board of Works, sworn and examined.

103. *To the Chairman.*—My Board has undertaken to supply water to the Commonwealth authorities at the Naval Base on condition that the Commonwealth lay a pipe line from the Notting Hill reservoir, which is situated about 1½ miles to the east of Oakleigh. I have no information as to costs. I would rather that you called the engineer of water supply upon that point. I have no doubt as to our being able to supply the Naval Base with a continuous water supply. The

encroachment upon the metropolitan supply would not be too great. There may be legal difficulties in the way of the Commonwealth and the Metropolitan Board coming to some arrangement, but we considered that in offering to supply the Defence Department we were justified in risking any little doubt upon that point. The Board has approved of supplying the Naval Base. I am aware that some of the objections on the Peninsula are desirous of obtaining a supply, but the Board has not considered any scheme yet. For water delivered at Notting Hill the charge to the Naval authorities would be 1s. per 1,000 gallons. The Board is not permitted to supply water outside the metropolis at a price lower than is charged inside the metropolis. The Board would not undertake any reticulation for the Naval authorities, nor would it erect a service reservoir in the vicinity of the Base. It would certainly be necessary to have a reservoir in the neighbourhood of the Naval Base in order to provide for abnormal demands. I do not think that it would be necessary to have a special Act of Parliament passed to enable the Board to enter into an arrangement with the Commonwealth. The Board is prepared to take the risk. Pipes would have to be manufactured, and the laying of the main to the Naval Base would depend on the output of pipes by the factories; laying would probably keep pace with manufacture. All that the Naval Base would get from the Metropolitan Board would be a supply from the reservoir at Notting Hill. I have no doubt that the Board could supply all the water asked for by the Naval authorities in their letter of request.

104. *To Mr. Gregory.*—The construction of a pipe line to the Naval Base would, I am informed, cost about £20,000. Though the Board reticulates in the metropolis for the price of 1s. per 1,000 gallons, it has no power to charge a lower price outside its area where it does not undertake reticulation. It charges Moorabbin and other districts 1s. per 1,000 gallons, and they pay the capital cost of reticulation, just as would be the case with the Naval Base. Supplying water to the Peninsula and Naval Base is an expensive proposition. There would be very little business along the main, and a bigger pipe would be necessary, so that I doubt whether the charge would be any less than to the Naval Base alone. The distance are great, and the Peninsula is very dry. To obtain a supply of water in that area is very difficult. I do not know the particulars of the Dandong scheme, but I doubt whether any such scheme could supply the water at a cheaper rate than buying water from the Board. The Board has no power to lay pipes outside the metropolis, except for the purpose of bringing water to the metropolis.

105. *To Senator Keating.*—The Board has not considered the question of supplying the intermediate towns, because it did not know what the demand would be. It knew what would be required for the Naval Base, but it did not know what the future supply to the Peninsula might be. A larger pipe would be required. No question as to legal difficulties in connexion with supplying the Naval Base has arisen. Some of the places outside the Metropolitan area which the Board supplies are Moorabbin, a small portion of Oakleigh, a small portion of Werribee alongside the Werribee farm main, and Sunshine. With the exception of Werribee the local authorities have provided the mains outside the metropolis. In

the case of Werribee, the Board has a main to the farm, and the local authorities take the water from it.

106. *To Mr. Finlayson.*—The Water Supply Committee of the Metropolitan Board is now considering the question of supplying Mordialloc, Carrum, Frankston, and Mornington, but the matter has not come before the Board. The feeling is that to supply these districts would be a great departure from the principle for which the Board was established. Our system was created under an Act of Parliament for the supply of the metropolis. The supply of water outside the metropolitan area is quite a different policy, and I doubt whether we should be justified in doing it without a special Act of Parliament. Certainly the Governor in Council, at the request of the municipalities and the Board, can extend the metropolis in any direction within 25 miles of the Melbourne Post Office, but I do not think that the extension to the Peninsula could be called an extension of the metropolis. Frankston, I think, is just outside the 25-mile radius. I am not in the position to give any information as to the probable supply if Melbourne grows at its present rate. No information will be available until the summer is over. This season we have met conditions never before experienced. The Yan Yea intake for the twelve months ending 31st January was 16 per cent. lower than in any previous recorded year, and the Maroondah stream is now running at about 20 per cent. less than it has ever run before. All streams from high mountains, getting their supplies from snow, have suffered worse than those which do not depend on snow. Streams like the Yarra and O'Shanassy have probably suffered more than those which are not dependent on snow. This year there is great probability of the Goulburn and Yarra being 20 per cent. worse in stream-flow than in previous years. The period of lowest stream-flow is towards the end of April, but to-day the streams are lower than they have been in any April. We have to make our calculations on the worst year on record. If by the end of April streams are 20 per cent. worse than in any previous year, it stands to reason that we can supply 20 per cent. less population from such streams than we thought we could. We have our eyes open for other catchments, and will probably recommend the Government to extend our sources of supply almost at once. We have not made up our minds to adopt further storage. The Yan Yea reservoir holds 6,400,000,000 gallons, but we only get an intake of 3,300,000,000 gallons last year. A supply of water to the towns between the Board's boundary and the Naval Base would be a matter of policy; there would also be the question of whether there would be enough water. If at the end of the summer we are of opinion that it would be unwise to commit ourselves to supply additional areas until we have more water, then larger works would mean considerable delay. The construction of a dam at Maroondah would take, perhaps, three years. The extension of the O'Shanassy scheme to the Upper Yarra could be completed much more rapidly. Prior to last year the minimum flow of the Upper Yarra was 14,000,000 gallons per day, but that would be ample for some time to come. Owing to the extension of settlement the Board will probably recommend an extension of the metropolis in two or three directions almost at once.

107. *To Mr. Laird Smith.*—In the metropolis each consumer gets credit for an amount of water

up to the amount of water rate he pays. Any consumption beyond that quantity is paid for at 1s. per 1,000 gallons.

108. *To Mr. Sampson.*—We have exhausted all the streams within the present catchment area. I am absolutely opposed to allowing settlement on catchment areas. No settlement is allowed on the Metropolitan Board's catchment areas, and I think that recognised authorities are opposed to allowing it unless filtration be introduced. The marking off of a reserved area on both sides of a stream is not a sufficient safeguard. The Government willingly acceded to the Board's request to grant the whole area of the O'Shanassy watershed. Large sums have been spent in the past buying out settlers in the watersheds.

109. *To Senator Lynch.*—The Board's Act provides that water supplied outside its area shall not be sold at less than the charge for water inside. Though we are experiencing a season never before contemplated, I think there will be enough water to supply the Naval Base. The position of the country is most dangerous. There was no waste over the by-wash last year at the Yan Yea reservoir. We started the winter with a depth of 12 feet 7 inches, and only filled up to 15 feet 10 inches. The reservoir held 2,700,000,000 gallons at the commencement of the summer, instead of 5,400,000,000 gallons, its capacity when full. It was practically only half full at the commencement of summer, but then we did not have the benefit of the O'Shanassy scheme for the whole of the previous winter. Had we had the benefit of that scheme during the whole of the winter, we would have taken Jess water from the Yan Yea, and would therefore have had more water conserved at the beginning of the summer. I have not discussed with the Premier of Victoria the prospect of getting legislation passed to enable the Board to supply the towns in the Peninsula and the Naval Base, and I have not obtained an expression of opinion from the Board upon the point. The Board is testing wood pipes, but mostly large ones. I cannot express any opinion upon them. The next generation will probably be able to form an opinion. Our engineers wrote to the leading American engineers to get their experience, but they all replied that wood pipes were still on their trial. The water supplied in the metropolis is the very best for boiler purposes. I understand that ship-owners prefer it to any other.

110. *To Mr. Laird Smith.*—We have not had sufficient experience with electric tramways to form any idea as to trouble from electrolysis. I should not think that the electrification of the railways would affect us. I should think that wood pipes would be immune, but the difficulty in regard to wood pipes is that, with high pressure, there must be a considerable amount of iron binding to strengthen the pipe. The strength all lies in the iron, and the maximum life of the pipe is, therefore, the life of the iron. If you have much iron binding you might as well make the whole pipe of iron.

111. *To Mr. Finlayson.*—The Metropolitan Board will undertake to supply water to the Naval Base immediately the Naval authorities are prepared to receive it, and is also prepared to guarantee a continuous supply.

112. *To Senator Lynch.*—I am not prepared to say that the Board would subordinate the requirements of the Naval Base to the requirements of the city in the case of experiencing another year such as the present. I think it

would be a matter of contract. No consumer has any right over another in the metropolis. The quantity of water the Naval Base would consume would be immaterial to the Metropolitan Board.

(Taken at Melbourne.)

THURSDAY, 25th MARCH, 1916.

Present:

Mr. RILEY, Chairman:

Senator Keating,	Mr. Finlayson,
Senator Lynch,	Mr. Gregory,
Senator Storey,	Mr. Sampson,
Mr. Fenton,	Mr. Laird Smith.

Caldor Edkins Oliver, Engineer-in-Chief Melbourne and Metropolitan Board of Works, sworn and examined.

113. *To Senator Lynch.*—The area of the jurisdiction of the Melbourne and Metropolitan Board of Works for the purpose of water supply extends to a radius of 10 miles from the post-office, but we have gone outside that area for water supply purposes. It may be assumed from that that the Board has power to extend the area of its jurisdiction for this purpose. I think that to secure a water supply for the Elmdon Naval Base the Commonwealth authorities will have to come to us. I have some idea of the difficulties in the way, and I do not think there is anything else they can do. I have under consideration at present a scheme for taking the water down to Carrum, but that is still in the air.

114. *To Mr. Sampson.*—I have not inspected the catchment area of the Menbulk estate, but I have a general knowledge of the country. It has a lower elevation, and is a different class of country to that comprised in the catchment area of the Melbourne and Metropolitan supply. I am against settlement on the catchment area of a water supply. Where there is settlement, there is always danger of typhoid and other bacteria polluting the supply, and I should not consider fencing both sides of streams a sufficient protection against this. It is true that settlement is not close in an agricultural district, but everything depends upon the value you place upon the purity of the supply, and the risk of its pollution by bacteria. Fertilisers are largely used on cultivated lands, and they are conducive to bacterial growth. In my opinion, it is better to prevent all settlement upon the catchment area of a water supply. It is true that there is settlement on the catchment area of the Ballarat water supply, but the settlement was there before the supply was provided for, and they had to take what they could get. The greater part of our catchment area was Crown lands, but I could obtain a return showing how much land we purchased, and what we paid for it. There are roads through our reserves, but they were there before we took over the area, and we have always been against any extension of roads. They are undoubtedly a source of contamination. The Government were asked to provide a new road between Maroondah and Fernshaw, and we were absolutely against having another road there without closing the present road.

115. *To Mr. Finlayson.*—I should object to either agricultural or pastoral settlement upon the catchment area of a water supply. If sheep were depastured on the area danger might arise from fluke or other diseases getting into the flock. In the case of settlement upon a catchment area the introduction of sanitation tanks along the pipe

track should undoubtedly assist in the purification of the water, but you would have no guarantee that it would be cleared of all impurities. A filtration system to secure the removal of impurities would be expensive. I should say that the best system of filtration would be a biological system—the first and second half of a septic tank—intermittent sand filtration. That would insure a reasonably safe water supply, even though there should be agricultural settlement on the catchment area. I am very strongly against anything like close settlement on a catchment area. Of course, the London example may be said to be against this, because one part of the London supply is taken from the Thames at a point below the outlet into that river of the sewage from a district with a population of over 4,000,000 people. They have overcome the difficulty there by very costly filtration.

116. *To Senator Lynch.*—The Yan Yean reservoir is a long distance to the north-west of Notting Hill, and the O'Shannassy catchment area is a considerable distance to the north of the Monbulk catchment area. We preferred to make use of the O'Shannassy catchment area, because it covers over 32,000 acres and in some parts has an elevation of 4,000 feet, giving a snow catchment, whilst the Monbulk catchment is a very small area of comparatively low elevation. Although the Committee may have had evidence that there is about 3,000 acres of watershed on the Dandenong Range, we went to the further point on the ground of insufficiency of supply. I had never looked upon the area referred to as being of any practical use to us, although it might be of use to Dandenong proper. The Monbulk district to which you refer is also a comparatively settled district. Notting Hill is only 330 feet above sea level, whereas our off-take in the O'Shannassy is 900 feet. The lower Dandenong area was never seriously considered by the Board.

117. *To Mr. Finlayson.*—I do not know of any objection that exists, or could be raised, by the towns on the pipe line between Notting Hill and the Flinders Naval Base, against an exclusive service for the Base passing those towns by without serving them, because it would be a totally different line of pipe. If you came down from Notting Hill along the forebore by Frankston and Carrum a larger pipe would be required in order to supply those towns and the Base also. If the Committee were willing to recommend the expenditure necessary for an absolutely exclusive service for the Naval Base, the inland route would be preferable. I cannot see that there can be any objection to the establishment of such an exclusive service. It would be a matter of policy, upon which I think our chairman touched, as to whether the Board would be willing to supply the water on the one pipe line for a service sufficiently large to supply Hastings, Cranbourne, and other towns on the route as well as the Naval Base. From an engineering point of view, I can see no difficulty. As to the water-supply point of view, we are even now aiming at an extension of our water reserves, because we are rather short. We are not very keen on supplying outside our present radius, we want to keep it down as much as possible. You may say that our willingness to supply the Naval Base is based on purely patriotic motives.

118. *To Mr. Fenton.*—As to the question whether, from a practical point of view, it would be wise to have two pipe lines running down through the same district to supply the same people, you should remember that there is some distance between the two as planned on the map. If you could get enough water from Monbulk to

supply the other places on the peninsula, as well as the Naval Base, one scheme ought to be sufficient. As a practical man, if I was assured that there was a plentiful supply of water, I would say, "Have one scheme for the whole lot."

119. *To Mr. Gregory.*—We are using about 1½ miles of wooden pipes on the O'Shannassy, but it is too early yet to talk about tonnage. For four or five years we have had a short length of 6-foot wooden piping near Erwinston reservoir. We also laid down for the Mont Park Asylum for the Government, about a mile of 6-inch wooden piping. Wooden pipes are considerably cheaper than cast-iron pipes. They would cost about 40 per cent. less than steel pipes, and the steel pipes are much cheaper than the cast-iron pipes. As to the use of wooden pipes, it resolves itself into this: If you have the money, put down steel or cast iron. If it is only a temporary supply, put down wooden pipes. The best information I can get from America is to that effect. They say that if you use wooden pipes, in about 10 or 12 years' time you begin to wish you had never put them in.

120. *To Senator Story.*—We have some of the reinforced concrete pipes—invert siphons—on the O'Shannassy scheme. They are dearer than wooden pipes and cheaper than iron. We have put them only under low pressure so far, but I they can be made to stand any pressure. I made some experiments with them. We had 6-foot pipes built to stand different pressures. They were put under these pressures, and they stood them well. I can supply the Committee with the estimated cost per mile of laying steel and cast iron mains with 6-inch, 7-inch, 8-inch, and 9-inch pipes respectively. I think the estimate of cost already furnished to the Committee was given by our own people. For 9-inch pipes the cost of steel and cast iron is very nearly the same. For 6-inch pipes the cast-iron pipes are cheaper; when you get to the larger sizes, such as 15 inches and 18 inches, the steel pipes commence to come cheaper. For 8-feet pipes there is no comparison. The steel pipe that we use is not the Mannesmann tube; it is the lock-bar type. The Mannesmann tube is not exclusively a German pipe; it is manufactured in Wales also.

121. *To the Chairman.*—If the Committee decided to get a water supply from the Board of Works, and arrangements were completed accordingly, I think the work could be carried out over the 40 odd miles, and we could give the Naval Base a supply in less than six months. Of course, the pipes would have to be made. If the pipe-makers are not very busy now, I would let them go straight ahead. If a reservoir were required at the Base also, that could be gone on at once without waiting for the pipes to come along. I think you could rely on having a supply at the Base in less than twelve months.

122. *To Mr. Finlayson.*—As to the relative life of steel or cast-iron pipes, the life of a pipe with the water that we have here is dependent entirely on the coating. We have wrought-iron pipes twenty years old that plates have been cut out of, and they are as good to-day as the day they were put in. If we had the same water as they have at Coolgardie, and the coating is injured, of course the pipe is gone. I have no objection in ordinary circumstances to the use of steel pipes as against cast iron. In fact, I prefer the steel pipes at any time, because when the cast-iron pipe breaks, it breaks altogether. The steel pipe gets only a pin hole in it, and by simply putting a clip on it, you can go on for a considerable time afterwards.

123. *To Mr. Gregory.*—Most of the injury appears to come from the outside, apparently from chemicals in the soil, but since the hessian coating outside was adopted, we have had no trouble with them. We had pipes taken up just the other side of the river that have been in nearly twenty years, and have been rusting them. All that we have had to do has been to pick up the pipes, clean them, re-coat them, put two or three small patches on them, and use them again.

124. *To Mr. Finlayson.*—Steel pipes are being largely used instead of cast iron on account of the less cost. If Brisbane has put in a new steel pipe service of the lock-bar type, it must be based on the very latest information. Steel pipes will stand pressure better than the cast iron. The Americans call the lock-bar pipe the "100 per cent. joint." In the old-fashioned pipe, with the riveted joints, you have got only about 60 per cent. of the strength of the plate, but the way the lock-bar pipe is made, it is equal to the whole strength of the plate. There are a good many points in favour of the steel pipe as against the cast iron. As long as the coating is good, the steel pipe is good. When the coating is gone, the pipe is gone.

124. *To Mr. Laird Smith.*—Steel pipes can be made, and are being made, in Australia. We are not having them made as small as 12 inches. I do not think the lock-bar pipe can be made smaller than 16 inches. I do not anticipate any trouble from electrolysis owing to the installation of so many high potential electrical stations, in view of the later forms of electricity. So long as the potential between the rails is all right, and there is proper bonding, there will not be a difference of potential of more than one volt between rails and pipes. In the old days they had nothing of that kind. There used to be stray currents, and you might get up to 20 or 30 volts, as there was a considerable difference of potential. I have seen results of electrolysis of pipes in Sydney, but I have never had results here. Wherever we get the lines coming anywhere near us, we bond right on to our pipes straight out so as to prevent any difference of potential.

125. *To Mr. Fenton.*—The cost of cast-iron pipes has gone up slightly recently. I think there is a great prospect of a further increase. The difficulty with the steel pipes is in getting the plates out. There must be a lot of trouble just now in that regard. There is not the same difficulty in the manufacture of cast-iron pipes, because all that is required for them is the pig iron, and there is a fair supply of that available.

(Taken at Melbourne.)

MONDAY, 1st NOVEMBER, 1915.

Present:

Senator LYONCH, in the Chair;	
Senator Keating,	Mr. Finlayson,
Senator Story,	Mr. Sampson,
Mr. Fenton,	Mr. Laird Smith.

Thomson Murray, C.E., Engineer, Victorian State Rivers and Water Supply Commission, sworn and examined.

126. *To the Chairman.*—I would like to read a brief statement about the pollution and purification of water supplies which bears on the Bunyip scheme and the Monbulk scheme. The first two pages of the statement were prepared by my as-

stant, Mr. C. M. B. Naylor. I asked him to look up the various authorities dealing with the question of the pollution and purification of water supplies, and he prepared a brief statement which does not go into technical details. It reads as follows:—

**POLLUTION AND PURIFICATION OF WATER SUPPLIES.**

Pure water is quite unknown on the surface of the earth. Rainwater rarely contains less than one grain of solid matter to the gallon, often considerably more. (Hiley, in his book on "Water Supplies and their Purification.") says:—

"Country rain" may contain pollen granules, dried tissues, spores of fungi, insects, and bacteria, so that it must always be properly filtered if used for drinking.

"The bacterial content of ordinary soil is very large, ranging from 10,000 to 5,000,000 per gram of soil, while in polluted soil the bacterial content may rise to 100,000,000 per gram. Waters circulating through the upper layers will, of course, carry off many of the germs, including pathogenic ones."

Allen Hazen, in his treatise "Clean Water and How to Get It," says:—

"The ideal catchment is one free from human habitation and covered with forest."

But it should be remarked that this is not perfectly free from pollution in the form of putrefying vegetable and animal matters, birds, rabbits, rodents, &c.

"It is often impossible to remove population from a catchment area, and, in fact, it is often unnecessary to do so."

"Very good water is drawn from areas upon which there are many residents, when proper and well-known precautions are taken. There are 778 people per square mile upon the Cochinquin Catchment, U.S.A., and 62 upon the Croton, New York supply, yet it is not to be supposed that the waters drawn are seriously impaired by these inhabitants. And as better means of handling the water are used, the influence of population upon the quality of the water becomes less."

Mr. J. S. Dethridge, M.Inst.C.E., in his pamphlet on the "Purification of Town Water Supplies," states:

"Many large English and Continental cities, notably London, are content to take portion, and in some cases the whole, of their water from rivers that receive the sewage from densely populated areas, and to treat it filtration to render the water safe for use."

"The population on the London catchment area exceeds a million, nevertheless, when filtered, the river water is found to be as safe as that from deep wells in the chalk."

"Excellent are the results of sand filtration at London, those of Hamburg, which draws on the polluted waters of the Elbe, are perhaps more satisfactory."

Hazen says:—

"In 1893, the city of Lawrence, U.S.A., put into service a sand filter for the express purpose of reducing the death rate of the population supplied, and it accomplished this purpose in a most striking manner. Comparing the five years after it was in service with five years before it was in use, there was a reduction of 70 per cent. in the typhoid fever death-rate, which had been excessive for many years. No less remarkable was the reduction in the general death rate from all causes from 22.4 to 15.0 per 1,000 living."

On Mr. Naylor's statement I have penned the following remarks:—

Filtration removes 95 to 99 per cent. of bacteria and pathogenic germs. No residual nor unsettled amount of either catchment is immune from contamination. It should be noted that all surface waters are subject to pollution, and should not be used for drinking without either being boiled or filtered. Profitable suitable stored water when either settled or unsettled areas is effectively filtered, it will not be injurious to health; and, with delivery of such supply, sufficient in quantity, the scheme which will entail the least cost and annual charges should, having regard to financial and other conditions, be adopted.

I shall proceed now to speak briefly and generally about the combined scheme from the Bunyip and then deal with the separate scheme. Part of the separate scheme is included in the larger scheme; in fact, practically the whole lot could

form part of a larger scheme. The limit of the Monbulk scheme is  $9\frac{1}{2}$  square miles of catchment area. Mr. Sambell's first estimate was for a catchment of 4 square miles, comprising the east and west branches of the Monbulk Creek. In April last he enlarged the catchment area by providing an estimate of the cost for additional works for diverting water from Menzies' Creek by a weir and tunnel at Aura Station, together with the pipe main, thence to the proposed reservoir on the west branch of Monbulk Creek. It is on that Mr. Sambell is basing his estimates at the present time. He thus added another square mile by taking water from the Menzies catchment, making 5 square miles. This proposal was to supply, by gravitation, Carrum, Frankston, Mornington; and by the Langwarrin route the Naval Base at Westernport, and it was known as the Monbulk scheme. Being asked to go further into the matter, Mr. Sambell prepared an estimate for an extension of that scheme by taking water from Sassafras Creek and diverting it into the Menzies Creek watershed, and thence to Monbulk. On account of the levels, the pipe-line had to go through the Menzies Creek catchment. For this extension scheme, this adds  $2\frac{1}{2}$  square miles to the gathering ground, increasing such from 6 to  $7\frac{1}{2}$  square miles. Mr. Sambell has prepared estimates for a reservoir on Sassafras Creek, and a pipe-line leading to the main from Menzies to Monbulk. There is water from an area of half a square mile on the Emerald Creek which may be diverted into the pipe from Sassafras Creek to Menzies' Creek, making an area of 8 square miles. Then there is another catchment, namely, Ferny Creek, having an area of  $1\frac{1}{2}$  square miles. Recently, for examination, Mr. Sambell made estimates of the cost of storage on Ferny Creek and of the pipe-line from Ferny Creek to join the leading main from Monbulk reservoir to Carrum. That will make, with the 8 square miles already mentioned, a total area of  $9\frac{1}{2}$  square miles. This is the practical limit of the gravitation source in connexion with the Monbulk extension scheme. Of course, you could add to those catchments by pumping schemes from creeks at a low level in the Dandenong Ranges, but that, I take it, does not enter into the consideration of this question in view that other less costly supplies may be obtained. I have not made an estimate of the probable cost of the scheme with a catchment area of  $9\frac{1}{2}$  square miles. Mr. Sambell's estimate is still incomplete in that connexion. He has presented no detailed estimate for the Ferny Creek supply, and he has made no estimate for the Emerald Supply, which he has in hand at the present time.

127. *To Mr. Sampson.*—Mr. Sambell has made an estimate of the cost of his scheme for the 5 square miles, and also a revised estimate in that regard. He has also made a further estimate for the extension of the water from the Sassafras catchment. That adds an area of  $2\frac{1}{2}$  square miles. But he has not made an estimate for diversion of water from Emerald Creek catchment, though he has done so for Ferny Creek.

128. *To Mr. Finlayson.*—The alteration which Mr. Sambell made, upon my suggestions to him, has materially altered the scheme in this way: that there would be a better service than he originally contemplated, and at about the same cost. That better service would be secured by the extension of the catchment area, and by improvements in the distribution—by the adoption of a large central reservoir at Mount Eliza, the omis-

sion of the Frankston separate basin, and modifications in size of other service reservoirs in the Peninsula.

129. *To Mr. Sampson.*—I would rather not say at this stage whether I would recommend the Monbulk scheme. I would prefer not to commit myself to an expression of opinion now.

130. *To the Chairman.*—The Bunyip combined scheme is a scheme which would serve the whole of the Mornington Peninsula, and also the Naval Base, as distinct from the separate supply to the Naval Base. The catchment area embraces 330 square miles. The head-works would be on the Koo-wee-rup main channel at a point about 5 miles north-east of the township of Koo-wee-rup West. The leading pipe main to the pumping station would be about 18 miles in length; the rising main would be 6 miles in length from the pumping station to a central distributing reservoir at Mount Eliza; and thence there would be pipe-lines radiating to the Naval Base, to Mornington, to Frankston, and on to Carrum. Every one would share alike from that reservoir; no body would not have an advantage over another body. The supply to each place from the central reservoir would be by gravitation, and the pipe off-takes would be so fixed that there would be no trouble as regards the division of the water: all would share alike. The pipe-line from the central reservoir at Mount Eliza to the Naval Base would discharge into a storage basin some 3 miles from the Naval Base—the site chosen by Mr. Sambell—and from that point there would be a leading main to the Base. That is an outline of the general scheme. It does not state any idea of the cost or charges or revenue, but, speaking broadly, the estimated cost of the scheme is about £135,000. It is a scheme in which the first cost would be considerably less than in the scheme from the Monbulk. It includes, of course, an extension to the Naval Base. The annual charges at first would be slightly more than the annual charges of the scheme from the Monbulk, but as population took place they would become less. The annual charges would not be much more in one case than in the other; they would be about 5 per cent. more from the Bunyip than from the Monbulk, but the first cost from the Bunyip would be at least £25,000 less than from the Monbulk. The main outstanding feature of the scheme is that it is a low-level supply. What I mean is that the leading main of 18 miles from the weir to the pumping station would be under a very low pressure. That means economy in piping. The leading main from the Monbulk scheme would be under a very great pressure, which would mean costly piping as compared with the Bunyip low-pressure scheme. I will now make further comparisons. The catchment areas are as 330 square miles to some 94 square miles. The minimum discharge of the creeks in a drought year is as 8,600,000 gallons per day on the Bunyip channel to 1,750,000 gallons per day in the scheme from the Dandenong Ranges. The increased minimum supply from the Bunyip means that you could go ahead and do with less reservoir accommodation from the Bunyip than you could from the Monbulk. There is increased cost of reservoir from the Monbulk as compared with the Bunyip. The Monbulk scheme is a gravitation supply, while the Bunyip scheme is a pumping supply. There is an increase in cost in the Bunyip scheme due to pumping. Then, as regards the distribution of water, the Bunyip central reservoir is one which would have a maximum top water level of 300 feet above the sea; the Monbulk reservoir would have at the outlet

a level of 620 feet above the sea, and there would at times be pressure due to the 620-ft. level of water, that is static pressure, which means the use of thicker or larger pipes than from the Bunyip scheme. Although the Monbulk scheme would discharge the water into the Mount Eliza reservoir—the is a reservoir with a top water-level of 300 feet—yet at times there would be a pressure due to the reservoir of 620-ft. level at Monbulk. With the Bunyip scheme, the fact that the top water-level would never rise above 300 feet means the use of thinner pipes. That fact would give an advantage in distribution. Although it may appear strange to the Committee, there would also be a better grade or fall for discharging the water, because the "central reservoir," as it is called, is in the centre of the whole system. A 9-in. pipe from this point would discharge about double the quantity of water, owing to the improved fall from the central reservoir, as compared with a pipe of the same diameter from the Monbulk. The reason of that is that a pipe from the Monbulk would have to bring water up to full level at the central reservoir; and to maintain such full supply height, there would be less grade available from Monbulk for the discharge of the main. There would be a gravitation supply up to the central reservoir.

131. *To Mr. Sampson.*—I estimated the cost of the combined scheme at £135,000, but I did not mention its capacity. It was intended to put a substantial weir at the offtake from the Koo-wee-rup channel, and a reinforced concrete pipe under a very low pressure. There would be a slight fall from the Koo-wee-rup main channel under a very low pressure. There would be a very slight fall from the Koo-wee-rup main channel to a basin at the pumping station, and the pipe-line would be suitable for reinforced concrete work. The pipe would be 21 inches in diameter, and discharge at the pumping station over 1,440,000 gallons per day. As regards a comparison between the two schemes, the Monbulk scheme would provide for a supply of 1,000,000 gallons per day, so that the Bunyip scheme would provide for 440,000 gallons more per day at the pumping station, where there would be a pump to discharge 60,000 gallons per hour. It was only intended that the pump should work intermittently; it would not be regular pumping. I presume that it would pump in the summer up to sixteen hours a day, and occasionally in the winter. The water would be pumped into a reservoir of 40,000,000 gallons capacity at Mount Eliza, that is in connexion with the scheme to cost £135,000. The reservoir which Mr. Sambell proposes to have at the Naval Base would still contain 10,600,000 gallons. The service basin at Frankston which he proposes should be done away with was to have a capacity of 1,640,000 gallons. That basin would be done away with, and the supply would be direct from the 40,000,000-gallon reservoir at Mount Eliza to Frankston and on to Carrum. The Mornington basin would remain in the case of either scheme, but there would be a shorter pipe line from Mount Eliza to the service basin for Mornington. The main to the Naval Base would discharge so as to give an assured maximum supply: it would discharge up to 320,000 gallons per day. Then there would be a much larger supply from the service reservoir near the Naval Base into the Naval Base. There would be a 7-in. pipe from the central reservoir of 40,000,000 gallons at Mount Eliza to the storage of 10,600,000 gallons near the Naval Base. And from the reservoir near the Naval Base there would be, I consider, a 9-in. pipe to

the Naval Base. That would enable excellent supplies to be provided. I have now given a general idea of certain details of capacity in connexion with the Bunyip scheme. I might add that there would be an elevated tank in the Carrum district. It would not be at Carrum, but about a mile south-east of Morlandale—that is, at or near Appuldorpe. As regards the separate scheme to the Naval Base, there would be the same sized catchment, namely, 330 square miles, and the same point of offtake. Describing the scheme generally, there would be a weir at about 5 miles north-east of Koo-wee-rup West, and thence a 16-in. reinforced concrete pipe from a tank near the weir to the pumping station, which would be erected at the same site as for the combined scheme. The precise site would be a mile south-east of the village of Peareedale, at some low ground about three-quarters of a mile from Watson's Inlet.

132. *To Mr. Sampson.*—The length of the pipe-line from the weir to the pumping station would be 18 miles, as in the other case.

133. *To Mr. Finlayson.*—The 16-in. pipe would carry 500,000 gallons per twenty-four hours. The water would enter into an excavated and bricked basin at the pumping station, and from that basin it would be filtered and pumped through a rising 9-in. main 5 miles in length to a high point at the 260-ft. level—that is a point  $2\frac{1}{2}$  miles south of the Somerville railway station, being near the Hastings and Warragotta roads. Then the water would be discharged from the 9-in. rising main into a service basin with a capacity of 700,000 gallons. From that basin there would be  $6\frac{1}{2}$  miles of 7-in. pipe to the storage reservoir of 10,600,000 gallons previously mentioned in connexion with the Naval Base supply. From the service reservoir there would be 3 miles 1 chain of 9-in. piping to the Base, discharging 305,000 gallons in 14 hours under a working pressure of about 37 lbs per square inch. The filtered supply in connexion with this scheme would be carried out by a mechanical filter of the Candy type 3 units with a diameter of 9 feet each and filtering 10,000 gallons per hour. Going back, the pumps would have a capacity of 20,000 gallons per hour. The reason why there are to be three filters of 10,000 gallons per hour each is to enable cleansing to be carried out, but the pump would have a discharge of 20,000 gallons per hour. That is, I think, an outline of the separate pipe scheme.

134. *To Senator Story.*—The estimated cost of the Bunyip separate scheme is £27,600.

135. *To Mr. Fenton.*—As regards the pipe-line, there would be 18 miles of 16-in. gravitation main, 5 miles of rising main,  $6\frac{1}{2}$  miles of gravitation 7-in. main, and 3 miles of 9-in. main, making a total of 31 $\frac{1}{2}$  miles.

136. *To Mr. Laird Smith.*—At the present stage I do not like to express an opinion as to the probable cost per 1,000 gallons of a supply delivered at the Naval Base under the different schemes. All that I can say now is that my investigations indicate that there would be less annual charges for a separate scheme from the Bunyip than from the central reservoir system. That is with a charge of either 8d. or 1s. per 1,000 gallons. I did take out certain figures, but I want to revise them. So far as I can conjecture, there would be a few hundred pounds less annual charges from the Bunyip separate scheme than from the Metropolitan Board's service, taking 8d. per 1,000 gallons as the charge for the water.

137. *To Senator Story.*—I think that there would be a little more piping required to take a

supply from the Metropolitan Board's system, but either scheme would take about the same time to carry out, I should say. There is pumping in one case, but not in the other. I think, however, that the work could be so arranged that both could be carried out in about the same period of time.

138. *To Mr. Laird Smith.*—I have already given the Committee an analysis of the water taken from certain points in the Bunyip catchment. In May last, the Commission forwarded to you reports on analyses of the water in connexion with the Warragul supply. The township hearing that name gets a supply from one of the head sources of the Bunyip, that is, from the Tarago. Then an analysis of the water at Koo-wee-rup has been made. A sample was taken on the 30th March, 1915, when the stream was very low.

139. *To the Chairman.*—It is a good time of the year to take water for the purpose of an analysis. When I visited Bunyip with Mr. Neylon in the beginning of September last, I had a further sample taken with the view of ascertaining the solids in suspension in the water.

140. *To Mr. Finlayson.*—From the purification point of view, the water is generally inferior when the river is low. I will say that, from the analytical point of view, it is a less favorable time to take a sample. Of course, you get flood waters which would not be pumped. They are subject to discoloration, still that phase would not enter into the question.

141. *To the Chairman.*—When the river is low is a safe time to take a sample of the water for analysis. I will now read a report on the analysis which was made.

Department of Agriculture, Victoria.

Agricultural Division,  
Melbourne, 14th April, 1915.

REPORT ON ANALYSIS OF SAMPLE OF WATER  
FROM KOO-WEE-RUP CHANNEL FOR MORNING-  
TON PENINSULA SCHEME.

SUBMITTED BY THE STATE RIVERS AND WATER SUPPLY  
COMMISSION.

	Parts per 100,000—		For com- parison— Yan Yean Supply
	1.	2.	
Total Solids dried at 150° ..	11.60	11.70	4.80
Chlorine ..	3.60	3.60	1.10
Hardness, temporary ..	2.75	2.75	2.00
Hardness, permanent ..	Nil	Nil	Nil
Nitrogen, Ammoniacal ..	.0162	.0180	.0210
Nitrogen, Ammoniacal ..	.0023	.0029	.0033
Nitrogen as Nitric ..	.0050	.0062	.0148
Oxygen absorbed at 100° in 5 minutes ..	.32	.32	.47
Oxygen absorbed at 100° in 1 hour ..	.63	.68	.64
Reaction before boiling ..	neutral	neutral	neutral
Reaction after boiling ..	alkaline	alkaline	alkaline
Bacteria grown on alkaline nutrient media in 48 hours at 20° C. ..	850	644	

This is a good sample of water for a domestic supply. Has a low content of mineral and organic impurity, and compares favorably with the Melbourne water.

P. RANKIN SCOTT,  
Chemist for Agriculture.

Sample taken by Mr. A. A. Moller, at Road Bridge, Koo-wee-rup, 30th March, 1915.

Flow, 330 cubic feet per minute.

T.M.

21st April, 1915.

All these samples are soft waters. In connexion with some places we have a hardness of 37 parts per 100,000. At Warragul, for instance, the water is very hard. The term "hardness" means that it is difficult to get any lather. The presence of ammoniacal nitrogen in a water is no indication of pollution. The less the ammoniacal nitrogen the less is the pollution. I might mention that although Nos. 1 and 2 samples are less than the Yan Yean water at that particular date, they are all practically good waters. From the oxygen point of view, there is very little difference in the samples. They are all good waters from that stand-point. This report contains no statement of the bacteria in the Yan Yean supply, but that information can be got from the Metropolitan Board of Works. They have statements showing varying quantities of bacteria in the water. They may have a thousand per cubic centimetre or they may have 2,000. These details can be obtained from the printed reports of the Board.

142. *To Mr. Fenton.*—I should say that the samples of water are all in the same category. You cannot say that one is better than the other.

143. *To the Chairman.*—I think that the sample taken by Mr. A. A. Moller would be a representative sample of that period of the year.

144. *To Mr. Fenton.*—The sample was taken at Koo-wee-rup bridge—that is, from the channel in Koo-wee-rup West. It was a very low flow; in fact, I should say that the water then would be inferior to ordinary summer water. The sample was taken at a point at least 5 miles down stream from the proposed weir. It was not taken at the site of the proposed weir. The sample which was taken to ascertain the solids in suspension was got by Mr. C. M. B. Neylon, in my presence, on the 8th September last, from the Koo-wee-rup main channel, at the junction with the nine-mile drain, near the proposed weir. It was analyzed by Mr. Scott, who furnished a report, dated 10th September, 1915. He ascertained the solids in suspension as 4.45 parts per 100,000. The sample was taken when there was a considerable volume of water in the Bunyip River, a discharge at the rate of 70,000,000 gallons per diem. Notwithstanding that fact, the analysis showed only 4.45 parts per 100,000, a quantity which is very trifling. The water looked slightly discoloured in the mess, but in a bottle it looked practically clear. It would be a fair sample of the water during the spring of the year. The analysis shows that it is not a turbid water. It is a water which is not laden with sludge.

145. *To the Chairman.*—In that respect the water compares favourably with the Yan Yean supply. I am in touch with Mr. Sambell, and shortly you will get a full, detailed statement from the Commission. I cannot say now when it will be ready, but it will be submitted as soon as possible.

146. *To Mr. Finlayson.*—As regards the number of towns drawing a supply from that catchment area, Warragul is the only town which has a pipe reticulated service. Its supply is taken at about half-a-mile down stream—that is, from a place called Rokeby. The town takes its supply from a watershed of 50,000 square miles in the north-east corner. It pumps the water to a height, including friction head, of 350 feet, and without friction head, to a height of about 300 feet. Possibly Bunyip (a little village) may desire to get its water supply from the Bunyip.

147. *To Mr. Fenton.*—Probably Drouin, too, will want a supply from that source.

148. *To Mr. Finlayson.*—The map on the wall here shows Warragul as being just outside the catchment area. In a drainage of 330 square miles there is sufficient water, without storage other than the local distributing reservoirs, to serve at least 80,000 people. That would include Warragul, which now has a population of about 2,000; South with a population of about 1,000; and Bunyip with a population of under 500. The northern part of the catchment area consists principally of State forests. In the parishes of Nyook, Nyook West, Tonimbuk East, and Tonimbuk, it is mostly Crown land. It is primarily reserved for the purpose of State forests. The balance of the catchment area is pastoral country.

There is an area of about 80 square miles of forest country, and the balance, of 250 square miles is alienated and partly alienated land. Approximately the population in the catchment area is 4,000. I consider that it is a good town catchment as it is. It has a good drainage; but, of course, as time goes on, there will be additional settlement in the district, subdivision, and so on. I would say that increase would have a tendency to cause pollution of the water, but not such a pollution that could not be dealt with by means of filtration. I consider that by satisfactory filtration you could provide against any injury to the water supply. As regards the arrangement of weirs in the river at the present time, the Warragul Trust has a small weir near Rokely—at the pumping station there. It is only a very small structure; it is only of use to them for pumping water. There are no other weirs that I know of beyond the proposed work. So far the State Councils interested in the water scheme have not expressed a preference between the Monbulk scheme and the Bunyip scheme. They have not yet been officially approached on the subject. On the grounds of economy I would say that the best place from which to take the water and distribute it would be the central reservoir, and not the pumping station. There would be greater economy in delivering the water at a central station. It would mean an extra length of pipe line, but beyond that, ultimately it would mean economy. The scheme is likely to be put before the shire councillors for their consideration as soon as matters are settled with Mr. Sambell, who has yet a few estimates to furnish to us. I think that it should be submitted to the councils within a month. Let me point out on the pressure that the reinforced concrete pipes from the offtake would carry. The pipes are simply designed to take a head of 80 feet, because not more than about 60 feet head would be involved leaving 20 feet as a margin. The 18 miles of reinforced concrete pipe line—that is, from the weir to the pumping station—would be under a varying head up to 60 feet, but the pipes themselves would be able to take an 80 feet head. It would be a low pressure pipe-line. It would hardly be suitable for the employment of wood pipes. The trouble with a low pressure pipe-line in wood is that you have to keep the main fully charged. In Victoria there are two or three firms making reinforced concrete pipes. The firm of Hume Bros., of Adelaide, has a piece near Marlyrnong. In examining schemes in connexion with water supply, the Water Supply Commission consider that the life of a reinforced concrete pipe properly made is very much longer than that of a wooden pipe. On that ground the annual percentage to be put aside for the former is less than in the case of the latter. Speaking generally, the annual charges

in connexion with a reinforced concrete pipe are 4 per cent. interest, 1 per cent. redemption fund, and 1½ per cent. depreciation fund, making a total of 6½ per cent. In the case of wood piping, the annual charges under favorable conditions are 4 per cent. interest, 1 per cent. redemption fund, and 2½ per cent. depreciation fund, making a total of 7½ per cent. In the case of such a main as this, if it was wood piping, I should say that it would want a charge of at least 8 per cent. because of the low pressure. It is a cardinal principle in connexion with wood piping that the main must be kept charged with water, otherwise it will have a short life.

149. *To Mr. Fenton.*—As regards the initial cost per chain, there is not very much difference between the two kinds of piping—the prime cost is very similar. I should say that the Commonwealth would have to get the approval of the State Rivers and Water Supply Commission to divert water from the Koo-wee-rup main channel. The Commission would say to the Commonwealth, "You can divert water, but you must allow a certain compensation supply to go to the settlers down stream." Provided that a compensation supply is sent to those settlers, there would be no objection to a diversion. So long as the various supplies in connexion with the channel and the river were satisfied, there would be no opposition. There is such a large volume—a minimum flow of over 3,000,000 gallons per day—that there would be an abundance of water. I do not think that there would be any difficulty in that respect. There has been some talk of irrigation in connexion with Koo-wee-rup, although at the present time it is only drainage works which are being carried out. Irrigation in that district has been spoken of, but no scheme has been evolved. If the Commonwealth was treated on the same basis as a private consumer, a licence-fee would be charged for taking water from the stream. No licence-fee is paid by the Waterworks Trust and other authorities which are constituted under the Water Act; but in the case of private diverters, a small licence-fee is charged. The State Rivers and Water Supply Commissioners would need to settle the question of diversion by the Commonwealth. I have told you what has been done in other instances. I think that no serious difficulty would arise between the two Governments, but it is entirely a question of economy—of deciding what is best to be done in the present circumstances. It would be well before going to the length of adopting a separate scheme to see whether there is no hope of getting a combined scheme. The cost of a 15-inch pipe line, 18 miles length, would be 227,500, while a 21-inch pipe line would cost £38,000.

150. *To Senator Storr.*—I think it would be possible to pump the water from the pumping station to some point in a direct line with the Naval Base, and thus save the extra cost of going round two sides of the triangle. The separate scheme I outlined a little while ago in connexion with a supply from the Bunyip River to the Naval Base provided for the same route as the combined scheme from the weir to the pumping station, but there was a divergent route from the pumping station, as shown in blue on the plan exhibited on the wall here. The rising main of 5 miles from the pumping station to the service basin of 700,000 gallons, is shown in blue, too. The delivering main from that basin to the storage of 10,500,000 gallons is also shown in blue. By having a pumping station for the Naval Base only there would be higher pumping charges—that is through not having a larger and more economical



pumping plant—but there would be no saving in the cost of the piping. Although there would be certain savings due to having a large pump, the water would have to be lifted to a greater height in connexion with the combined scheme than in the case of the separate scheme—that is, 100 feet higher. What I mean is that there would be a certain saving due to a larger economical pumping plant; but as against that, there would be a set-off, due to not having to raise the water to so high a level. Mount Eliza, roughly speaking, would be 100 feet higher than the service basin of 700,000 gallons. Certainly there would be advantages in having the combined arrangement, but there would be disadvantages from your point of view. I am rather inclined to say that it will take some time to get a decision on the subject of the adoption of a scheme from the local authorities. They will want to be fully seized of the whole matter.

153. To Mr. Finlayson.—So long as matters are arranged with the State Government, there will be no difficulty about the Commonwealth embarking on a scheme of its own if the shire councils show any disinclination to come in.

152. To Senator Story.—The shire councils in the Mornington Peninsula will have to decide first whether they prefer the Bunyip scheme to the Monbulk scheme. I do not know what they are likely to do. They might hold to the Monbulk scheme.

151. To Mr. Sampson.—My estimate of the cost of the separate scheme is, as I said before, £57,500. The discharge of water into the storage reservoir of 10,600,000 gallons, some 3 miles from the Naval Base, would be 320,000 gallons per 24 hours. The limit of the scheme would be 108,000,000 gallons per annum, that is, taking 340 days at 320,000 gallons per day; but you would not want to draw water in winter. Suppose that there was a maximum population of 4,000 at the Naval Base, during 160 days in the year—that is, in the summer—the average quantity would be 320,000 gallons per day, totalling 51,200,000 gallons. During 180 days in the year—that is, in the winter—the average quantity would be 120,000 gallons per day, totalling 21.6 million gallons, making a grand total of 72.8 million gallons. Then there would be certain losses to allow for, say, 7,000,000 gallons. In round numbers the yearly supply pumped to the Naval Base would be 80,000,000 gallons. I am not prepared to say now what would be the cost per 1,000 gallons under the separate scheme, but I will prepare an estimate of the cost of the water delivered at the Naval Base under the separate scheme, and also an estimate of the cost under the combined scheme. I believe that either scheme would give a pure supply to the Naval Base. I would not put one scheme before the other. The allowance is so great—there is such a provision for an increase of population at the Base—that I think there would always be an abundant supply. Sir William Creswell, Mr. Fanstone, and I think Admiral Henderson, stated that the population in 20 years was estimated to be 4,000, but in none of the papers that I have read so far has any increase on those figures been contemplated. I understand that it will take a considerable time before the population reaches the concrete main. I have told you that the discharge would be 600,000 gallons a day, and that the pump supply would be 20,000 gallons an hour simply with one plant—that is, 480,000 gallons a day, if it should become necessary to

pump day and night. Then the rising main would discharge 320,000 gallons a day. If the supply needed in the reservoir, of 10,600,000 gallons at the Base, got beyond that volume per day you would have to put in an additional rising main until you got to the stage when an additional pump would be needed. If it is decided to push on with the separate scheme I would say that a start could be made within a few months, provided that everything between the Commonwealth and the Water Supply Commission had been settled. How long it would take to complete the scheme would depend upon the manufacturers of the pipes. I did inquire of a few manufacturers how long they would take to manufacture the pipes. One man told me that he could finish the work in 18 months, but if necessary he could do the work in twelve months single handed. If the work was divided up between the manufacturers, I would say that it could be done in a year. I think that, if great expeditions were used, it would be possible to have the scheme completed in twelve months, so that it could be made use of.

154. To the Chairman.—My estimates of the cost of the combined scheme and of the separate scheme do not include the cost of reclaiming any land in the watershed. In view of what I have said in regard to the pollution and purification of water supplies, I do not think it is necessary for the Commonwealth to resume any land except for the purpose of the works themselves. For the separate scheme the installation of a mechanical filtering plant, including housing, would cost about £2,500. It would not come to very much per gallon. Of course, you know that the water would be forced through the filters and up the rising main to the service basin of 700,000 gallons. There would be very little addition in work and expense wanted. In connexion with the combined supply the Federal Government would have to deal with the Dandenong Shire Council, the Frankston and Hastings Shire Council, and the Mornington Shire Council, and also with the State Rivers and Water Supply Commission. I cannot state within what time it might be possible to get unanimity between the shire councils. As regards getting a separate gravitation supply for the Naval Base from the Dandenong Ranges, extending easterly to Gembrook, I desire to say a few words. I had a discussion on the subject with Mr. Hill the other day. There are ways and means of getting an independent gravitation service from several creeks, apart from those mentioned at the Dandenong Ranges—that is to say, from the Cardinia Creek, the Toomuc Creek, and possibly the head waters of the Ararat Creek, but so far as I can judge, the length of pipe line would be considerable. The catchment on either of them would be sufficient for a separate supply for the Naval Base, but not one of the catchments would be sufficient for a combined supply. One way to the great distance the cost would be considerable. I think that there would be a considerable handicap. In my opinion a supply taken from either of those three valleys would cost in round numbers about £100,000, owing to the length of the pipe line. So far as I know, irrigation supplies are subservient to town and domestic supplies. In the case of irrigation large bodies of water are wanted, but in the case of a scheme of this kind, relatively speaking, small quantities of water are required. I think that precedence would be given to the supply of the towns and to the Naval Base, rather than to an irrigation service. Their requirements would have to be satisfied first.

(Taken at Melbourne.)

WEDNESDAY, 3rd NOVEMBER, 1915.

Present:

Senator LYNCH, in the Chair;

Senator Keating,	Mr. Gregory,
Senator Story,	Mr. Sampson,
Mr. Fenton,	Mr. Laird Smith,
Mr. Finlayson,	

Thomas Hill, Engineer, Department of Home Affairs, sworn and examined.

155. To the Chairman.—The evidence given by the Director-General rested with the presentation of a scheme by Mr. Sambell to supply the whole of the Mornington Peninsula from the main Dividing Range; and it was left to the Committee to say what further they required from the Department after hearing Mr. Sambell. Since then, Mr. Murray, who also heard the evidence of Mr. Sambell, has suggested that water should be taken by pumping from the Koo-wee-rup closer settlement area, and sent by gravitation to the Naval Base. I am prepared to take the matter up from that point. Thought was given to the Bunyip scheme; but it was turned down, owing to the fact that the supply would be obtained from the main drain running through the Koo-wee-rup closer settlement area. This main drain, which takes the flow of the Bunyip River, was constructed some twenty or thirty years ago, and reclaiming the large area known as the Koo-wee-rup drainage scheme. That dates from 1885, when the swamp was covered with densely-grown ti-tree scrub. The idea of Mr. Murray's scheme is to tap the drain near Koo-wee-rup at a point above the centre of the settlement. This settlement, within a distance of 3 miles on each side of the drain, is cut up into small allotments, as shown on each side on the plan, and with 200 houses, represents about 1,000 people. The drainage from the two townships of Bunyip and Garfield ultimately reaches the main drain. The settlement may be taken roughly as 14 miles long by 5 or 6 miles wide. The suggested offtake from the main drain is about central, or at a point approximately 7 miles from Bunyip. The whole of this area is drained by subsidiary drains into the main drain, down which the Bunyip River flows on its way to Westport Bay. For this reason it was not considered proper to take a water supply from this source. While at ordinary times there is possibly no contamination in the main drain, yet, during periods of heavy storm, it would not be possible to say that contamination would not reach there. Sudden storms cause considerable danger of pollution from the subsidiary channels, and from the houses on the main drain. It is admitted that the flow of the Bunyip River is very considerable—sufficient at once wash away any danger of infection, especially if, as suggested by Mr. Murray, there be sand filtration; but it cannot be denied that the area of the water-bed will become more and more densely populated as time goes on, there being good agricultural country in the watershed, the remaining area being about 80 square miles of State forest land; but immediately above the Koo-wee-rup settlement the river runs for a considerable distance through good agricultural country which at present has not been cut up, but is in large

estates. An inspection of the area immediately around the drain shows that, with the exception of the subsidiary drains coming in at intervals, the actual population of the houses lying alongside the drain will not contaminate the water, except by downward filtration through the soil, and this is not very possible. The danger more to be feared is, in my opinion, that from heavy storms bringing the pollution into the main drain by way of the subsidiary drains. One or two cases were noticed not far from the main drain and on the subsidiary drain. The value of filtration, as suggested by Mr. Murray, is not underrated. It must be remembered, however, that it is individual cases that have to be considered in connexion with water supply, especially in the case of a highly efficient body of men such as we shall have at the Naval Base. If only, by one accident to the filters on any particular day, or any particular two days sickness were to arise, there is the danger of the whole scheme being condemned by the medical authorities, who would not doubt ask why we had not obtained the water supply from an absolutely immune source. In regard to filtration, one of the first difficulties forecast—and one which I think increases the cost of the works over Mr. Murray's estimate—was that to pass the water into the mains after filtration until it has been bacterially examined, is not a good practice; in fact, in continental towns, this is interdicted. Any such bacteriological examination is generally specified to be by incubation in saline plates, and exposed to a temperature of 29 degrees centigrade for two days. Then, if the number of bacteria is found to be within 100 to 200 per cubic centimetre, the water is considered safe. The number of the bacteria varies daily and monthly for certain reasons, one of which is the necessity for changing the filter. The character of the water that is being filtered is affected by the flow, whether it is the ordinary minimum flow or flood, and the variations have been noted. In Berlin, the results vary from 28 to 1,666 per cubic centimetre daily. Then there is also the changing of the filters. These require to be what is known as scraped; the top film of the sand has to be removed at stated intervals as the flow diminishes, and after the scraping, it takes some time before they are restored to their maximum efficiency. The number of bacteria in the water to be filtered varies at different seasons. In the Potomac River, the number of bacteria was, in December, 967; January, 3,774; February, 2,536; March, 1,210; April, 1,521; May, 1,064; June, 348; July, 265; August, 254; September, 178; October, 75; November, 110. There are other similar instances, but I merely quote this one at random, and it will be seen that there is a variation from 75 up to 3,774. The bacterial pollution of streams is always greater during high-water stages. Increased carrying power means more silt, and bacteria accompany such disturbance of the soil particles. This is just the time that I would look for trouble with the filters, owing to the water carrying more silt and making it more difficult to filter. As to filtration, it is stated that bacteria can find its way through the filter under the actual working conditions, when a filter is new. In saying that, I am not by any means running down sand filtration, because, although the sand filter is not by any means disease proof, and is an imperfect means of purification, it is the best imperfect method that has yet been devised. If the water shows over 200 of bacteria, it should not be admitted into the main. The germ contents of any water coming into contact with soils are

differently affected by the soil layers. To recapitulate, immediately within the neighbourhood of the proposed take-off is a large area under agricultural cultivation, with all its concomitants of poultry and animals; and there is no drainage other than through the soil or into the main drain. At present, the ground is fresh and new; but as years go on, the population will increase. No doubt, members of the Committee may have noticed references in the newspapers to the trenches in Plauders, where there have been numerous typhoid cases, due to filtration through soil impregnated with bacteria. A large portion of the water-ashed is alienated land and will be increasingly occupied, and in the absence of any drainage scheme for small towns, drainage into the swamp area would, in my opinion, cause the use of water from the main drain at Koo-wee-rup, even with sand filtration, to be regarded with very grave doubt. The suggestion I make is that the members of the Committee should pay a visit to the place and see the conditions for themselves. The next point I should like to touch on has reference to the cost. While agreeing with Mr. Murray's figures in the main for the separate system for Bunyip, I think that the capital cost should be increased by about 10 per cent., making about £65,000; such increase to be for the provision of a stand-by in the pumping plant. I should not like this naval station, in case of a breakdown, to be dependent on one pump. I think that some of Mr. Murray's figures are a little low; but they do not affect the result much. I should personally, as I say, assess the first cost as representing about £65,000, as against Mr. Murray's estimate of £57,000. I understood from Mr. Murray he had not thoroughly gone into the question of the annual charges, though we had some conversations about them; and I think that his estimate of £4,130 ought to be increased to at least £5,500. Some of his items, notably maintenance and management, are, I think, a little low. His figures include interest and sinking fund at 4½ per cent. He has put down 5 per cent. for depreciation of the pumping plant, whereas I think that 10 per cent. would be quite a fair thing. I should not like to say that a set of pumps would last thirteen years. I concur with his estimate of 1½ per cent. in reference to the reinforced concrete pipe; but I think that his 2½ per cent. is too low in regard to the wood piping. He has a caretaker put down at £20 per annum, an engineer at £3 a week, and fuel and stores at £225; but I would increase maintenance and management from £500 to £700 per annum. Then, again, I think that attendance and repairs for the main drain at £27 is too low, and it ought to be at least £100. To sum up, the annual cost of a separate scheme, as suggested by Mr. Murray, should, in my opinion, be about £5,500, with interest and sinking fund at 4½ per cent., as against the £4,130 estimated by Mr. Murray.

166. *To Mr. Sampson.*—If we take the quantity at 120,000 gallons a day the cost would come out at about 2s. 8d. per 1,000. This, however, is a scheme capable of much more than that, and the cost will be reduced as the consumption increases. If you double the quantity, you can get it almost at half the cost. For some years, the cost of the water per 1,000 gallons would be much higher than what I have stated; what I mean is that we shall not be using as much as 120,000 gallons a day for some years yet. My estimate is based on a population of 2,000 at 60,000 gallons a day; but that is high. Melbourne is in such a position that quantity proportionately with all its manufacture. It will be some years before 2,000 are at this place,

and in the meantime the cost will be much higher than what I have stated. I should now like to make a rough comparison with the Notting Hill scheme; and this comparison is based on Mr. Murray's estimate of the immediate cost. Mr. Murray's estimate of the capital cost of the Notting Hill scheme, with 9-in. wood piping, was £55,000; and the estimated annual charges, paying 1s. per 1,000 gallons to the Board of Works, at £5,635. At 8d. per 1,000 gallons, the figure would be £4,935. However, I consider that these figures should be increased. Mr. Murray puts the interest on sinking fund at 4½ per cent., and the depreciation of the wood piping at 2½ per cent. only. With a consumption of 120,000 gallons a day, the results would work out somewhat similarly to those of the Bunyip pumping scheme; but the quantity of 120,000 gallons a day will not be needed for some years. If we take the figure at 30,000 gallons a day—which will be quite sufficient for the next few years—a considerable economy is shown in the case of the Notting Hill scheme. However, I should like to prepare a tabulated statement and submit it to the Committee later, so that they may have before them the exact figures.

157. *To Senator Stary.*—I do not anticipate that any great quantity of water will be required for shipping for some years to come. The departmental officials, in their inquiry as to separate catchment, were arrested by Mr. Sambell's scheme; and I think that the Committee might look further into the matter, with a view to a separate scheme of their own, before coming to a final conclusion. There are along the Dividing Range a number of suitable areas, and the Toomue Creek is one that ought to be examined. This is in granite country, and an area of about 2 or 3 square miles would do. It could be entirely freed from any population, and would prove sufficient for fifty years to come. It would be a gravitation scheme—the Dividing Range being quite 1,000 feet or more above sea-level. The length of the main would be very little more than that from Notting Hill; and the capital cost would only be increased by the purchase of land, and the construction of an earthen bank reservoir. I think it could certainly be done under £100,000, and would give water from an absolutely unpolluted source. The head of the Toomue Creek is about 8 miles north of Pakenham. The line would be about the same as the Notting Hill line. There is not much settlement there; and, as it is not very good country, the settlement could be bought out. In the £100,000 I mentioned, I include £20,000 for land. The advantages of a scheme absolutely our own appeal to me; but the idea of the Department, as stated by the Director-General of Works, is that it would be difficult to separate a scheme for the Naval Base which entails an expenditure of public money from any scheme of supply for the whole Mornington Peninsula. I mention this only in view of the suggestion for a separate system.

158. *To Senator Keating.*—I should hardly like to use the word "contamination" to describe my attitude towards the Koo-wee-rup swamp, and would rather say that I have a fear of what might happen under the possibility of such a scheme. All the house, yard, and stock drainage runs into the soil, and may not reach the main drain for years. But a sudden thunderstorm is liable to wash it through the subsidiary drains into the main drain, or the soil may become steadily impregnated. There is no sewerage system here—just the ordinary pan system, and so forth. I

now a paragraph in the newspapers a little while ago suggesting an abandonment of the Monbulk for the Bunyip scheme; but as the matter was before this Committee, and under consideration, I did not pay much attention to it. This is not at all a new matter, but has been under consideration for some time. I do not know whether the features that I have dealt with this morning have been under the notice of those who favour the other scheme; but I have told Mr. Murray of the objections that I have, and he quite understands that I was coming here to give the evidence I have this morning. The scheme to which you refer was roughly considered when we originally thought of a water supply for the Naval Base; but we did not dream of it being possible to take water from the main drain. This is one of the reasons why I wish the Committee to see the place for themselves. Before Mr. Murray gave his evidence on Monday last, we had discussed the scheme, and I pointed out to him that I was strongly against his ideas; and we have both given evidence with a knowledge of that divergence of opinion. Mr. Murray relies on filtration, and I say that filtration is a splendid thing; but while it may be all right for 203 days of the year, it may escape you one of the other two days, and this would be enough to do the mischief. As to the figures, and as to practicability, we agree; but I do not like the conditions. I have noticed the drainage that goes through the Monbulk, Cardinia, and the Meuzies catchments; but Mr. Sambell, in submitting his evidence, proposed to clear these areas of settlement. I understood that the properties beyond Sharbrooke were suggested as properties to be purchased; but, if not, this must prove a much worse case, because it will become a densely populated neighbourhood. There is a regular township just above the reservoir, but the drainage from that could be deviated. In periods of storm, the pollution of the water is very much greater, and I think that applies to all streams. In places where there is no settlement, but where the country is densely covered with timber, the pollution will be very much reduced, but there will be some bacteria. When the tap water in Melbourne is very often cloudy and dirty after a storm, it may mean that the water has in it clay in suspension, and it is an indication of the probability of its being polluted with bacteria. It means more silt and increased carrying power, for the bacteria accompanying disturbances of the soil particles. I do not think that that is a recent discovery.

159. *To Mr. Gregory.*—The water used at the Naval Base is purely for drinking purposes, and it is taken down in trucks. It is got from the end of the Board of Works scheme at Merdiallee. The water is taken to the railway and pumped across to the cooking-house, and it costs us about £40 a month; but, owing to the Department paying off men, I think the cost will drop to about £25 a month. For other purposes, we get water locally. I am told by the resident engineer that it is proposed to take there about 600 men from Williamstown in the course of a couple of months. We have been carrying cooking and drinking water for about 500 men so far, but the number has been reduced to about 250, so that when the other 600 men come we shall have to provide for about 250 more than previously. I understand that water will be required to provide certain ships of the Navy, and it is essential that it be the very purest. If it were decided to adopt the Bunyip scheme, I should seriously consider the use of ozone, or some other means of sterilizing. The ozone sterilization is the safest, and would be

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inexpensive. There is a certain amount of pollution in the New York and other catchment areas for big cities. The London authorities, if they have not already done so, are considering the advisability of getting water from the Welsh mountains, in the same way as Manchester and Birmingham have already done. These, however, are special cases, in which we have heavy pollution with contaminated streams. It has been found that filtration very much reduces the contamination, and as I have already said, it is the best imperfect method that has yet been devised. The Koo-wee-rup drain was cut to take the drainage of the swamp; before that it was a 4½-acre swamp. Now, however, it is all closely settled, and I should say there are 1,000 people on the area. The sanitary system there is primitive. Mr. Sambell estimated the cost of the land in the Monbulk scheme at £8,000, and I think that would provide for a great deal of it, with deviation drains for the rest of the area. There are good slopes, and the country will lend itself to deviation in certain portions. A point of difference between Mr. Murray and myself is in that he does not think that all the population should be withdrawn from the water-ashed area; he relies on filtration, while I rather rely on a clean area for the start. We cannot get a clean area without going to the Dividing Range, or right to the head of the Bunyip. You could get a supply of 300,000 or 400,000 gallons a day within an area of a couple of square miles. That would be ample for the Naval Base; but I would not like to undertake the Peninsula under 30 or 40 square miles. I believe that the peninsula will be heavily populated some day, and that it should be supplied from the Board of Works scheme.

160. *To Mr. Fenlon.*—If there were a proper system of drainage for the swamp, independent of the main drain, a great deal of my objection would cease; but that would be a very difficult and costly matter. I do not say that any of the drainage goes into the stream at present, but only that it may go. I am familiar with the Coliban scheme, and I know that it is liable to contamination. In estimating the water required at the Naval Base, we only take into consideration Naval requirements, and make no provision at all for population outside. We are advised that the Commonwealth cannot do so, except in combination with others. I think that the establishment of the Naval Base might make a difference of about 25 per cent. in the population to be served, though in my opinion the effect of the establishment of the Base in this regard is much exaggerated. Most of the men employed at the Base will get provisions and other supplies from centres like Melbourne, and run their own outside, wet or dry—spending very little money outside their own boundary. I do not think that the water supply to other people would have much effect on the local supply of goods. Assuming that there are 4,000 people connected with the Naval Base, I do not think that we would have more than 2,000 people surrounding them. Doubtless State Parliamentary authority would have to be got for supplying these other persons with water; but I do not think there would be much difficulty in regard to that.

161. *To Senator Stary.*—The cost of the water taken to the Base means from £1 to 25c. per 1,000 gallons, and the Naval Committee have been pressing for a quicker and better supply. The Notting Hill scheme is the easier proposition, meaning simply a cast-iron main. The next simplest scheme is, I think, the Bunyip scheme; and the



third, the Dividing Range separate scheme. I am speaking in each case of a separate scheme to supply the Base only without delay; and the time required to complete the work would be nine months for the Notting Hill scheme, fifteen months for the Bunyip scheme, and sixteen months for the Dividing Range scheme. I would recommend the use of cast-iron pipes for a good deal of the length from Notting Hill, but I should like to put down wood piping in certain portions to test the life of such piping. However, at this stage, I am not prepared to recommend 43 miles of wood piping which has not yet been sufficiently tested in other countries to justify the difference in the expense as against cast-iron piping. I should think that the cost is as £40,000 to £60,000. Reinforced concrete would not lend itself as a 9-in. pipe from Notting Hill; the pressure would be too high to make it an economical proposition. The pressure would not prevent the use of wood piping; but I doubt whether the binding on the wood piping would last. I think, however, that wood piping is worth an experiment. It has been found that water that contains bacteria within 200 per cubic centimetre is reasonably safe for human consumption—that is the safe number after the water has passed the filter bed. Under the circumstances, bacteria may multiply, but not the harmful ones. All water contains bacteria, but not necessarily bacteria that is harmful; and the water is, as it were, put through a sieve.

102. *To Mr. Pinlayson.*—I think we may take it that the cost of water at the Base will be increased from £40 to £60 per month owing to the removal of the men there from Williamstown. This £40 covers the whole cost of pumping, carriage, and everything. This is at a lower cost than under a separate system, but we are supplying only drinking and cooking water; the water used for building and other purposes is brackish water obtained locally. There will be no serious disadvantage if we take a little time to consider the question of water supply. Indeed, it is quite deserving of another month or two's consideration. There could be no serious disadvantage, at any rate, from a financial point of view. In order to tap the State forest reserves, it would be necessary to go 16 miles further than the suggested off-take. In 8 miles of that distance, however, the population decreases very much, because the country is out of the main settlement. It is generally forest country, and an ideal catchment area—it would give an ideal supply so far as the water is concerned. We should avoid all dangers of contamination such as I have pointed out, and I am satisfied that there is sufficient, indeed, a splendid—supply of water there. Mr. Murray's estimate of cost is £27,000, and, in order to reach this clean country, of which we are now speaking, we shall have to pay £30,000 more, I think. I should have to look into the matter to see whether a concrete main would do for this country; if so, it would cost about £27,000. We could not cast iron pipes from the high level for about £100,000.

103. *To Mr. Sampson.*—This State forest area would make a fine water-shed, without touching any of the alienated land, and it would be a granitic area of 80 to 100 square miles, and granite country at that. The elevation is about 1,200 feet, though the Baw Baws may reach as high as 3,000 or 4,000 feet; at any rate, we may take it that we should be over 1,000 feet for a reservoir site. I never liked the Monbulk scheme, and it is one I cannot recommend. I think it is deficient in catchment area for the supply of the whole Peninsula. It might be possible, by going higher up the Bunyip, to get a supply for the whole Peninsula.

104. *To the Chairman.*—I think there is possible risk which filtration would not always remove, and I am not prepared to trust filtration absolutely. In the Monbulk scheme, I should prefer a clean country, and the drainage should be either deviated or removed. That objection might be easily met in the case of the Monbulk scheme, but it could not be met, except at great expense, in the case of the Bunyip scheme. As I said before, the idea of the Director-General of Works is that this is public money, and that any way that would enable the Commonwealth to join with the rest of the Peninsula would be a proper method of expenditure. If there were combination with the small authorities on a business-like basis, there would be some advantage as time went on, but not in the initial stages. As the population of the peninsula increases, I think there will be a tendency for the price of water to be reduced. When I spoke of the Naval Forces only; the civil requirements will get their water from the Mornington, Frankston, and Hastings Trust. Land in the neighbourhood of the Naval Base is being sold privately every week, but there is no intention on the part of the Department to acquire any outside the present area for workmen's cottages, or any other purpose. The possibility of a township springing up has not entered into the calculations of the Commonwealth, because most of the men will be single, and canteen-fed, and will have a tendency to come to Melbourne for recreation purposes.

(Taken at Melbourne.)

TUESDAY, 9TH NOVEMBER, 1915.

Present:

Mr. RILEY, Chairman.

Senator Keating, Mr. Finlayson,  
 Senator Storry, Mr. Sampson,  
 Mr. Fenton, Mr. Laird Smith.

Thomas Hill, Engineer, Department of Home Affairs, recalled, and further examined.

104a. *To the Chairman.*—When I was before the Committee previously, the Acting Chairman asked me to prepare figures showing the relative annual use to prepare figures showing the relative annual use for five, ten, and fifteen years of the Notting Hill and Bunyip pumping schemes, based on an estimated supply of 30,000 gallons per day for the first five years; 60,000 gallons per day for the next five years; and 120,000 gallons per day for a third period of five years, which is the proposition put forward respecting the Notting Hill site. In my report to the Director-General of Works my estimate was based on a 4½ per cent. charge for interest and sinking fund, but several members of the Committee thought I should make it 5½ per cent., and I have prepared tables on that basis. The estimate of the Bunyip scheme is based on a supply of 120,000 gallons per day for the first five years, 240,000 gallons per day for the second five years, and 360,000 gallons per day for the third five years. That was the scheme put forward by Mr. Murray—to take water from the Koo-woo-rop main drain, and, by gravitation and pumping, deliver it straight to the Naval Base. In regard to the Notting Hill scheme, as there has been a slight increase in the cost of materials since the estimate was furnished, I will submit an increased estimate of the capital cost over and above the figures furnished by the Director-General of Works some months ago.

NOTTING HILL NAVAL BASE SCHEME.

Capital Cost using D-in. Wood Pipe.

42 miles 9-in. wood pipe, at £1,000 per mile	£42,000
Service Reservoir, 10½ million gallons	3,700
Castings	800
Land	500
Provision for extras	1,200
Engineering, Surveying, Supervising, and Contingencies	4,800
Total capital cost	£53,000

Annual Charges.

Interest and Sinking Funds, 5½ per cent. on £53,000	£2,815
Depreciation, 5 per cent. on £33,000	2,650
Maintenance and Management, exclusive of general expenses at Base	100
Total	£5,565

30,000 gallons per day at 6d. per 1,000 gallons = £411 pa.

Annual Charges for 5 Years at 30,000 Gallons per Day.

1st year	£111 + £5,065 = £5,176
2nd "	0,076 × 2 = 1,512
3rd "	0,076 × 3 = 1,825
4th "	0,076 × 4 = 2,404
5th "	0,076 × 5 = 3,038

60,000 gallons per day at 6d. per 1,000 gallons = £822 pa.

Annual Charges for 5 Years at 60,000 Gallons per Day.

1st year	£222 + £5,065 = £5,287
2nd "	0,487 × 2 = 974
3rd "	0,487 × 3 = 1,461
4th "	0,487 × 4 = 1,948
5th "	0,487 × 5 = 2,435

120,000 gallons per day at 6d. per 1,000 gallons = £1,644 pa.

Annual Charges for 5 Years at 120,000 Gallons per Day.

1st year	£164 + £5,065 = £5,229
2nd "	7,300 × 2 = 14,600
3rd "	7,300 × 3 = 21,900
4th "	7,300 × 4 = 29,200
5th "	7,300 × 5 = 36,500

Total charges for 5 years, £20,385.  
 Total charges for 10 years, £40,770.  
 Total charges for 15 years, £61,155.

Capital Cost, using 6-in. Cast Iron Pipes.

42 miles 6-in. C.I. pipe	£35,000
Service Reservoir 10½ million gallons	3,700
Land	500
Provision for extras	1,200
Contingencies	800
Total	£41,200

Annual Charges.

Interest and Sinking Funds, 5½ per cent. on £41,200	£2,265
Depreciation, 5 per cent. on £21,000	1,050
Maintenance and Management, exclusive of general expenses at Base	100
Total	£3,415

30,000 gallons per day at 6d. per 1,000 gallons = £411 pa.

Annual Charges for 5 Years at 30,000 Gallons per Day.

1st year	£411 + £3,415 = £3,826
2nd "	£471 × 2 = 942
3rd "	471 × 3 = 1,413
4th "	471 × 4 = 1,884
5th "	471 × 5 = 2,355

60,000 gallons per day at 6d. per 1,000 gallons = £822 pa.

Annual Charges for 5 Years at 60,000 Gallons per Day.

1st year	£822 + £3,415 = £4,237
2nd "	£482 × 2 = 964
3rd "	482 × 3 = 1,446
4th "	482 × 4 = 1,928
5th "	482 × 5 = 2,410

120,000 gallons per day at 6d. per 1,000 gallons = £1,644 pa.

Annual Charges for 5 Years at 120,000 Gallons per Day.

1st year	£164 + £3,415 = £3,579
2nd "	£604 × 2 = 1,208
3rd "	604 × 3 = 1,812
4th "	604 × 4 = 2,416
5th "	604 × 5 = 3,020

Total Charges for 5 years, £20,855.  
 Total Charges for 10 years, £41,710.  
 Total Charges for 15 years, £62,565.

When the first estimate was submitted to the Navy Department, alternative figures were given for 9-inch and 6-inch pipes, but the Department asked for the 6-inch pipe to be used. There would be no trouble with a 6-inch pipe if it ran continuously into the reservoir. At the end of fifteen years the water supply would be sufficient for the requirements of a population of 4,000 people. I think it will be many years before it becomes necessary to supply that number. With the service reservoir at the 100-foot level, the discharge per day through a 6-inch pipe would be 103,000 gallons. With the service reservoir at 120 feet, the discharge would be reduced to 93,000 gallons, and at the 140-foot level the discharge would have dropped to 83,000 gallons. With the same levels the amount that would be supplied through a 9-inch pipe would be respectively 288,000 gallons, 273,000 gallons, and 262,000 gallons. Not very much would be saved by putting in a smaller pipe if iron pipes were used. The excavation would be the same in each case. The figures I have prepared with regard to the Bunyip scheme are based on supplies of 120,000 gallons, 240,000 gallons, and 360,000 gallons per day. The total estimated cost of this scheme, as estimated by Mr. Murray, was £57,500.

BUNYIP NAVAL BASE SCHEME.

Revised Estimate of Annual Charges on a basis of 120,000 gallons per day.

Interest and Sinking Fund, 5½ per cent. on £57,500	£3,162
Depreciation, 10 per cent. on £2,000 for pumping plant	200
1½ per cent. on reinforced concrete pipe, £27,000	405
5 per cent. on filtration plant, £2,000	125
10 per cent. on wood pipes, £12,500	1,250

Maintenance and Management.

Caretaker at head of Main	£50
Engineer	200
Fuel and Stores	300
Oil	35
Repairs	55
Contingencies	70
Total	£700
Pipe Main Attendance and repairs	150
Filers, labour cleaning	20
Provision sum for unforeseen expenditure	48
Total	£928
6,000 × 20 × 12 = 3,935 pence per day of 120,000 gallons.	
365	
120	
3,985 = 33·2 pence per 1,000 gallons, or 2s. 6d.	

105. *To Mr. Sampson.*—It would not be possible to save very much on this estimate if the supply were cut down to one of 30,000 gallons per day. It might be possible to reduce the consumption of coal somewhat, and stores generally might be reduced to £100. On a supply of 30,000 gallons, the cost would be between 11s. and 12s. per 1,000 gallons; on a supply of 60,000 gallons per day, the cost would be 6s. 6d. per 1,000 gallons. I am prepared to reduce the item for depreciation of the wood pipe, if necessary. Only a small length of 6½ miles would be required, and I estimated the depreciation at 10 per cent., because of the nature of the soil, which is sandy, and might affect the wire round the pipes of 60,000 gallons any reduction on that item would make very much difference to the general estimate. On the figures for a supply of 240,000 gallons per day, I have simply put in another shift, with the increased charges that would be necessary in consequence.

Revised Estimate of Annual Charges on a basis of 240,000 gallons, working two shifts

Interest and Sinking Fund, $\frac{3}{4}$ per cent on £57,500	£2,162
Depreciation, 10 per cent. on £2,000 for pumping plant	200
14 per cent. on reinforced concrete pipe, £27,000	403
4 per cent. on filtration plant, £2,500	125
10 per cent. on wood pipe, £12,500	1,250

Maintenance and Management.

Caretaker at head of Main...	£50
Engineer...	400
Fuel and Stores...	650
Oil...	50
Repairs...	110
Contingencies...	140
Pipe Main Attendance and repairs...	1,350
Filers, labour cleaning...	160
Provision sum for unforeseen expenditure...	53
	£3,740

$6,740 \times 20 \times 12 = 4,437$  pence per day of 240,000 gallons.

4,437 = 18s 5 pence (16d.) per 1,000 gallons.

Revised Estimate of Annual Charges on a basis of 360,000 gallons, working two shifts

Interest and Sinking Fund, $\frac{3}{4}$ per cent on £57,500	£2,162
Depreciation, 10 per cent. on £2,000 for pumping plant	200
14 per cent. on reinforced concrete pipe, £27,000	403
5 per cent. on filtration plant, £2,500	125
10 per cent. on wood pipe, £12,500	1,250

Maintenance and Management.

Caretaker at head of Main...	£50
Engineer...	400
Fuel and Stores...	900
Oil...	75
Repairs...	165
Contingencies...	110
Pipe main attendance and repairs...	2,000
Filers, labour cleaning...	150
Provision sum for unforeseen expenditure...	60
	£4,712

$7,412 \times 20 \times 12 = 4,874$  pence per 360,000 gallons.

4,874 = 13s 1 pence (14d.) per 1,000 gallons.

166. To Mr. Sampson. Using a 9-inch wooden pipe from Notting Hill, the cost per 1,000 gallons on a total daily supply of 30,000 gallons would, for the first five years, average 11s. 1d. At 60,000 gallons the cost per 1,000 gallons would be 5s. 6d., and at 120,000 gallons a day the cost would be 3s. 4d. per 1,000 gallons. With cast-iron pipes the figures are respectively 7s. 7d., 4s. 2d., and 2s. 6d. per 1,000 gallons. In fifteen years, using cast-iron pipes from Notting Hill, a capital cost of £61,000 would have been involved, in addition to which charges for interest and water would amount to £70,785, based on supplies of 30,000, 60,000, and 120,000 gallons per day respectively for each quinquennial period. Roughly, the total cost would be £132,000. With the Bunyip scheme, supplying 120,000 gallons a day, the capital cost would have been £37,500, and maintenance and water £91,000, a total of £148,500.

167. To the Chairman.—The Director-General made his recommendation in favour of the Notting Hill scheme, because a supply would be im-

mediately available, and the work could be quickly completed. The Bunyip scheme was looked into some time ago, but investigation was not carried very far.

168. To Mr. Finlayson.—The 120,000 gallons is regarded as the probable maximum supply required by the neighbourhood, as some members seemed to think that provision ought to be made for a future township.

169. To Mr. Sampson.—At the last meeting of the Committee members seemed to think the cost of the Bunyip scheme was rather high. I drew attention to the fact that the scheme would appear very much better if a larger consumption were taken into account. On the supply of 360,000 gallons per day, the cost works out at 1s. 1d. per 1,000 gallons—sufficient for a population of 12,000 people.

170. To the Chairman.—Probably if a joint supply scheme were decided upon, it might be possible to deal with 360,000 gallons per day. In that case my estimates would have to be increased slightly to cover additional cost of reticulation services, but otherwise the charges would be practically the same. A 9-inch pipe would be quite sufficient for all requirements.

171. To Mr. Finlayson.—The chief advantage of the Notting Hill scheme is that we may not use cast-iron pipe, and therefore it would be possible to save to that extent. Otherwise it would be better if the Naval Base had its own independent supply, using the water as it was required. I do not think it would be possible to reduce the capital cost by putting in a pipe sufficiently large for our needs and working the pump on three shifts. In my view, it would be better to put in pipes capable of supplying 120,000 gallons per day, and work only one shift a day. I am not enamoured of the Bunyip scheme with the present offtake. My objection would largely disappear if we could obtain supplies from an intake above the township of Bunyip. This would increase our capital cost considerably, probably by £14,000 or £16,000, but such a proceeding would guarantee a very fine supply for a very long time, and I think a better quality of water would be obtained at the head of the Bunyip.

172. To Mr. Fenton.—I think the Bunyip scheme with the intake as at present would cost £5,000 per annum—that is, including pumping, coal, interest, and sinking fund.

173. To Mr. Finlayson.—I would place the main service reservoir for a joint scheme at a spot on a point on the Longvarrin Ridge about 3 miles above Frauston. The inlet to the offtake is at the centre of the Koo-wee-rup settlement. From there, about 18 miles of slight gravitation would be experienced to a point just immediately north of Westport Bay. From there water could be pumped to a reservoir at 350 feet on Mt. Eliza, from which it would gravitate in all directions. For the separate scheme water could be pumped to a site about  $\frac{1}{2}$  miles north of Hastings, near Somerville, and passed to the Naval Base by gravitation. So that a larger scheme of general supply would not cost a great deal more, though Mr. Murray proposed to increase the 16-inch reinforced concrete pipes to 21 inches, and to construct a larger reservoir on Mt. Eliza. Such a scheme would be much the cheaper if the water is good enough, and if the State Rivers Board would undertake to supply the Naval Base together with the municipalities and shires in the district. Several years would probably elapse before everybody concerned could be brought to agree to such a scheme. Our

position would be very much the same if the water were taken to a service reservoir on Mt. Eliza, and other authorities desiring supplies were permitted to act on their own initiative in taking supplies from there. I do not think there would be any difficulty in regard to the quantity of water required for the Naval Base if this course were adopted. A better general scheme could be arranged, however, if the offtake were taken higher up the Bunyip, and it might be worth while suggesting that representatives of the interested shires and municipalities should accompany the Committee on an inspection of the locality.

174. To Senator Storey.—At present water is conveyed to the Naval Base by train from Mordialloo. Three trucks per day—3,000 gallons—are sent at a cost of about £30 per month.

175. To the Chairman.—The Director-General of Works proposed the Notting Hill scheme as being probably the most satisfactory for a separate supply. I agree with the Director-General. The Bunyip scheme, in my opinion, would be a good scheme if it were taken further up. As a single scheme to supply the Naval Base only, I favour the Notting Hill scheme.

176. To Mr. Finlayson.—I would favour a combined scheme if it were possible to serve all the interests likely to be involved. Such a scheme, however, would occupy a longer period in construction, and there might be some difficulty as to the payment of the initial costs.

177. To Mr. Fenton.—If a combined scheme were adopted there would be no difficulty in supplying the need for the Naval Base. As an engineering matter it would be possible in a scheme to supply the Naval Base just as easily as it would be possible to supply Frankston or Carrum. The difficulties I foresee are the other ones.

178. To Mr. Finlayson.—It would be possible to take water from the reservoir at Mt. Eliza to the Naval Base within a year. For the first part of the bigger scheme reinforced concrete pipes would be considerably cheaper than cast iron. The proposed offtake is at a level of 110 feet. Over a distance of 18 miles the drop is only about 30 feet, so that reinforced concrete pipes would be quite suitable.

179. To Mr. Fenton.—I would much prefer the Bunyip scheme if the offtake were higher up. It would be possible under the present scheme to utilize the now proposed offtake and extend higher up later, but I think the offtake ought to go up another 5 or 10 miles.

180. To the Chairman.—It may be that the Government will be called upon to pay easements for the right to cross a number of good paddocks growing English grasses half-way between the suggested inlet and the pumping station.

(Taken at Melbourne).

THURSDAY, 24th FEBRUARY, 1916.

Present:

Mr. RILEY, Chairman.

- |                  |                  |
|------------------|------------------|
| Senator Keating, | Mr. Finlayson,   |
| Senator Lynch,   | Mr. Gregory,     |
| Senator Storey,  | Mr. Sampson,     |
| Mr. Fenton,      | Mr. Laird Smith, |

Percy Thomas Owen, Director-General of Works, Department of Home Affairs, recalled, and further examined.

181. To the Chairman.—Since giving evidence in this inquiry, I have, in company with Mr. Hill,

visited the Bunyip Creek, and gone into what is now known as the No. 3 or Bunyip scheme, but before giving my views in regard to it I should like to recall to the Committee the evidence that I gave concerning schemes No. 1 and No. 2, the Metropolitan and the Cardinia or Monbulk schemes. In regard to them I said:

There will be, in the course of years, a large increase of population at the seaside resorts, Mordialloo, Carrum, and Frankton, that general locality being the most alluring of such resorts within easy access of a large city. Admitting such a probability, the population would demand water from a supply, and if it then transpired that the Crown had paid a large sum for a supply which in no way improved conditions in such localities, there would be a stigma for a lack of foresight; on the other hand, if a pipe main were laid large enough to meet all demands, the increased cost should not be a charge against the Commonwealth.

I pointed out that until the Cardinia Creek proposal had been definitely dealt with, we could not go much further with the Metropolitan scheme, because the shire authorities would have to approach the Metropolitan Board of Works before the Board could do anything, and that if a scheme were adopted which would merely meet the requirements of the Naval Base, the population of the Mornington Peninsula would be left unsupplied. During my absence in India an estimate was prepared of the cost of supplying the Naval Base from the Metropolitan system, but I have not submitted it, because it seems to me that any scheme adopted should provide water for the whole peninsula. However, I shall mention that estimate subsequently.

I understand that the engineer for the shires has increased the catchment area included in the Cardinia Creek scheme, but I am still of opinion that the catchment area available under that scheme is not sufficient to provide the supply that is required, and, moreover, the water would be drawn from a district which is being fast covered with orchards and in which settlement generally is increasing. Therefore I propose to drop out of consideration the Cardinia Creek, Monbulk, or Shires scheme. This being done, the choice lies between the original Metropolitan scheme and the No. 3 or Bunyip scheme. Regarding the Metropolitan scheme we are no nearer to a solution than we were a year ago. The shire authorities do not seem to be in a position to approach the Metropolitan Board of Works, and their engineer would, no doubt, wish to exhaust the possibilities of the scheme which he put forward before other schemes are dealt with. Therefore I do not think that we are in a position to consider the Metropolitan scheme any further. But the Bunyip scheme, of which I was not aware before I left Australia, offers advantages which should bring it under very favorable consideration. Topographically the catchment area of the Bunyip River is the natural source of water supply for the Mornington Peninsula, just as the Cardinia Creek catchment area is the natural source of water supply for the district extending out towards Berwick. Moreover, the Bunyip River possesses a larger catchment area than the Cardinia catchment area, and there is an excellent run-off from that area on the Peninsula. I visited the locality with Mr. Hill. We went to Tooradin, and through Koo-wee-rup, and saw the proposed offtake at the 40-foot level. Mr. Murray, I understand, has suggested that the initial capital outlay would be comparatively small if the offtake were at the 40-foot level, but my view is that population will increase in the

locally so rapidly that, should his proposal be adopted, it would be difficult to prevent the pollution of a portion of the drainage area, and that it would be better to adopt a take-off situated above the possibility of pollution. Mr. Hill has pointed out to me an off-take above the junction of the Cannibal Creek with the Bunyip River which seems to meet all requirements. At that point there is a good flow of excellent water. Water could be taken from that point to a pumping station at the north of Westport, and thence by a rising main to a reservoir at Mount Eliza, whence the Naval Base would be supplied. I have since discussed the matter with two members of the State Rivers and Water Supply Commission, and it has been suggested that the off-take should be made at the 330-foot level, where the flow is much the same as near Cannibal Creek at the 164-foot level. This would necessitate about 7 miles more of pipe line, but would give an increased gravity head, and that would increase the cost consumption wherever pumping had to be undertaken. I have also discussed with Mr. Hill and with the officers of the Commission the advisability of having a take-off, in the first instance, at the 40-foot level, and continuing the pipe line at some future time to the 164-foot level. Certain advantages would be gained by doing that, but I think that, in course of time, more water would be required for the Peninsula than could be delivered through a 21-inch pipe, and there might be some difficulties in the way of using steel-riveted or wooden pipes along the No. 1 route, which would not occur if the pipe line route of the No. 3 scheme were followed. Cast-iron pipes could be used, but their costliness puts them out of the question. A spiral-riveted pipe for the No. 1 scheme, with a 21-inch concrete pipe line from the 40-foot take-off, was £135,000. That included the cost of a filter bed, and other expenditure, amounting to £40,000, which left about £94,500 for the rest of the scheme. The pumping arrangements, the reservoir and the delivery pipe line may be regarded common to both schemes. But if the No. 3 pipe line were substituted for the No. 1, a 15-inch steel pipe would cost approximately £69,500, a 15-inch wooden pipe, £77,000; an 18-inch steel pipe, £66,500, and an 18-inch wooden pipe, £91,000. If you added to the £94,500 I have just mentioned, £69,500 for a 15-inch steel pipe, you would get an estimate of £164,000 for the No. 3 scheme, or of £161,000 if an 18-inch steel pipe were adopted. I favour this increase in expenditure—of about £20,000—because it would provide a supply to which no execution could be taken. If we took off at the 40-foot level, we should, in the course of a few years, have to increase an expenditure of £135,000 by about £30,000 to provide an off-take at the 164-foot level, and should not then have a good gravity head at the 330-foot level, although the river flow would be practically the same. I have no definite gauge readings with which to support that statement, but I think that it expresses the opinion of both Mr. Hill and Mr. Murray. In considering this matter there are problems to be dealt with which, in my opinion, make it advisable that the Committee should meet the State Rivers and Water Supply Commission, a body which is the guardian of the public interests, so far as the disposal of the waters of the State are concerned.

182. *To Mr. Fenton*.—A discussion of the kind I suggest seems to me advisable, not only for financial, but also for general reasons. If the three authorities said that they would not fall in with any scheme the Commission would have to

settle with them. The shire authorities, the Commission, and the Commonwealth authority are the three parties interested in this matter.

183. *To the Chairman*.—If the scheme of which I have been speaking were adopted, the Commonwealth would be the customer of the State water authority, and would pay for the water it used according to the meter charges. I think that the Commonwealth has the power to provide itself with an exclusive water supply, but, in my opinion, by doing so, it would usurp a function of the State, and would make it necessary later to put down a separate line of pipes to provide water for the public, whereas a comprehensive scheme would meet the requirements of both the Commonwealth and the public. Of course, if no arrangement could be come to with the State authorities, the Commonwealth would be justified in providing its own water supply, but I think that the Commission is sympathetic, and that as soon as the way is clear it will be ready to come to a definite agreement. The life of a wooden pipe, or of a cast-riveted pipe, is not so long as the life of a steel-riveted pipe, but the cost of the latter puts it almost out of question, though the kind of pipe to be used would be a matter for the Commission to decide, if the scheme had to be carried out by it under an agreement which would make the Commonwealth its customer for water. No doubt the Minister for the Navy would desire security in respect of the Naval Base supply, and that would be given by the making of a reservoir on Mount Eliza capable of storing 40,000,000 gallons. Further, in times of stress, the daily consumption of 60 gallons would be reduced to 50 or 25 gallons, which would make the reserve life of from ten to fourteen years. Possibly a wooden pipe would last as long, but I prefer the steel pipe, because it is better proven. The wooden pipe has not been proved in connexion with a scheme of this size, in country such as that with which we have to deal. We know fairly well how the spiral-riveted pipe will stand, but we do not know how the wooden pipe will stand. A 15-inch pipe would not supply the population which it may be expected will eventually settle on the Mornington Peninsula, but such a pipe would give a sufficient supply for the next fifteen or twenty years, and by the establishment of a sinking fund which might increase the cost of the water by 1d. per 1,000 gallons, its cost could be repaid within that time, and a bigger pipe could be put in when needed. Any scarcity of water at the Naval Base could be further guarded against by providing a second storage reservoir there capable of holding 2,000,000 gallons. With a cast-iron 6-inch pipe from the big reservoir to the smaller reservoir, the water supply at the Base would be reasonably certain.

184. *To Senator Lynch*.—It might be necessary to give the Department of Defence first call on the water supply, subject, perhaps, to a limitation of consumption in times of stress.

185. *To Mr. Fenton*.—My estimate of the cost of the No. 3 scheme—£154,000—is merely an approximation. A close estimate could not be made until the route had been examined, and the proposal had been considered by the Commission.

186. *To the Chairman*.—What the Commonwealth would pay would be a meter charge of so much per 1,000 gallons, and that would depend on the capital cost and working expenses of the scheme. I gathered from Mr. Murray that, if the No. 1 scheme were adopted, the meter charge might be 1s. 6d. per 1,000 gallons, and on the figures I have given, perhaps 1s. extra per 1,000 gallons would have to be charged.

187. *To Mr. Sampson*.—The charge of 1s. 6d. per 1,000 gallons is based, I believe, on a consumption of 120,000 gallons per diem at the Naval Base.

188. *To Senator Keating*.—A point to be considered is whether it is advisable, having regard to the existing settlement on the Bunyip catchment area, to take-off from the 40-foot level. In my opinion it is not.

189. *To the Chairman*.—I favour the No. 3 scheme, with a take-off at the 330-foot level.

190. *To Senator Keating*.—With a take-off at the 330-foot level, there would be a pipe line at 42 miles to the Mount Eliza reservoir. The estimate of cost—£164,000—covers that pipe line, the reservoir, the pumping station, and a complete scheme for supplying the Naval Base, as well as for supplying the township, as far along the shores of Port Phillip as Mordialloc. I would substitute for the 21-inch concrete pipe, suggested by Mr. Murray, a steel spiral-riveted pipe. From the intake to the service reservoir near Mount Eliza, the Metropolitan scheme would necessitate a pipe line of 42 miles, and the Monbulk scheme a pipe line of 26 miles; then there would be a delivery main from the reservoir to the Naval Base. If the No. 1 scheme were adopted, there would be annual charges in connexion with the maintenance of the filter beds and for pumping, but no filter bed would be needed for the No. 3 scheme, and the pumping charges would be less.

191. *To Mr. Laird Smith*.—If the No. 3 scheme were adopted, water would gravitate from the in-take to the pumping head at the service reservoir, whence it would be forced to the top of Mount Eliza. An alternative scheme has been suggested which would allow the water to gravitate to the Naval Base, a supply being pumped to Mount Eliza.

192. *To Senator Keating*.—If the supply of the Naval Base were the only consideration there would be no pumping at all.

193. *To Mr. Sampson*.—If a gravitation supply were provided for the Naval Base, a storage reservoir, capable of holding 2,000,000 gallons, would be made at the Base.

194. *To Senator Keating*.—The 15-inch wooden pipes cost £1,900 a mile, and steel pipes £1,700.

195. *To Mr. Finlayson*.—I think that we should have trouble in obtaining the locking-bar pipes, and probably a heavier make of pipe would have to be used. In my opinion, the cheapest pipes are the steel spiral-riveted pipes. The reinforced concrete pipes may cause trouble at the joints when the pressure is very great. They told me, three years ago in Adelaide, that they were perfecting the joints, but I do not think that a perfect joint has yet been invented. The 21-inch pipes cost £2,200 a mile, but for a larger head they would cost nearly £3,000.

196. *To Senator Lynch*.—Under the scheme of which I have been speaking, the Commission would be the undertakers, and the Commonwealth would buy its water, paying for it according to the meter measurement. Of course, the charge for water would depend on the capital cost of the works. The capital cost of the scheme is a matter for the consideration of the Committee in that regard. I am of opinion, however, in expressing it I am going beyond my province—it would be better for the Commonwealth to co-operate with the State in this matter than to resume the catchment area at Bunyip for a special water supply for the Naval Base. In Sydney, Melbourne, Perth, and Hobart the Commonwealth authority, as well as the public, has to depend on State authorities for water supply. I am not of opinion that the Commonwealth would be the largest consumer on the

Peninsula were the scheme under consideration to be carried out. By having a conference with the Commission the Committee might be in a position to arrive at a definite decision as to the source of the supply, the route of pipe lines, the position of the Mount Eliza reservoir, and other matters, and to recommend a scheme which all parties could accept. A conference ought to enable the Commission to state the financial position, and this might thus be brought where it could receive the necessary consideration. The Commission is the authority which determines whether water shall be drawn from any catchment area, and, if so, under what conditions. It would see, I think, that the most economical scheme was adopted.

197. *To Mr. Finlayson*.—The Bunyip catchment area is part of the State Forest Reserve. It is a good, clean catchment area, and the water that comes from it is of good quality. I have no doubt from information given to me that there is a sufficient supply available at the 330-foot level to meet all the requirements of the Naval Base. I do not think that it would seriously diminish the supply available for other purposes to give a separate supply to the Naval Base; but it is possible that if the Commonwealth did not work in harmony with the State in this matter the construction of a compensating dam might be demanded. Under a friendly arrangement, there would probably be no such demand. I have not been over the route of the proposed pipe line for the No. 3 scheme, though I know the country generally. That route was suggested by a consideration of Mr. Murray's plan. I cannot say that it would be followed exactly. If the supplying of the Flinders Naval Base alone were considered, it would not be necessary to have a pumping station at the head of Westport, nor a reservoir on Mount Eliza. Water would gravitate probably, if there were no large storage reservoir on Mount Eliza, it would be considered necessary to provide for the storage of about 10,000,000 gallons at the Naval Base. If the State authority provided a water supply for the Peninsula, and the Commonwealth had its own supply, a pipe line might be best from the Mount Eliza reservoir to meet emergencies. I am not able to say whether the State authorities would arrange for a water supply for the Peninsula if the Commonwealth gave the Naval Base an independent supply. I think that, at the present time, the population of the peninsula is not sufficiently large to justify the expense.

198. *To Mr. Sampson*.—In my opinion, it would be an advantage to have, by way of a standby in time of war, a storage reservoir capable of holding 40,000,000 gallons. I do not think it likely that the State authorities would provide a water supply for the Peninsula if the Commonwealth provided independently for the Naval Base. I favour a combined scheme. Mr. Sambell stated in evidence that the daily quantity available from the Monbulk catchment area would be 1,250,000 gallons. The daily delivery of a 15-inch pipe from the 330-foot level in the No. 3 scheme would be 1,400,000 gallons, and of an 18-inch pipe 2,000,000 gallons.

199. *To Mr. Fenton*.—I understand that if a scheme were inaugurated for the peninsula the procedure would be to approach the State Rivers and Water Supply Commission and through that body obtain the money from the State Government. In consultation we had with some members of the Commission the question of security of the pipe-line cropping up, and I ventured the opinion that the Commonwealth would have the first claim

on the 40,000,000 gallons storage supply. I gathered that they regarded that as a reasonable proposition, and that if at any time there was a scarcity of water it might be necessary to reduce the consumption for other than Naval requirements. Apart altogether from any arrangement, the Naval requirements in regard to the water supply would be paramount, but I would suggest that this be embodied in any agreement under which the Commonwealth carried out the work. I understand, however, that the powers of the Minister of Defence are very great, and that, independent of any agreement, he would be able to make the Commonwealth supply of water secure.

200. *To Senator Story.*—I prefer the Bunyip scheme to the other two that have been considered. In my opinion, it is better to take the high-level line. I have made an examination of the water, and I understand also that a chemical analysis has been made. I am satisfied concerning its purity. In the event of any hitch occurring in the negotiations with the State Rivers and Water Supply Commission, the departmental estimate of the cost of a scheme to give the Naval Base a supply for the next ten years from the 40-foot level is £37,500. This is in evidence, and it provides for concrete pipes with wood pipes from the reservoir down. The estimate, of course, includes filter beds; but on top of that there would be the pumping costs, so that in comparison with the gravitation scheme these fixed charges would have to be taken into account. The total annual charges are placed at £6,060. A gravitation scheme, combined with a fairly large storage at the Naval Base, is more attractive than a pumping scheme.

201. *To Mr. Sampson.*—I understand that members of the State Rivers and Water Supply Commission estimate that it will take two years to complete the scheme, but I think it probable that this estimate could be reduced somewhat. I should say it would take from eighteen months to two years.

Thomas Hill, Engineer, Department of Home Affairs, recalled, and further examined.

202 *To the Chairman.*—Before Christmas I was asked to investigate the upper waters of the Bunyip, and also to look into the Toomuc scheme. As regards the Bunyip scheme the levels are shown on the State Rivers and Water Supply Commission plan. They were taken by me in view of an extension of No. 1 scheme. The levels were taken as shown on the plans 245 and 330 respectively. They have been checked, and have been accepted as fairly approximate. It will be noted that the stream, instead of proceeding due north as shown in the original plans, makes a fault at about the 285-foot level to the northwards, and thence proceeds south-west, following generally the trend of the Dividing Range. Very little water comes into it, and the flow at about the 330-foot reduced level is about the same as it is where the Committee saw it at about the 160-foot level. The main body of water seems to come from higher up in the north-westerly direction. The stream from the north, shown as the original Bunyip, is very small indeed. I was disappointed to find that it did not rise quickly, so as to better provide for gravitation purposes. I found that it took a considerable time before the 330-foot level was reached. The character of the country is sandy ranges, with peppermint and stringy-bark timber, and there is no settlement except here and there of some small flats of a few acres extent under cultivation, which would not affect the character or quality of the water. The country is very suitable for the construction

of off-takes at any point practically, for storage reservoirs. Where necessary they could be economically constructed.

203. *To Mr. Laird Smith.*—Timber from the State forests is at present being obtained from this area. There is very little land under cultivation, and I should think that there would be no difficulty in securing this area in perpetuity as a watershed for the water supply of the Peninsula.

204. *To Mr. Penton.*—It would be more economical in the laying of a pipe-line, to follow the track of the stream than to cut across the spurs of the hills. I found the quality of the water very good, and the flow well maintained.

205. *To Mr. Gregory.*—The Committee already has in evidence the result of analyses made of the water. I found that a good deal of the brown stain disappeared as I got a little higher up. The stain disappeared, and we made to test the water for domestic purposes, and I gather that it would not be deleterious in its effect on boilers. Probably it would be as well if this aspect of the question were specially inquired into.

206. *To Mr. Penton.*—It is possible, of course, that in an examination of the water for human consumption some other element may have been overlooked. I was also asked about the practicability of extending scheme No. 1 and scheme No. 2, and I would point out that the route along the main channel may be subject to alteration in the future by irrigation works in the Koo-wee-rup Swamp. I think it possible, however, that the pipe line there would not interfere with such works except perhaps, in a minor way, at crossings. From the levels that are shown on the plan, I furnished information to Mr. Murray, and from this was deduced the proposed gravitation scheme shown as No. 3, and marked in blue. I have roughly approximated the area of the watershed that will be covered by that scheme, at about 50 square miles of country with a good rainfall, and a good, clean catchment.

207. *To Senator Lynch.*—When I was there with the Director-General the run-off was the lowest that had ever been seen. The gauge-reader, who has been there for many years, told me that it was about 8,000,000 gallons per day minimum, but I think that would be subject to some correction by the officer in charge of gauging for the State Rivers and Water Supply Commission. It is probably slightly on the high side, as the gauge is not an actual notch with a knife edge. The reading is taken with a Droyer meter, and the volume of water is judged on the velocity through certain sections. I also plotted along the plan for the Committee a solid blue line showing a possible gravitation scheme right through to the Base, and cutting out the connexion with the rest of the Peninsula. This would deliver into the storage basin at the Naval Base from about the 330-foot level to about the 140-foot reduced level. The size of the pipe would be determined by whatever the Committee thought reasonable for requirements, but I would suggest that the Committee ask for a 9-inch pipe for the separate scheme. This would give about 300,000 gallons per day. The 16-inch pipe is suggested because it would best suit a water supply for the whole of the Peninsula. The No. 1 scheme would not serve all requirements so well. The No. 3 scheme, assuming a supply is needed for the whole of the peninsula, would serve a large area in the north by gravitation, because the pipe line would be under pressure, and there would be no necessity for pumping. If, however, the pipe line followed the route shown in red along the original channel all the water would have to be lifted to the Mount Eliza reservoir.

208. *To Mr. Gregory.*—In my opinion, the quantity of water required for the Naval Base would be negligible compared with the minimum flow, but in a question involving riparian rights the State Rivers and Water Supply Commission have the power to say how much water is required for irrigation and other purposes, and I should say that if the scheme provides for the whole Peninsula they would want at least 1,000,000 gallons per day.

209. *To Mr. Sampson.*—In the course of time, and as the Naval Base develops, I think the State requirements of 120,000 gallons per day will be too small. If the pipe line for the scheme No. 3 were laid as shown in the plan in solid blue there would be very little likelihood of disturbance through future State Government irrigation works, but it is possible that if it followed the main channels of No. 1 and No. 2, there might be some disturbance along portion of the route through irrigation schemes, for it has been shown that just as the swamp needs draining, so also in certain circumstances it needs irrigating. The other scheme I was asked to look into was for an entirely separate supply from the head of the Toomuc Creek. In that watershed there is an area of nearly 2,170 acres, as shown on the attached plan and coloured green and yellow. Its level varies from about 1,000 feet to a little over 1,000 feet. At the site where the reservoir will be constructed, there is an area of 1,600 acres under cleared, 69 acres partly cleared, 240 acres under 200 acres under crop, and 1 acre under orchard. I have estimated the value of this land as follows:—Uncleared land, £4 per acre, £6,640; partly cleared £7 per acre, £453; cleared land, £17 per acre, £28,000; cleared and under crop, £17 per acre, £24,400; orchard (1 acre), £50, total, £14,173. There are several houses on the land. For instance, on block 37 there is a house valued £600; on 37, a house valued £300; on 41, buildings valued £350, and some sheds valued £70. There are also some accessories valued £60, bringing the total value of buildings and land to £16,563. That would be the minimum expenditure before the Government could secure the area, and it might be increased at any time, with the result that a higher expenditure would be necessary to buy up the land to keep the watershed clean. It would be fairly practicable to construct a reservoir of 150,000,000 gallons at the site indicated in blue. I estimate this would cost £7,000. Then there would be 43 miles of pipe line to the Naval Base. I estimate that the 6-inch cast-iron pipe would deliver at the Base 150,000 gallons per day, and a 9-inch pipe 350,000 gallons per day (twenty-four hours). I am assuming, of course, that the main would be under pressure, and as it would be of small dimensions the cost between the two sizes would not be so very great. The 43 miles of 6-inch pipe I estimate would cost £4,076 laid complete, and a 9-inch pipe would cost £23,000 more, making the total cost of the separate scheme, including land, reservoir, and £3,000 for a storage reservoir at the Naval Base, £70,000 for a 6-inch main and £105,000 for a 9-inch main. Assuming that the full quantities of water were used—that is, the full quantities which would be delivered through each main—interest on the basis of 6 per cent. (5½ per cent. interest and sinking fund, and 3 per cent. on the cost-iron pipes) of the 6-inch main the interest would represent £4,200 a year, and if 150,000 gallons per day were used the cost per 1,000 gallons at the Base would be 1s. 6d. With a 9-inch pipe the interest would be £9,030, and if 350,000 gallons per day were used the cost would

work out at slightly over 1s. per 1,000 gallons. The weak point in this assumption is that it provides for the full quantities. If only half the quantities were used the cost per 1,000 gallons would be doubled.

210. *To the Chairman.*—It would be necessary to spend the money I have indicated if the Commonwealth desired to get the freedhold of the area. It is possible, in the event of the Toomuc scheme being adopted, that the State Rivers and Water Supply Commission would make a demand for the release of a certain amount of water for the requirements of the inhabitants lower down.

211. *To Mr. Gregory.*—Assuming that only 150,000 gallons per day were used the cost per 1,000 gallons, with a 6-inch main operating, would work out at about 1s. 9d.

212. *To Mr. Laird Smith.*—I think it would be a pity, if water for the Naval Base could be obtained elsewhere, to adopt the Toomuc scheme, and thus put out of commission a considerable area of really good land so close to Melbourne.

213. *To Mr. Penton.*—The Toomuc watershed land is similar to the Monbulk country. I think the people who may be settled in that locality would have strong claims for water. In fact, I arrived at the conclusion that this watershed should be reserved for irrigation requirements of land lower down the Toomuc Valley.

214. *To Senator Lynch.*—The uncleared country is all good cultivation land, and I have assessed it at £4 per acre, while the cleared land is valued at £15 per acre. It is much better than the land in the Bunyip watershed. I regard the latter as being about one-third the value of the Toomuc country.

215. *To the Chairman.*—In order to allow members of the Committee to study the schemes in detail I will prepare a schedule showing the estimated cost of each.

216. *To Mr. Sampson.*—To visit the Bunyip watershed it would be possible to proceed by vehicle to the 245 feet level, but you would have to proceed thence on foot.

217. *To Senator Lynch.*—Roughly speaking, the Bunyip watershed is fifteen times larger than the Toomuc watershed.

218. *To the Chairman.*—If the Committee approved of an entirely separate scheme for the Base I think Mr. Murray's proposition to take the water from the Bunyip, if added to by the extension: that is, an intake pipe from 16 miles up, to a point approximately about the 160-foot level, would be preferable. This would involve some pumping, but only at the 200 feet level, and the cost would not be very high for the requirements of the Base alone, representing perhaps a charge of 2d. or 3d. per 1,000 gallons on the cost of the scheme. This would insure practically an unlimited supply, and if at any time it was considered advisable to increase it, there would be no question about the water not being available. I think it possible that, with the Toomuc scheme in operation, and with a reservoir of 150,000,000 gallons as proposed, if there were a succession of two or three dry years, the supply would not be equal to the demand in the future, assuming that the population of the Naval Base reaches 2,000 or 3,000, and that the surrounding population also increases.

219. *To Mr. Sampson.*—I saw no indications of the settlement in the country which would be affected by No. 2 and No. 3 schemes, though the land has been taken up, but the cost of reumption, in order to keep the watershed absolutely free of settlement, would be a matter for further consideration. As far as I can see the land is very poor, and

would never carry a heavy population. In my opinion, the area of the Bunyip scheme is sufficient for the requirements of the whole peninsula. From this point of view I would prefer the combined scheme, if this matter were taken up by the State Rivers and Water Supply Commission, because there would then be in authority a body having complete control in regard to land or riparian rights. The combined scheme will be as cheap, if not cheaper than a separate scheme, and I think it will be possible to get the minimum quantity of water at a cheaper rate, while the supply for the Naval Base would be just as secure. In order to secure a greater storage the reservoir at Mount Eliza could be increased, and I am confident that the claims of the Naval Department for priority in the use of water would be exercised if necessary. Any injury to the supply main or the head waters could be remedied in from a few hours to at the most two or three days, but even if the supply main were damaged, there would be 40,000,000 gallons in storage at Mount Eliza, and the risk could be disregarded.

220. *To the Senator, Perth.*—If the storage reservoir were damaged it could be repaired in a few days. I should think it could easily be protected from attack.

221. *To Mr. Sampson.*—A storage reservoir at the Base with a capacity of from 5,000,000 to 10,000,000 gallons could easily be guarded.

(Taken at Melbourne.)

TUESDAY, 30th MAY, 1916.

Present:

Mr. RILEY, Chairman;

Senator Story,      Mr. Gregory,  
Mr. Fenton,        Mr. Sampson,  
Mr. Finlayson,

Ebenezer Shaw, Commissioner of the Victorian State Rivers and Water Supply Commission, sworn and examined.

222. *To the Chairman.*—In my capacity as a Commissioner of Water Supply I present to the Committee a report by the State Rivers and Water Supply Commission, with a plan, of a proposed water supply for the Mornington Peninsula and the Flinders Naval Base from the Bunyip River. We did not consider it advisable to proceed further with the Monbulk scheme; the catchment area was limited; it was not sufficiently untouched; and we were of opinion that that source of supply should be reserved for local requirements, which must increase in the course of time. We consider that if the head waters of the Bunyip River can be brought across at a reasonable cost, that scheme will provide the most satisfactory solution of the difficulty, and will give scope for development in all directions in future. The details of our proposal are contained in the report I am submitting. A strong feature of the scheme is the introduction of the two large reservoirs. One would be established near Frankton, and the other about 4 miles north of the Base. Their capacity would be so large that for the present population they would hold about a year's supply. We anticipate that they would hold at least six months' supply for the future population which the scheme is designed to serve. These reservoirs enable us to keep down the size of the main to meet only the average consumption, and to store the surplus at the period of low use so that in summer time water may be distributed in

large volumes. This provision gives absolute security against any shortage of supply. A branch pipe line is taken from the Base reservoir to a spot about a mile north of the Base, where there would be a service basin for the requirements of the Base also, with a capacity of three or four weeks' supply for the anticipated consumption in the early history of the Base. Should anything go wrong with this branch main at any time there will be no difficulty in repairing it. We think that adequate provision has been made for all requirements. We realize that certainty and security are essential, especially as regards the supply for the Naval Base, and there need be no fears on those grounds if this scheme is carried out. The same security is given to the towns which will be supplied. We shall be able to supply Borwick, Beaconsfield, and other small towns on the route, and we hope that in the course of time the increased demand from these will help to clean up the cost to everybody. There is a difficulty at the outset in putting the scheme on a financial basis. The works are on such a scale that they could supply three times the present requirements without extra cost, so that as the demand increases, we shall be able to put the scheme on a better paying basis. The difficulty at the present time is to discover a basis sufficiently financial to satisfy the local people and the State Government. If we were to put forward a scheme which involved the State in a considerable loss, it would be viewed with disfavour. For that reason we ask the Naval Base to give us large a contribution as possible, especially at the beginning of the scheme. We believe that the supply should be given to the Base at 1s. per 1,000 gallons. The trouble is that at the start the Base will not use sufficient water to make that price payable. But we consider it better to fix the price at 1s. for all time as a working proposition, and to fix a minimum consumption in order to insure a revenue to meet the working expenses. The report speaks of a minimum contribution by the Base of £4,000 per annum, which would entitle the Base to draw 210,000 gallons per day to be used for any purpose. That would give ample water for all requirements, and would allow of a lavish use in some directions. I discussed this proposal with Mr. Hill this morning, and he regarded the contribution of £4,000 as very large. No doubt it is, but the Base is not in a position to supply itself any cheaper. We have no desire to take advantage of that necessity, but we must put the scheme on a financial basis. It may be suggested that some arrangement is possible whereby, later, other parts of the scheme progress, the contribution by the Base may be diminished. The Commission would be perfectly agreeable to a proposal of that sort. I had a conversation with the Chairman on the subject, and we think that the Commission would be agreeable to a modification whereby the initial £4,000 per annum might be reduced in three years to £3,000, and in a further three years to £2,000, at which figure it would have to remain. The Base would pay at the rate of 1s. per 1,000 for all water consumed, but the minimum payment would be £4,000 at the outset, reducing to £3,000 in six years. We believe that after six years' operations the scheme would be able to pay its way without the extra £1,000 from the Naval Base. I would suggest that the Committee should agree to the minimum of £4,000 subject to the modification I have indicated. It would be well if the Committee could come to a decision immediately, because the Treasurer has to be approached, and the other interested bodies

must be interviewed. The Commonwealth will be required to find a total of £150,000, for which the Commission would pay interest and redemption at the rate of 6 per cent. Our usual rates are 4½ per cent. interest and 1 per cent. redemption. If the Treasurer will agree to advance that money and the scheme is accepted by the other bodies interested, we shall be able to proceed with the work forthwith. The report from the Commission is as follows:—

STATE RIVERS AND WATER SUPPLY COMMISSION.

MORNINGTON PENINSULA WATER SUPPLY SCHEME.  
*Retculated Supply to the Naval Base and to Somerville and other Towns.*

The conditions under which retculated water supplies must necessarily be given to the Naval Base as well as to most of the towns on the Mornington Peninsula are of a very peculiar character.

In the first place, there is a very large influx of summer visitors to such favorite seaside resorts as Mornington, Frankston, Carrum, Chelsea, Aspendale, and Hastings. Consequently provision must be made not only for the usual increase from winter to summer consumption for the permanent population, but, in addition, direct provision for the main for an even greater extra summer population. Unquestionably, the coastal towns of the Peninsula are coming more and more into favour as summer resorts, and a good and sufficient water supply would cause still more rapid extension in the near future. No scheme of supply would be on a satisfactory basis which did not make ample provision to meet, in the most economical manner, this extraordinary increase in the summer population.

It is, of course, very difficult to make a reliable estimate of such a fluctuating population. For instance, the present winter residents in the coastal area extending from Mornington to Aspendale would perhaps not number more than 100,000, while the mid-summer population would probably be well over 10,000. Very liberal allowance must be made for material increases in the near future, especially as regards the floating population.

In dealing, therefore, with the question of supply to those towns coming within the scope of what is known as the Mornington Peninsula scheme, including the supply asked for at the Naval Base, it would be wise to make provision for a less population than 15,000 during winter and three times that—or 45,000 during summer months, say from December to March inclusive. The extra 30,000 will not require water for more than one-third of a year on an average.

Provision for the fixed population of 15,000, with its usual equipment of gardens, must be made on the ordinary basis of an average of 60 gallons per head per day throughout the year. This average daily consumption should also be sufficient for the floating or summer population as its consumption would naturally be less throughout the year on account of the transitory character of its residence. On this basis, the 30,000 floating population, operating seasonally, or one-third of the year, would only consume during that period a volume equal to that of a fixed population of 10,000 operating for a full year. A suitable scheme about these matters, making provision for an equivalent of a fixed population of 25,000 persons using an average of 60 gallons per head per day throughout the year. It should also provide for the storage, during periods of low use, of sufficient water to meet the chief centres of consumption with distributing mains therefrom of ample size to meet the maximum summer requirements of any possible source. On account of the remoteness of any possible source of supply, reasonable economy can only be secured in this way. Direct service to the retulations from the headworks necessitates main pipe lines of such large dimensions as to be prohibitive in cost. The scheme outlined below and on plan attached is laid down on this basis.

Supply will be drawn from the main stream of the Bunyip River at the point indicated just below "The Falls," distant from Frankton some 48 miles by the straight line. The area of the river catchment beyond at this point is about 20 square miles. It is situated in all virgin country, which could be strictly reserved for water supply purposes. The rainfall is high, so that there should be ample without storage for the required purpose even in the driest years. The volume of the stream would be available there being no compensation flows of any kind necessary, as just below the offtake other good streams join the river. During the late

summer in March and April, when the stream at "The Falls" was as low as ever known, the estimated volume passing was by least 10 c.f.a. This represents about 60 acre-feet per day, or some five times the volume required under the scheme.

As shown by analysis, the water is of excellent quality—equal to that of the metropolitan supply. The level of the river bed at the offtake is 375 ft. R.L., on account of the rocky nature of the bed and banks at this point, the draw-off level can be raised to 415 ft. R.L. at a low cost. This will give a sufficient working head for the scheme.

The feeding main from the source of supply is designed to deliver steadily 1,250,000 gallons daily, which is the average daily consumption of 25,000 persons at 50 gallons per head per day. During periods of low consumption, the excess goes into two storage reservoirs established at selected suitable sites, the larger about 4 miles south-east of Frankton, and the smaller about 4 miles north of Naval Base. The combined capacity of these reservoirs will be 237,000,000 gallons, or rather more than six months' average consumption. The distributing mains from the reservoirs will be of sufficient size to distribute through the various retulations this stored water as well as that brought in by the constantly running supply main, so as to meet the full summer demands of the 45,000 people for which provision should be made.

The contour and nature of the country traversed by the first portion of the line of supply is favorable to the use of an open race. This fact saves valuable head, and a materially lowers the cost of the scheme. Water will therefore be conveyed the first 17½ miles through 13½ miles of open race combined with some 4 miles of 18-in. diameter piping over main water-courses at intervals. This race will be cement lined, and will have any necessary sluicings over depressions intersected. All proper safeguards to avoid pollution can easily be secured. From the end of the race a pipe line 22½ miles will be carried to a relieving basin at the bifurcation some 3½ miles north-east of Langwarrin reservoir. The supply of this will be 281,000 R.L. This main will be 16-in. diameter, and the best results will probably be secured by the use of wood pipe on account of its continuous high hydraulic efficiency. The route of the pipe line is shown on the plan. It has been carefully chosen so as to keep the pipe in clean, well drained and relatively high country, requiring the least possible expense on the main. These conditions naturally bring the line close to Ficksburg, Beaconsfield, Borwick, and Cranbourne, and thus enable these townships to be supplied and to secure the benefits of the scheme.

From the relieving basin at the bifurcation, a south-westerly branch main 14-in. diameter and 6½ miles in length will take supplies to a storage reservoir near Frankton. A suitable site for this has been found near the head of Sweetwater Creek, where, by means of an (150 acre-feet) can be impounded at a cost of about £5,000. The full supply level of this reservoir will be 255.60 R.L.

From this reservoir a distributing main, 16-in. diameter and 2 miles 50 chains in length, will serve Frankton, and also feed the compound main 14-in., 12-in., 10-in., 8-in., and 6-in. diameters, some 8½ miles in length, which will give supply to Seaford, Carrum, Chelsea, and Mornington by means of an 8-in. main 2½ miles long, which will feed a service basin, 1,500,000 gallons capacity, and full supply level of 200 R.L., to be established on the high ground north of the township.

From the bifurcation a main 9 inches in diameter and 11¼ miles in length, will run past Somerville township, which it will supply en route, to a storage reservoir situated about 4 miles north of the Naval Base. A very suitable site for this is available in allotment 35x and 35n, Bittern, where, by building a cartlan dam across a small watercourse, a storage of some 80,000,000 gallons (200-acre-feet) can be created at a cost of about £2,000. The full supply level of this will be 220.00 R.L. The Naval Base will draw supply from this reservoir by means of a compound main 8-in. and 6-in. diameters, about 3½ miles in length, which will feed a service basin 1,000,000 gallons capacity, built at a suitable elevation near the north boundary of the Naval Base area.

Hastings and Tyabb will be connected with the base reservoir by a 6-in. diameter main some 13 miles in length.

In planning out the scheme, the imperative necessity for keeping the first cost of the scheme within reasonable limits has been kept clearly in view. The routes of branch mains have been selected with great care, so that with the introduction of relieving basins at suitable spots, such as Frankton and Somerville, the cost

economical methods of construction can be employed, after providing ample for satisfactory service. This wood pipe reinforced for only light or moderate heads, or steel pipe, can generally be employed, and even cement concrete pipes in many suitable situations.

On account of the present high and uncertain prices of many classes of material, when arranging details every advantage must be taken of the natural surroundings in order to secure the most economical results.

Including provision of £5,000 for contingencies, the estimated cost of the scheme is £156,000. Under present conditions, it is very difficult to keep cost down to reasonable reliable figures. In framing the above estimate, due consideration has been given to the fact that the completion of the whole scheme will occupy a period of some two to three years. Under these conditions, no doubt a fair proportion of the work would be carried out at something like normal prices.

Upon the reasonable basis of rating for Frankton, Mornington, and other seaside townships set out in schedule attached, and on the assumption that the Naval Base authorities will be willing to pay at the rate of 1s. per 1,000 gallons, with a minimum of £4,000 annually, the estimated annual revenue is £11,500.

The estimated annual expenditure is £19,000. The slight loss incurred at first would, no doubt, be rapidly overtaken, and the scheme should, in the near future, assume a very sound financial position, probably allowing for some reduction of the initial ratings.

It is proposed to base all sales of excess water to ratepayers on a price of 1s. per 1,000 gallons, so that all moderately large consumers would be on a footing equal to that of the Melbourne ratepayers.

Although the township of Bunyip is not at this juncture specifically included in the operation of the scheme, on account of incompleteness in the necessary surveys, it is probable that, should the residents so desire, this town could be given a reticulated supply at a rate which would not be excessive. The township of Gardfield might also be given supply in conjunction with Bunyip.

From the preceding remarks relative to the quantity of water available at the proposed offtake on the Bunyip River, it will be seen that even in dry years, and with out storage, there will be a considerable excess in the river flow at that point after meeting all the requirements of the scheme.

This surplus would amount to at least 15 acre-feet per day, or, say, 450 acre-feet per month. There is no doubt that, if it were made available, such a volume as this could be profitably employed in the irrigation of orchards along the race forming the first part of the line of supply, on lines similar to those used for the supply of Haccourt orchards from Collium races. The country is of granitic character, very suitable for apple-growing, and there is already a fair acreage of gardens in this district. No doubt, considerable impetus would be given to this industry if a fair amount of supplementary water could be given when required.

It is not proposed to embark on any large irrigation project, but it is certain that much could be done to evolve a limited irrigation area on lines of natural growth by the utilization of the race portion of the Bunyip scheme to its fullest legitimate extent.

It is estimated that, with an extra expenditure of £5,000, the offtake weir, the race, and head-pipe lines could be enlarged so as to permit of 20 acre-feet per day being sent along the race. This would supply the full scheme to the Base and the towns, and at the same time allow of the diversion of at least 400 acre-feet per month for the use of orchards suitably situated along the line of the race.

Later on, and by degrees as required, the scope of this proposal could be enlarged, without risk, by building small storages in suitable gullies interested. Flow being lifted steadily during the off season would utilize the race to its fullest capacity, and ultimately make available some 4,000 acre-feet annually. No financial burden should be laid in the evolution of such a project. At the beginning, only some £350 annually would be required to meet interest, redemption, and depreciation on the extra £5,000 capital outlay. The proposition should be on a sound financial basis from the beginning, and should ultimately develop into a good payable one.

If the whole scheme be carried out, the extra provision of £5,000 should be made to enable this proposal for giving irrigation supplies, when available, to be carried out.

This project was designedly not included in the original town supply scheme in order that the clear-cut issues of that scheme should not be clouded in any way.

It must be clearly pointed out that the use of any portion of the Bunyip water for irrigation on lines set out above, would not in any way diminish or jeopardize

the supply for the Naval Base and the various towns. No irrigation of any kind would be allowed until all demands for these places had been fully and promptly met.

#### Estimated Cost of Works.

Concrete weir and other headworks on Bunyip River, item .. .. .	£2,000
Race and pipe line from Bunyip weir to head of main pipe line—	
4 miles 18-in. diameter main, at £2,500 per mile .. .. .	10,000
13 1/2 miles open race with cement lining throughout and flumes when required, at £400 per mile, say .. .. .	8,000
Main pipe line from end of race to bifurcation north-east of Langwarrin, 10-in. diameter, 22 1/2 miles at £2,100 per mile, say .. .. .	18,000
Branch pipe main from bifurcation to reservoir, near Frankton, 14-in. diameter, 6 1/2 miles at £1,600 per mile, say .. .. .	10,500
Branch pipe main from bifurcation to reservoir, near Naval Base, 9-in. diameter, 1 1/2 miles at £1,000 per mile .. .. .	11,500
Reservoir, near Frankton, capacity 177,000,000 gallons (650 acre-feet), item .. .. .	5,000
Reservoir near Naval Base, capacity 80,000,000 gallons (300 acre-feet), item .. .. .	2,000
Branch pipe main from Frankton reservoir to Frankton, Seaford, Carrum, Chelsea, and Aspendale, forming supply main to all reticulation services at these places—	
2 miles 20 chains, 10-in. main from reservoir to Frankton town boundary at £2,000 per mile, say .. .. .	£5,300
5 1/2 miles compound main 4-in., 12-in., 10-in., 8-in., and 6-in. diameters, from Frankton town boundary to Aspendale, at £1,200 per mile .. .. .	10,500
	15,500
Branch pipe main from Frankton reservoir to Mornington service basin, 8-in. diameter, 5 1/2 miles at £1,000 per mile .. .. .	5,500
Branch pipe main from base reservoir to Naval Base service basin—	
30 chains 6-in. main, and 2 miles 70 chains 8-in. main—3 1/2 miles at £1,050, say .. .. .	3,300
Branch pipe main from base reservoir to Hastings and Tyabih—1 1/2 miles, 6-in. diameter, at £700, say .. .. .	1,200
Service basin at Mornington, capacity, 1,600,000 gallons (6,000 cubic yards) .. .. .	1,400
Service basin at Naval Base, capacity, 1,000,000 gallons (4,000 cubic yards) .. .. .	1,000
Relieving basins at bifurcation, Somerville and Frankton .. .. .	1,600
	4,000
Valves and special fittings on main pipe line, item .. .. .	500
Reticulations, comprising all branch services other than branch main pipes above set out—	
Frankton .. .. .	2,000
Mornington .. .. .	3,500
Seaford, Carrum, Chelsea, and Aspendale .. .. .	5,400
Carrum and Somerville, including all minor works .. .. .	1,600
Hastings and Tyabih .. .. .	1,000
Berwick and Beaconsfield, including service basins and all minor works .. .. .	4,900
Pakenham, East and West, including service basin and all minor works .. .. .	1,600
Valves and special fittings on reticulations .. .. .	1,000
	20,500
Purchase of land, easements for pipe lines .. .. .	1,000
Engineering and supervision .. .. .	3,000
	£11,000
Provision for contingencies .. .. .	5,000
Total .. .. .	£156,000

#### Estimated Annual Revenue.

From properties served, based on a minimum of 30s. per annum on all occupied allotments and a minimum of 1s. 6d. per annum on all vacant allotments with various ratings as under:—	
1s. 6d. in £1—	
At Carrum, Chelsea, and Aspendale .. .. .	£3,100
At Frankton and Seaford .. .. .	1,400
2s. in £1—	
At Mornington .. .. .	1,000
2s. 6d. in £1—	
At Berwick and Beaconsfield .. .. .	600
At Pakenham .. .. .	200
At Cranbourne .. .. .	200
At Somerville, Hastings, Tyabih, and Cris Point .. .. .	500
	7,000
From Naval Base for a supply as required at 1s. per 1,000 gallons, with a minimum annual payment of	
From railways and other sales of water by agreement .. .. .	4,000
	500
Total .. .. .	£11,500

#### Estimated Annual Expenditure.

Interest and redemption on cost of works, £156,000 at 5 per cent. .. .. .	7,800
Depreciation provision for wood and steel pipes, £100,000 at 2 1/2 per cent. .. .. .	2,500
Turncocks, three at £180 each .. .. .	540
Maintenance, repairs, and management .. .. .	1,100
Contingencies .. .. .	60
Total .. .. .	£12,000

(Taken at Melbourne.)

WEDNESDAY, 31st MAY, 1910.

Present:

Mr. RILEY, Chairman;

Senator Storey, }  
Mr. Fenton, }  
Mr. Gregory, }  
Mr. Finlayson, }  
Mr. Simpson.

Thomas Hill, Engineer, Department of Home Affairs, recalled and further examined.

223. To the Chairman.—The scheme for the supply of water to the Naval Base, as outlined by the State Rivers and Water Supply Commission, is practically that which was suggested to the Committee by the Commonwealth Director-General of Works and myself. It is only modified in detail as the result of further surveying and the estimated cost approximates the amount already submitted in evidence, namely, £160,000. The water- shed has been slightly reduced, but not so as to deteriorate from the scheme. The rough estimate was about 50 square miles, but it was practically unknown country, and the location of the creeks was not too well known. Surveys now show that an area of 39 square miles is sufficient. Back Creek has been excised, and the area has been reduced to include the main Bunyip River and Tin Creek. The only other scheme that approximates to it is the Notting Hill scheme—that is, taking water from Notting Hill and running it through a 9-inch pipe to the Naval Base, and paying 6d. per 1,000 gallons. That worked out at a minimum cost of £4,171 per annum as against the present offer of £4,000 per annum for a number of years, with a future possible reduction. As a matter of fact, the estimate in regard to the Notting Hill scheme would be under the

figure now, because the cost of cast iron pipes has increased from £8 15s. a ton to £10, according to some quotations we got the other day. The Notting Hill estimate was based on a daily consumption of 30,000 gallons, whereas under the present scheme we get 250,000 gallons for the same money. The cost of 60,000 gallons a day under the Notting Hill scheme would be £1,582, and the cost of 120,000 gallons per day would be £3,044; therefore we are getting double the quantity of water for the minimum estimated cost of any other scheme. I except Mr. Samble's scheme, which gives a minimum of £3,825 per annum for 120,000 gallons a day at 1s. 6d. per 1,000; or £7,000 for 250,000 gallons a day. As to the quality of the water, unless the Monbulk watershed was bought right out, the present scheme is incomparably better. Applying the test of the different schemes that have been put forward, it certainly works out best. Another advantage will be the fact that the money will be spent to better public purpose by giving a water supply to the whole of the peninsula, whereas in the case of the Notting Hill scheme the money would simply be spent on a separate supply for the Naval Base, an very much impressed with the amount of storage that researches have shown can be found under this scheme. For instance, a storage of 80,000,000 gallons is available within a few miles of the Base. At another point, a few miles further away, there would be a storage of 178,000,000 gallons. The country is suitable for storage reservoirs. The natural creek basins can be availed of by putting banks across them, obviating necessity for building expensive tanks. If the main failed anywhere except within the last mile or two there would be six months' supply quite close to the Base, and handy in case of any war trouble. The pressure is even better than was estimated. It was estimated that the reduced level above low water at the intake would be 330 feet, but we find that it is 410 feet, and from that point the water will run in an open race to the pipe inlet at a pressure of 380 feet, and will be delivered at the Base at a pressure of 160 feet. The scheme is gravitation throughout. There will be no need to pump from the intermediate reservoirs. There will be 220 feet pressure head at the reservoir, about 6 miles to the north of the Base, which pressure is reduced to 160 feet at a small service reservoir of 1,000,000 gallons to be provided near the Base, from which a 12-inch pipe will run to the Base and give a quick delivery in case of fire. This small service reservoir will be an excavation of about 6,000 cubic yards in good holding ground, which will need only a small skin of concrete slabs.

224. To Mr. Finlayson.—This scheme will deliver the water at this service reservoir. The Commonwealth will have to incur expenditure in providing the service reservoir of 1,000,000 gallons, and in putting down 2 miles of 12-inch piping to the boundary of the Naval Base. The State Rivers and Water Supply Commission will run their own separate main from the main reservoir to any settlement that may spring up around the Naval Base, so as not to interfere with any demand that might be made on the Naval Base main. The service reservoir will cost £1,000, and 2 miles of 12-inch piping will cost £4,000. Another half-a-mile of 12-inch piping will be required to carry the main from the boundary into the centre of the Base. The cost of that work and of the reticulation is now being estimated. I shall supply



the Committee with the figures. The Department recommends the adoption of the scheme submitted by the State Rivers and Water Supply Commission. It is the best that has been put forward.

225. *To Mr. Gregory.*—In previous evidence we indicated a desire to run the main further north in order to get out of the wet country, and enable the use of cheaper pipes. This has been done, and steel and wood pipes can be used, while it is proposed to use cement for a certain distance from the relieving basin towards the Naval Base. The pressure at that point will not be high; it will be almost an enclosed channel, to which the use of concrete will adapt itself very readily. Joints of concrete pipes are not satisfactory where there is high pressure, but they will be perfectly satisfactory in this case, where the main is practically a channel. There will be no trouble in regard to expansion or contraction once the water runs through. There might be trouble until the pipes are charged if they happen to be left uncovered on a very hot day. I am satisfied as to the use of cement pipes in this case.

226. *To the Chairman.*—The Naval Base will become the customers of the scheme at the service reservoir near the Base.

226A. *To Mr. Gregory.*—I have no hesitation in indorsing what the officers of the State Rivers and Water Supply Commission do. They have been very good. So far they have consulted us over the matter frequently. I have been in touch with Mr. Shaw right through. The scheme is practically that for which we have been working—a joint scheme—and it is a good one.

227. *To Mr. Sampson.*—Mr. Shaw and I do not think that the population around the Naval Base will be very large. At the present time it is not worth while putting in any reticulation for the people who are there, and I think that if the State Rivers and Water Supply Commission undertake that work the risk should be left to them. I do not think that we can look in that direction for any reduction in the cost of the water, but we ought to be able to look for a reduction through the increased consumption between Frankston and Aspendale. The area from Mordialloc to Mornington will be served, and the scheme is capable of extension at a not very high cost to Point Nepean. It can all be done by gravitation. The scheme has developed from the departmental scheme, following on a visit of the Committee to Westernport, where the objection to using the Bunyip River so low down was raised, and the suggestion was put forward that we should go to the head of the river. That suggestion has been shown to be perfectly practicable. In indorsing this scheme, we are indorsing our previous scheme with certain modifications, due to a better knowledge. A pressure of 160 feet is quite sufficient. It is all that we ever considered necessary. It will give a pressure at the top of the tallest building at the Naval Base.

228. *To the Chairman.*—The State Rivers and Water Supply Commission estimate that they will receive a revenue of £6,000 per annum from the area between Frankston and Mordialloc, but I think that before long that revenue will increase, and any additional increase will be obtained with practically no further expenditure. As that revenue increases the Commission ought to be able to consider the question of reducing the annual charge to the Commonwealth.

229. *To Mr. Gregory.*—It is understood that the annual payment of £4,000 will commence from the time when the supply is made at the service reservoir. All proportions of interest have been allowed for in the capital cost. The cost per 1,000 gallons on a population of 3,000 at the Naval Base, consuming 40 gallons per head per day, will be under 2s.

230. *To Mr. Sampson.*—All along I have indicated that the estimated consumption of water was over the mark. I have said in evidence that 50,000 gallons a day would be sufficient for the next five years, and 60,000 gallons a day for the following five years, while 120,000 gallons would be close upon the maximum consumption, taking everything into consideration, the supply of water to ships and the provision for workshops. It must be remembered that the men at the Naval Base will mostly be single.

231. *To the Chairman.*—Speaking as a departmental officer, and speaking from my personal point of view, the scheme submitted by the State Rivers and Water Supply Commission is the best.

THURSDAY, 1st JUNE, 1910.

Present:

Mr. HUXLEY, Chairman:

Sonator Story,	Mr. Gregory,
Mr. Fenton,	Mr. Sampson.
Mr. Finlayson,	

William Cattanel, Chairman, Victorian State Rivers and Water Supply Commission, sworn and examined.

232. *To the Chairman.*—Mr. Commissioner Shaw drew up the scheme for a water supply for the Flinders Naval Base, which has been submitted to the State Rivers and Water Supply Commission, of which I am Chairman. We have examined all the details of the scheme very closely, and with certain alterations, in which Mr. Shaw concurred, we are agreed that the scheme is one which can be approved. I understand that a copy of it has been presented to the Committee. The details are shortly that, assuming that money can be obtained at 5 per cent. to cover the rate of interest of, say, 4½ per cent., with ½ per cent. for redemption, and allowing for 2½ per cent. for depreciation, we believe that the scheme would carry itself after a year or two on payment by the Commonwealth of an annual sum of £4,000, say, for three years, and after rates had been levied on the coastal towns, an annual payment of £3,500 for the next three years. After the second period of three years the service could be continued in operation for a minimum payment by the Commonwealth of £3,000 per annum, and a charge for the water supplied to the Naval Base at the rate of 1s. per 1,000 gallons. To operate the scheme on this basis, we should require to levy a rate of 1s. 6d. in the £1 on the seaside towns of Carrum, Chelsea, Aspendale, Frankston, and Seaford; a rate of 2s. in the £1 on Mornington; and a rate of 2s. 6d. in the £1 on the townships of Berwick, Beaconsfield, Pakenham, Cranbourne, Garfield, Hastings, Tyabb, and Crib Point. In connexion with the rating of the towns mentioned there would need to be a provision for at least a minimum charge of 30s. per annum for every house—quite a number of the houses affected

would be very small, practically week-end shacks—and a minimum charge of 7s. 6d. for each vacant allotment of land anyways adjacent to the pipe lines. Assuming the rate of interest I have mentioned, we estimate that the revenue would be about £11,500 a year at first, and the expenditure £12,000 a year. That means an apparent loss of £500 a year. That is only an estimate, and we feel that the scheme is a big affair, fraught with untold advantage to the Commonwealth and to ourselves. It will be of great advantage to the extent that will be affected. The estimated total cost of the scheme is £180,000. Mr. Shaw has set out in details, which can be checked, the various lengths of pipes, mains, and other items that go to make up the estimated cost. The source of supply is from the Bunyip River, a long way above the level of the Koo-wee-rup Swamp. We have had the water analyzed, and it is about equal to the water supplied to Melbourne itself. We have had the flow in the river gauged, and on the supply for the driest year of which we have any records, there is a large volume of water passing the point from which we will take the water for this scheme. If the money could be provided on the terms assumed, and if there were no serious industrial troubles—and one has to make that reservation nowadays—we believe that we could get the water down to the Flinders Naval Base in twelve months' time. I accentuate the condition that there should in the meantime be no serious industrial trouble. I think there would be no difficulty in securing the pipes. We should make a point of providing for the supply for the Naval Base as the first branch of the work. The idea is to have a large basin which would make the supply for the Naval Base practically safe, and it is further suggested that there should be a service basin close to the Naval Base, and entirely under the control of the Commonwealth. We are quite prepared to construct this small basin, and it would not cost a great deal of money. We consider that it would be better that the Naval authorities should have this small service basin entirely under their own control. As a part of the scheme, we should also have a large basin to cover the supply to the seaside towns, so that during a time of stress—an exceptionally dry time when there would be a big drain upon the supply—this basin could be kept full and the supply kept going. So far as we could check the scheme there appears to be not the slightest chance that it would break down. It seems to be ample for a good supply of water, and judging by the rates that are charged by the State Rivers and Water Supply Commission in other places, the rates proposed under this scheme are not considered unreasonably high. Of course, when a rate of 2s. 6d. in the £1 is imposed, we are reaching the point at which people are likely to begin to grumble, and it may take considerable persuasion to induce some of the towns referred to to agree to come into the scheme. It will, however, be important for those concerned to remember that if they do not come into this joint scheme they cannot hope to secure a water supply for a very considerable time. In the same way, if the Naval authorities do not join in this scheme with the towns which have been referred to, the annual cost of a water supply for the Flinders Naval Base must be much higher than the cost at which it can be supplied under this scheme. I should like to emphasize the fact that the main item of expenditure under the scheme is the item of interest. If that is to be higher than the interest we have

assumed, the effect of course will be to alter the whole of our figures. We believe that if we can get the money at anything like 4½ per cent., we shall be able to continue the operation of the scheme for three years with a payment of £4,000; for the next three years with a payment of £3,500, and after that for an annual payment of £3,000, and a rate to the Naval Base of 1s. per 1,000 gallons. If the rate of interest should go up from 4½ per cent. to 5 per cent., we should have to ask the Commonwealth to give us a guarantee of £1,000 per annum for five years, £3,500 per annum for a second term of five years, and after that £3,000 per annum with the rate mentioned. We quite recognize that this is a national obligation, and we have not in any way tried to load one section of those served by the scheme on against another. We have tried to hold the balance as fairly as we could. I think that Mr. Shaw has succeeded admirably in the scheme he has submitted. He is himself quite sure that it can be carried out successfully, and he has had a very extensive experience in connexion with schemes of this nature. I have spoken to Sir Alexander Peacock, the Premier of the State, on the subject of the scheme, and have explained the position to him. It is rather keen about getting the scheme going. He authorized the Under-Treasurer and myself to join the Committee in discussing the matter with Mr. Higgs, the Commonwealth Treasurer, to see exactly what can be done in the way of providing the necessary funds. At the present time I do not think it is possible for the State Government to get very much money independently of the Federal Government. You have suggested that the money might be obtained from the Commonwealth Bank, and on that point I would like to say that it must be borne in mind that the money for this scheme would be money lent to the State, and not to the particular body of which I am a member. I am not aware that the State Government of Victoria has at any time borrowed money from the Commonwealth Bank, and before expressing an opinion upon the suggestion made, I should prefer to consult Sir Alexander Peacock and the Under-Treasurer. It seems to me that the difficulty, if there be any, might be overcome by the Federal Government borrowing the money required from the Commonwealth Bank, and lending it to the State Government. I am not quite sure as to how the State Government would view borrowing from the Commonwealth Bank as against borrowing from the Commonwealth Government. I feel sure that there would be every disposition to do all that is possible to expedite the carrying out of the scheme. Steps will, of course, be taken to sound the local authorities concerned on the subject of their jointing in with the scheme. There may be some who will not like to approach them on the matter until there was good reason to believe that the scheme would be gone on with.

233. *To Mr. Sampson.*—The success of the scheme is dependent upon the places which have been mentioned coming under it. Their inclusion is an essential part of the scheme. There can be no doubt that the Commonwealth Government will secure a water supply for the Flinders Naval Base more cheaply by having the towns mentioned included in the scheme, and the towns will secure their water supply more cheaply by having the Commonwealth Government included in the scheme. It will take two or three years to complete the scheme, but if the money required is

available on the terms stated, we would start with the line to the Naval Base first. If only one or two of the small towns failed to come in, it would not materially affect the scheme. Apart from the usual protests which are always received upon the initiation of such a scheme, I do not expect that there will be very much trouble in inducing the towns to come in. I believe that they will very soon be willing to fall into line, but I should not like to force the situation upon them until I know that the scheme was fairly certain to be carried out.

234. *To Mr. Finlayson.*—There are four or five local authorities concerned in the proposed scheme which is contingent upon those local authorities and the Commonwealth Government coming in under it on the basis proposed. If either fail to do so, the scheme will fall. It would be possible to arrange a conference with the local authorities concerned at a week's notice, as soon as the financial question was cleared up.

235. *To Mr. Sampson.*—We require a guarantee of £4,000 per annum from the Flinders Naval Base for the first three years, and a guarantee at a lesser amount in subsequent years. But we also require a guarantee from the towns that would be served by the proposed scheme. That guarantee would be provided for under our Water Acts, which compel us to impose a rate each year. I have mentioned the rates on which the scheme is based, and that there will be a minimum rate for each house of 30s. per annum and a rate of 7s. 6d. for vacant land. Taking into account the average use of water by the average household, these rates will represent a higher charge than 1s. per 1,000 gallons, the charge proposed to be imposed upon the Commonwealth Government. One thousand pounds per annum is the estimated revenue from Mornington, from the rate of 2s. in the £1 proposed under the scheme. I do not think that the minimum guarantee required from the towns is any less than that required from the Commonwealth Government in respect of the Naval Base.

236. *To Mr. Gregory.*—It would not do to fix a rate for the Commonwealth Government at 2s. in the £1 on buildings at the Naval Base, valued at £100,000.

237. *To Mr. Sampson.*—Under the scheme, after six years have passed, the minimum guarantee required from the Commonwealth Government is £3,000, with the addition of the rate of 1s. per 1,000 gallons. This means that the guarantee must cover a minimum supply at the rate of 1s. per 1,000 gallons up to £3,000, and any more

water supplied must be paid for at the rate of 1s. per 1,000 gallons. We have very carefully examined the details of the scheme, and are absolutely satisfied that there is sufficient water passing our diversion point to even insure another efficient supply. In any case, the supply of water to the Flinders Naval Base is a national necessity. I think the Defence authorities could command a supply for the service of the Naval Base whether we liked it or not. But I feel sure that the State Rivers and Water Supply Commission would not have the slightest hesitation in saying that the Naval Base should have the first call upon the water supplied under this scheme. I believe there will be no hesitation on the part of the State Government or of the State Rivers and Water Supply Commission to concede that right.

238. *To Mr. Fenton.*—In the event of a considerable increase in the permanent population of the towns to be served under the scheme, and the construction of permanent buildings for the accommodation of the increased population, the minimum payment by the Commonwealth would still remain at £3,000 a year. But should the revenue from the other wing be materially increased in the way suggested, I am prepared to say that it would be unfair to unduly reduce the rating of the seaside towns and at the same time keep the Commonwealth contribution on a permanent basis. Any reduction made as the result of development of the districts served should be a general reduction on the basis of the contributions provided for under the scheme as now proposed. Our railway returns from such places as Chelsea, Aspendale, and other seaside towns indicate that the development of those places during the last four or five years has been something wonderful.

239. *To Mr. Finlayson.*—The estimate of cost includes £1,000 for the construction of a service reservoir at the Naval Base. It is proposed under the scheme to deliver the water in that reservoir, and the responsibility of the Commonwealth will begin from that stage.

240. *To Senator Story.*—Payments by the Commonwealth under the scheme would start when the water was supplied to the service reservoir at the Naval Base.

241. *To the Chairman.*—All the money required to give effect to the scheme would not be needed at once, but as the work progressed. The small basin which has been referred to would be entirely for the use of the Naval Base and under the control of the Naval authorities.