PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS.

Papers to be laid on the Table

of the

S e n a t e.

R E P O R T

together with

Minutes of Evidence and Appendix,

relating to the proposed

STORAGE AND REGULATING RESERVOIR, UPPER QUEANBEYAN RIVER.

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COMMONWEALTH OF AUSTRALIA.

PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS.

REPORT,

TOGETHER WITH

MINUTES OF EVIDENCE AND APPENDIX,

RELATING TO THE PROPOSED

STORAGE AND REGULATING RESERVOIR, UPPER QUEANBEYAN RIVER.

PRESENTED TO PARLIAMENT IN ACCORDANCE WITH THE PROVISIONS OF THE COMMONWEALTH PUBLIC WORKS COMMITTEE ACT 1913-14.

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MEMBERS

OF THE

PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS.

FIRST COMMITTEE:

EDWARD RILEY, Esquire, M.P., Chairman.

SENATE.	HOUSE OF REPRESENTATIVES.
Senator the Honorable JOHN HENRY KEATING.	JAMES EDWARD FENTON, Esquire, M.P.
Senator PATRICK JOSEPH LYNCH, Vice-Chairman.	WILLIAM FYFE FINLAYSON, Esquire, M.P.
Senator WILLIAM HARRISON STORY.	The Honorable HENRY GREGORY, M.P.
	SYDNEY SAMPSON, Esquire, M.P.
	WILLIAM HENRY LAIRD SMITH, Esquire, M.P.

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PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS.

PROPOSED STORAGE AND REGULATING RESERVOIR, UPPER QUEANBEYAN RIVER.

REPORT.

THE PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS, to which the House of Representatives referred for consideration and report the question of the construction of a storage and regulating reservoir on the Upper Queanbeyan River, has the honour to report as follows :—

OBJECTS OF THE SCHEME.

1. The provision of a dam on the Queanbeyan River is one of the works laid down in the progressive scheme of Federal Capital construction.

2. The objects to be attained by the work are :—

(*a*) To maintain the flow of the Molonglo River throughout the year;
(*b*) To provide water throughout the year to compensate for evaporation and absorption in the ornamental waters at the City site;
(*c*) To provide a uniform flow so that circulating water will be assured for the condensers for the power station; and
(*d*) To reduce the volume of flood waters at Canberra Plains during heavy rainfall on the Queanbeyan catchment area.

DESCRIPTION OF THE PROPOSED WORK.

3. It is proposed to construct a concrete dam on the Queanbeyan River at a point known as Studdy's, about 6 miles up-stream from the town of Queanbeyan. The wall will be about 100 feet high from the bedrock to the crest, and of a length along the crest of approximately 560 feet. It will be nearly 100 feet thick at its base, and about 48 feet thick half-way up.

This dam will impound a sheet of water with a surface area of about 1 square mile, reaching up-stream about 7 miles, and will have a capacity of about 6,400,000,000 gallons.

THE ESTIMATED COST.

4. The estimated cost of erecting such a concrete dam of the ordinary type section is about £100,000.

COMMITTEE'S INVESTIGATIONS.

5. The Committee having heard official explanations of the scheme visited the site of the proposed dam in company with the Commonwealth Director-General of Works, the Director-General of Public Works, New South Wales, the Federal Capital Director of Design and Construction, and the Departmental Engineer, and subsequently took evidence from the gentlemen mentioned, as well as from the Administrator of the Federal Territory, and from representatives of the Municipal Council of Queanbeyan.

6. All the engineers are agreed that the site is in a favorable position, and this being so, the Committee turned its attention more particularly to a consideration of the stated purpose of the work and whether necessity exists for carrying it out at the present time.

7. Attention was given to a suggestion that, in the event of the dam being constructed, advantage might be taken of the existence of the reservoir to provide a water supply from that point to the town of Queanbeyan. Inquiry from the Attorney-General elicited the opinion that there would not be any constitutional objection to the Commonwealth and the local government authority of Queanbeyan jointly entering into a scheme for the carrying out of a water supply for the Territory and Queanbeyan. (*Vide* Appendix.)

8. The revenue the Commonwealth might expect to obtain from this arrangement, however, would be small, as there are said to be only 300 ratepayers in Queanbeyan, and the suggestion might be considered as subsidiary to the main work if carried out, as an adequate water supply for Queanbeyan could be obtained from the same river by the construction of a much smaller dam at considerably less expense.

9. The Committee is satisfied from the evidence given before it that the construction of a dam in the position proposed will assure a regular flow in the Molonglo River, and have the effect of conserving, and to some extent controlling, flood waters, which is eminently desirable. At the same time, the Committee is of opinion that no sufficiently strong reasons were brought forward to show that urgent necessity exists for the work to be carried out, at any rate for some years to come.

It is probable that the population in the Federal Territory will be limited for the next five years, and existing or possibly further temporary storage arrangements will be sufficient for requirements during that period. Furthermore, any delay in the construction of the proposed dam will not interrupt or interfere with the carrying out of any permanent works.

10. In the course of its inquiries the Committee learned that the construction of a dam on the Queanbeyan River in the position now proposed would be followed later by the construction of at least one, and possibly two, dams on the Molonglo River if the levels of the proposed ornamental lakes within the city area are to be preserved. Under these circumstances the Committee is of opinion that the question of the construction of all the dams needed for the artificial lake scheme of the city should be submitted to it simultaneously in order that, if such works be considered necessary, a recommendation may be made as to the date and sequence of their construction.

11. It was also brought prominently under notice in evidence that about 60,000 casks of cement will be required for the Queanbeyan dam alone, while the whole of the works proposed for the Federal Territory will involve the use of about 50,000 casks of cement per annum for a period of 10 years. It was stated in evidence by the Departmental engineers that cement could be manufactured by the Commonwealth adjacent to the Federal Territory at 10s. per cask, as against the present price of 14s. 7d. per cask, delivered in the Territory. The Committee is of opinion that for Federal works the Commonwealth should make such arrangements as will insure an adequate and continuous supply of cement at a reasonable rate.

CONCLUSION.

12. Taking all things into consideration, the Committee is of opinion that, although the construction of the dam will eventually be necessary if the scheme of providing ornamental lakes within the city area is to be adhered to, there is no present necessity or urgency for such work.

13. 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 proposal to construct a storage reservoir on the Queanbeyan River, but does not consider the work urgent or immediately necessary. Seconded by Senator Story.

Mr. Sampson moved as an amendment That as the construction of the Queanbeyan dam is so intimately connected with the formation of the artificial lakes, and the cost saved in the event of the works relating thereto, both schemes can only be adequately considered in conjunction one with the other, consequently until this can be done, the construction of the Queanbeyan dam be postponed. Seconded by Senator Lynch.

The Committee divided on the amendment—

Ayes, 3.	Noes, 6.
Mr. Sampson,	Mr. Fenton,
Senator Lynch,	Mr. Finlayson,
Mr. Gregory.	Mr. Riley,
	Mr. Laird Smith,
	Senator Keating,
	Senator Story.

And so it passed in the negative.

The motion was then put. The Committee divided—

Ayes, 6.	No, 1.
Mr. Riley,	Mr. Sampson.
Mr. Fenton,	
Mr. Finlayson,	
Mr. Gregory,	
Mr. Laird Smith	
Senator Keating,	
Senator Lynch,	
Senator Story.	

And so the motion was resolved in the affirmative.

Edward Riley

Chairman.

Office of the Parliamentary Standing Committee on Public Works,
120 King-street, Melbourne,
17th March, 1915.

PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS.

MINUTES OF EVIDENCE.

STORAGE AND REGULATING RESERVOIR, UPPER QUEANBEYAN RIVER.

(*Taken at Melbourne.*)

THURSDAY, 28TH JANUARY, 1915.

Present:

Mr. RILEY, Chairman;

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

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

1. *To the Chairman.*—I have prepared the exhibited plans for the storage of water for Canberra. It will be seen that the river Molonglo passes through the centre of the city site in a westerly direction, and is formed of two streams junctioning at Queanbeyan, the Molonglo and Queanbeyan Rivers. The Molonglo is subject to periods of cessation of flow as I shall shortly show by reference to the gaugings which have been taken. It is also subject to heavy floods, especially on the Canberra plains from Queanbeyan to the city boundary. At times these floods bring down a large quantity of silt. The proposal is to conserve the flood flow—and so reduce the severity of the floods—and by conserving this water to maintain the flow of the river, and also make good the evaporation which will take place over the area comprised in the lakes. The lower lake, which is shown in blue on the map, comprises an area of about 3 square miles. The other lake—that is the lake which has been suggested by Mr. Griffin—has an area of 2½ square miles. On the basis of 36 inches a year an evaporation of 1 inch per day over a square mile would represent 14,500,000 gallons, so that an evaporation of ½ an inch per day on an area of 3 square miles would represent about 20,000,000 gallons per day. To make good this evaporation, and to cut down the floods, it is proposed to construct a reservoir on the Queanbeyan River at a point known as Stoddys, about 6 miles up stream from the town of Queanbeyan. This, with a wall about a hundred feet high, would hold about 6,400,000,000 gallons. A survey has been made of the site of the Queanbeyan reservoir. It is a very nice basin, and represents on the surface an actual square mile when full. It has a good dam site between two hills, with a crest length of about 500 feet. We are just sinking holes for the purpose of testing it, and so far the results have been very good. On the right bank, test holes have been sunk, and rock has been found close to the surface. Similar holes are being sunk on the left bank, where it is expected that similar results will be obtained. The estimated cost of erecting a concrete dam of the ordinary type section would be about £100,000. The Administrator of the Territory is obtaining a valuation of the land, and will be in a position to supply that information at a later stage. The dam will be on private property, but the Commonwealth has riparian rights over the Queanbeyan and Molonglo valleys—valleys acquired by virtue of the Federal Constitution. Early in 1912, when this site was selected by the Director-General of Works, a small concrete weir was placed across the stream for the purpose of gauging the flow, and the result may be seen on the two diagrams now before the Committee. They set out the daily gaugings of the river—of course, I am referring to the flow in the Queanbeyan. We commenced to take gaugings in January, 1912. The vertical coloured lines on the diagrams show the discharges in millions of gallons per day. It will be seen that on some days it was 160,000,000 gallons, and on other days 200,000,000 gallons. As a matter of fact, it went beyond our gauge. It is difficult in floods to measure the velocity of these streams. The red dotted line on the diagram shows the evaporation over the 3 square miles of lake, and the information contained therein will enable a good comparison to be instituted between the flow of the river and the evaporation. It will be observed that from the 13th January, 1912, to the 31st January of that year, the river ceased running, as it did again from the 28th January, 1913, to the 3rd February of the following year. Again, from the 5th January, 1914, to the 20th March of the same year it ceased running. That was followed by a flood which would have filled the proposed reservoir.

2. *To Mr. Finlayson.*—The sudden rises are due to the heavy winter rains. There are not sudden falls. The winter floods are needed to bridge over the gaps during the summer. Sufficient rain falls during the winter to fill the reservoir, thus making the water available during the summer, to make good any loss in evaporation and to keep a freshening flow through the lake. The winter floods are regular. The rainfalls at different points within the area are shown on the diagram. There is a rain gauge at Sunnybrae, and another at Toogong. Each division on the map represents an inch of rainfall. I may add that we have another gauge on the Molonglo just about the western boundary of the city, and it is exactly the same size as is the gauge on the Queanbeyan, so that by a comparison between any two days we can ascertain the loss from the Queanbeyan in flowing through the city site plus the discharge from the Molonglo. The total capacity

of the reservoir will be about 6,400,000,000 gallons. We have had floods down the Queanbeyan of 9,000,000,000 gallons and 10,000,000,000 gallons, and the sum of these would be more than enough in any one year to fill the reservoir.

3. *To Mr. Sampson.*—The total yearly flow of the Queanbeyan amounts to 9,000,000,000 or 10,000,000,000 gallons, but that is during dry years. We expect much bigger flows during wet years.

4. *To Senator Lynch.*—The evaporation at the reservoir and on the lake at the city site would be about the same—about 36 inches annually.

5. *To Mr. Sampson.*—The lake in the city site would be about 1,825 feet above sea level, and the crest level of the dam on the Queanbeyan would be 2,110 feet above sea level—a difference of 285 feet. The reservoir will be 100 feet high, so that the actual difference between the river bed at the site of the suggested dam and the lake level in the city would be about 185 feet. It is intended to store the flood waters for the purpose of covering losses by evaporation, and of keeping the river freshly flowing.

6. *To Mr. Finlayson.*—It has been suggested that another concrete dam should be erected at a point near Yarrolumla, and it will be 80 feet high. The construction of that dam with gates upon it would cost £75,000. Both dams are necessary for this scheme.

7. *To Senator Lynch.*—The settlement on the watershed comprises about 300 persons, who are to be found mostly at the source of the river. Queanbeyan is pressing to get a water supply from the Federal Capital, and this will be a handy source from which to get it. If we wish to guard against the pollution of the watershed area we must work through the Government of New South Wales. The Commonwealth has the right to ask them to arrest pollution at any time. An analysis of the water has been made by the New South Wales Public Works Department, which has recommended that a water supply should be provided for Queanbeyan, using the Queanbeyan River for the purpose, and erecting a little dam at the spot on which we propose to erect this larger dam. The New South Wales Works Department has reported that the quality of the water is good.

8. *To Mr. Fenton.*—There would have to be a cast iron pipe from Queanbeyan to the reservoir so as to provide the required head of water. The dam site is 2,010 feet above sea level, and Queanbeyan at the bridge is about 1,850 feet. The distance between these two points is 6 miles.

9. *To Mr. Finlayson.*—The population of Queanbeyan is about 1,500, so that the quantity of water which they would use would be really negligible, when the size of the proposed reservoir is considered. The nature of the country generally is tertiary, with buttress rocks of volcanic origin projecting through it. The rainfall averages about 22 inches annually throughout the watershed, but the minimum fall a little while ago was only 10 inches. It was more than this at its source. I believe that it was about 14 inches there. At the head of the range it might be 40 inches.

10. *To Mr. Sampson.*—The water supply gathers all the way along, but the chief supply is about half way down the watershed. The steady run is to be found in the upper half of the watershed even in the winter.

11. *To Mr Finlayson.*—I estimate that a storage capacity of 6,400,000,000 gallons is necessary to enable us to tide over more than one year Experience in Australia has shown us quite recently that for a reservoir to contain only one year's supply of water is not sufficient.

12. *To Mr. Gregory.*—The projected reservoir would hold a supply sufficient for two years, and would thus enable us to tide over one bad year. It would not matter if the lake at the Capital did recede a few inches in a bad year. It is not as if the residents would be depending upon it for their supply each day. If it did fall a few inches it would be only for a little time until the winter rains set in.

13. *To Mr. Fenton.*—I am afraid that the influence of a comparatively small expanse of water like the lake would not tend to increase the rainfall of the locality. It might possibly encourage the humidity of the area comprised in the city proper, but it would not do more.

14. *To Mr. Finlayson.*—It is the upper portion of the reservoir which really stores the water. If, instead of the dam being 100 feet in height, it was only 70 feet, its capacity would be approximately 1,800,000,000 gallons instead of 6,400,000,000, and the difference in cost would be about £20,000 Economy could not be effected after the dam had been built, because if we contemplated adding to it it would be necessary to make the base big enough to carry the larger dam. If a foundation were laid down sufficiently strong to carry a dam 100 feet in height, I doubt if the saving would amount to £20,000. I do not think it would be more than £6,000 or £7,000. When once the foundations are in, the actual mass of concrete is not so costly.

15. *To the Chairman.*—A smaller dam practically of the same type is now up 20 feet at the Cotter River. According to Vegmann's standard, if you have a dam of a certain height, and a certain water pressure, you must have a base proportionate to its height. We are now considering a proposal to use the city mains as a sort of electric sink, just as destructors in Melbourne are being utilized to burn refuse, and any current generated is discharged into the mains.

16. *To Senator Lynch.*—The total area of the valley of the Queanbeyan and Molonglo watersheds is something under 600 square miles. The area of the Queanbeyan watershed, which is proposed to be taken in with the other lake, comprises about 325 square miles.

17. *To Mr. Finlayson.*—The lake is a feature of Mr. Griffin's scheme regarding the laying out of the city. So far, consideration of any scheme has been confined to the city area proper, but competitors were informed in the details of the competition for the Capital design that there was a sufficient flow to retain the levels of the lakes. Speaking from memory, they were told that a run of 1,000,000 gallons per day was guaranteed. It was contemplated by the original Board that storage would have to be provided in the Queanbeyan and Molonglo basins; otherwise the flow could not be guaranteed all the year round. The Molonglo basin gives a very muddy discharge—much muddier than does the Queanbeyan. It has been examined with a view to ultimately placing a storage basin near Burbong. But its capacity is small, and as a lot of very good ground would be covered, it is not proposed to proceed with it immediately.

18. *To Mr. Sampson.*—The object of that scheme would be to prevent the destructive rushes from the heavy rain storms, to catch them in the reservoir, and to afterwards lower them down the stream in an even flow. Even in the absence of a lake, it would be necessary to store the flood waters and to retain the flow of the river. As I have already shown, it ceased to run on one occasion for a very long period.

19. *To Senator Lynch.*—The departmental view of the existing condition under which dual control is exercised is that the Queanbeyan watershed and the town of Queanbeyan itself should become Commonwealth property. Queanbeyan ought to be put absolutely under Federal control, the same as has been the other portion of the Territory. We have control of the Cotter watershed for example, but we have not control of the Murrumbidgee, which extends a distance of some hundreds of miles to its source. Of course we have control of it within our own Territory, but it is very doubtful whether we could stop the flow of the water. The experience of the past in regard to the dual control of the area over which the Commonwealth has riparian rights is that, with the exception of the town of Queanbeyan, the population is so small that no harm has resulted But if Queanbeyan itself had been Federal Territory, I have no doubt it would have been sewered ere now, and that it would have had a water supply of its own. We should then have been able to prevent the serious pollution of the Molonglo River. I may mention that there is also a cemetery right on the banks of that river, and that cemetery should have been closed. An application was recently made for sovereign rights over this particular area, and I saw a letter the other day in which the New South Wales Government refused to grant the request. Generally speaking, that country is not suited for closer settlement. It is rough, precipitous country, which is only suited for grazing. Of course, there are some small flats which will grow very good lucerne, but these are so small that they are practically of a negligible character.

20. *To Mr. Finlayson.*—The New South Wales Government will not object if we purchase the land necessary for the basin in which to store the flood waters. Our riparian rights carry with them the right to construct the dam. The State has always given us the land which we required when it was Crown land, and when we had to purchase the freehold we have had to indemnify the private owners.

21. *To Mr. Sampson.*—The only persons who might object to our action would be the people of Queanbeyan, and if they got a water supply they would raise no objection.

22. *To Mr Laird Smith.*—If the Committee decide that this is a proper work to proceed with, I propose to submit a report in which I shall recommend that the inhabitants of Queanbeyan be granted a water supply free of charge. Of course, the Shire would be required to lay the pipes and do all the work.

23. *To Mr. Fenton.*—We would only have the right to prosecute anybody for polluting the stream along its course through the New South Wales Government. We should have to make representations to them.

24. *To Mr. Sampson.*—The agreement with the New South Wales Government in respect of riparian rights over the Territory is embodied in a Statute.

25. *To the Chairman.*—I have plans in pencil showing how the dam will be constructed. I could supply plans of suggested sections showing size, &c., but I am always a little dubious about giving an estimate within £10,000 or £20,000 until all necessary holes have been sunk on the rock.

26. *To Mr. Finlayson.*—We have the materials to hand for making concrete, and that fact has considerably reduced the cost that would otherwise have to be incurred.

27. *To Mr Laird Smith.*—There is limestone country in the vicinity of the Capital site At a point called White Cliffs, on the Queanbeyan River, near Queanbeyan, we are putting down some shafts to test its quality, but the result has not been too good There are, however, deposits of limestone in the city site, and at the Cotter River; and the Canberra plains are known as the limestone plains. There are extensive outcrops of limestone all through these plains, and there is a tremendous outcrop just outside the Territory near Bungendore, at a place known as Fairy Meadow All through this country there are outcrops of limestone and marble.

28. *To the Chairman.*—A report was submitted to the Minister some nine months ago by the Director General dealing with the question of the advisableness of the Department manufacturing its own cement. The question is now being revived with a view to supplying not only the requirements of the Federal Capital, but of the Commonwealth Government. Large works such as sewerage and water supply at the Capital are to be constructed with cement.

29. *To Mr Laird Smith.*—It is excellent country for carrying out concrete work inasmuch as there are splendid gravel beds available. Cement delivered on the Cotter is worth about 20s. per cask. At the proposed site of the dam it will cost about 16s. per cask.

30. *To Senator Story.*—We consider that we could make cement for about 10s. per cask. That would mean a saving of 6s. per cask. Six casks go to the ton. The cost of cement delivered in the trucks at Queanbeyan is 14s. 7d. per cask. The Commonwealth Cement Company—that is the Portland Cement Company—have behaved very well to the Commonwealth. They have splendid beds of limestone and silica there.

31. *To Mr. Finlayson.*—It is estimated that the cost of establishing cement works would be £50,000.

32. *To Senator Story.*—We get silt deposits on the upper reaches of the Molonglo and in process of time—in hundreds of years—there will be considerable accumulations of it. The best means of preventing considerable quantities of silt finding its way into the dam would be to afforestate the watershed area. But whilst it is denuded of timber, and rabbits infest it, it naturally becomes dusty during long dry periods, and after the first rain falls it inevitably becomes muddy.

33 *To Senator Lynch.*—Water from the lake will be taken to the city site by opening the sluices, and letting it run down the river. If that method were found objectionable it would be an easy matter to put in a pipe In connexion with this scheme there will be no pipes other than those required to provide a water supply for Queanbeyan.

34. *To Mr. Finlayson.*—This scheme has not been objected to by the Department. It is really an initial proposal.

35. *To Senator Lynch.*—I do not think that we shall encounter any trouble with the New South Wales Government in the carrying out of the work.

36. *To the Chairman.*—If we were to delay carrying out these large works until the Commonwealth were in a position to manufacture its own cement we should arrest their progress for two years. The two great makers of cement machinery in the world are Smidth, of Copenhagen, and Krupp, of Germany. But quite apart from the war, fully eighteen months would be required to get any ordinary cement works into running order. The

Department has always been able to obtain supplies of cement, but it has never been able to get it from New Zealand cheaper than it can purchase it in the Commonwealth. Commonwealth Portland cement is of a beautiful quality. There is nothing better made.

37. *To Mr Finlayson.*—I am prepared to proceed with the erection of the dam immediately the necessary authorization is given. We have sixteen men at work there now. It would take about eighteen months to erect and would employ about 80 men. I would not lay down a portable tramway to give access to the dam, because we have a very fine traction plant, and there would be an objection raised to running a tramway through the streets of Queanbeyan to the city. This is not only a cement proposition involving about 10,000 tons of cement, but we require access for the tradespeople supplying the workmen.

38. *To Senator Lynch.*—The Commonwealth Cement Company produces an article equal to any imported, and superior to a good many of the imported cements. It is very even in its quality and can be used for every purpose. Its works are at Portland, in New South Wales.

39. *To the Chairman.*—It is the same formation which runs through the limestone country of which I have spoken. The Department has tested that country for coal towards Jervis Bay.

40. *To Senator Lynch.*—I do not think that we can produce sufficient cement at present to supply the local demand. The Geelong people and the Portland Company cannot supply the demand. It is not a question of price, but of supply.

41. *To Mr. Gregory.*—I cannot estimate the cost of all the work in connexion with the lake and the reservoirs. The cost of the Queanbeyan dam I put down at £100,000, and that of the other dam at £75,000. But the amended plan of Mr. Griffin is not before us, so that I do not know what the proposition is regarding the treatment of the banks of the lake. Consequently I cannot say what would be the total cost of the scheme. I have not the slightest idea whether it will exceed £250,000.

42. *To Mr. Sampson.*—The only quotation for cement which the Department has obtained is that from the Commonwealth Cement Company, whose price is 14s. 7d. per cask in truck at Canberra. That price has held good for the last two years, notwithstanding all fluctuations. When cement was 16s. and 17s. per cask in Sydney, the company did not raise the price to the Commonwealth. Before the Commonwealth could erect cement works of its own the Queanbeyan dam would have been completed. But I doubt whether the other reservoir will be built for many years. To construct the lake at the Federal Capital in the early stages of its history would interfere seriously with the progress of other works. Consequently, I do not think that we shall see it in our generation. The sewerage works of the whole city will consist chiefly of concrete, and it is also expected that concrete will be largely used in the erection of houses there owing to its cheapness. The Department can see that it will require 50,000 casks of cement annually for the next ten years, or 500,000 casks. The question of supplying private people with cement has also arisen, but it is doubtful if the Commonwealth can do that.

43. *To Mr Finlayson.*—Urgent reasons exists for proceeding with the projected dam, even though the lakes at the capital will not be required within our lifetime. The work is essential to keep the river running. Even if no lakes were to be formed, the dam will be required to regulate the flow of the Molonglo, and to prevent damage during flood time.

44. *To Senator Lynch.*—We have no idea of deriving a revenue from this work. We do not contemplate it for the purpose of cheapening lighting and traction power within the city. The cost of providing a turbine, generator, and mains might eat up in interest anything that we might get from the flow of the river for the purpose of generating electricity. We can generate electricity at the power-house for 1d. per unit. The power-house is in the centre of the city about three-quarters of a mile from the site of the Parliament House. Electricity is generated in Melbourne with Wonthaggi coal for ½d. per unit. I cannot say whether the carrying out of this work will enable us to provide cheaper power for the Federal Capital. I am just going into that question. By the time that we have constructed 5 or 6 miles of mains, turbines, generator, and appliances, I am very doubtful whether there will be much in it.

45. *To Mr. Sampson.*—I doubt if we should develop much more than 50 horse-power from the scheme I have outlined, and if a very dry year were experienced, we should develop none at all.

46. *To Senator Keating.*—The cost of obtaining that power would be some few thousand pounds.

47. *To Senator Lynch.*—In the absence of these works, the Molonglo will constitute a menace to public health, seeing that Queanbeyan is built upon it. At the Queanbeyan bridge there is a small dam which is practically filled with mud. This gets washed out with each flow down the streets, and we get the mud in the city. All the Queanbeyan drainage goes into the dam. It is not equally necessary to regulate the flow of the Molonglo, but it would be advisable to consider that matter with a view to the arrestation of floods. There is no site below the junction of the two rivers at which one dam would serve the purposes of both the dams proposed.

48. *To the Chairman.*—I have here the departmental file of papers relating to the manufacture of cement in the Federal Territory, and can give you a *résumé* of its contents. The first action taken was that of obtaining a geological report. Through the courtesy of the officials of the Victorian Mines Department samples were taken of the various deposits within the Territory. Laboratory biscuits or briquettes were made up by the State Geologists, and showed good results. On 6th August, 1912, the Commonwealth Director-General of Works submitted a report to the Minister in which he stated that—

(1) The Commonwealth is at the present time a large consumer of Portland cement.

(2) There is a prospect of still larger consumption in the future.

He then enumerates various works, including Federal Capital engineering works and building construction in connexion with which cement will be required—

(3) The total consumption per annum at present I estimate, roughly, at 15,000 tons. . . .

(4) The market price of Portland cement at the present time ranges from 13s. to 17s. 6d. per barrel. The price at the Federal Capital site is now about 18s. per barrel.

(5) The cost of manufacture of Portland cement in America is as low as 4s. per barrel.

It is known there as "dollar" cement, the cost of a cask of cement at the works being one dollar.

49. *To Mr. Fenton.*—That cement is of the same quality as that which we use here. Even in England the cost of cement at the works is only about 4s. per cask.

50. *To the Chairman.*—We are actually paying about three and a half times as much for cement as is paid for it at the works in the United States; but to the cost at the works freight must be added. The Director-General went on to say in this report—

(6) There is no guarantee what price the manufacturers of Portland cement may not raise it to within the next few years.

(7) The progress and cost of many Commonwealth works depends to some extent at the present time on the cement market. . . .

(8) I consider that the most lasting material used at the present day for building construction of the types undertaken by the Commonwealth are well-made modern bricks and concrete. Assuming that those materials will be used in the majority of Commonwealth buildings at the Federal Capital, the consumption of cement for engineering works and buildings there will be about 180,000 barrels. If the Commonwealth can save 10s. a barrel (and I see no reason why at the present market price of cement it should not save that sum per barrel) the saving on Federal Capital works alone would be about £90,000. . . .

(9) The proposal which I submit is that the Commonwealth shall now consider the advisability and expediency of manufacturing its own cement. . . .

These are quotations from the preliminary memorandum made by Colonel Owen after he had satisfied himself that there was something on which he could work. The next step taken was to obtain a report from an outside expert. Mr. Gibson, who is connected with the cement works at Adelaide and Geelong, and who, outside the Commonwealth Cement Company, is the leading cement expert in Australia, was chosen to make this report. He is not connected with the Government in any way. It was felt that the importance of the matter warranted the seeking of outside expert advice, and Mr. King O'Malley, who was then Minister of Home Affairs, approved of Mr. Gibson being retained. The Director-General recommended that the Department should forthwith obtain a report, accompanied with a complete scheme, and an estimate of cost of works and manufacture. A fee of £200, with railway fares and costs, was allowed Mr. Gibson who, Colonel Owen reported, on 4th June, 1913 was, according to good authority, a capable man to engage for this purpose. Mr. Gibson visited the locality, was shown the various deposits in the Territory, and then prepared his report, which was furnished in June, 1913, and was followed by a second report. In the first instance we supplied him with certain information as to the cost of power at the proposed site, which is about 6 miles from the power-house, is on allotment 35, and is just outside Queanbeyan. We could put in a siding there, and thus obtain the material very readily. This site being on the Molonglo River, the necessary water supply for manufacturing purposes would also be available. The first estimate of the cost of electric power delivered from the power-house was subsequently reduced, and in consequence of this, Mr. Gibson, in a second report, slightly amended his original figures as to costs. The power-house, which is now approaching completion, is fitted with the most modern equipment, including two 600 kilowatt engines, which will be running about three months hence. Acting upon Mr. Gibson's report, the Director-General, on 13th November, 1913, advised the Minister, "that approval be given for this Branch to take further steps towards the manufacture by the Commonwealth of Portland cement in Federal Territory for the purposes of construction of the city," and that further samples of limestone be obtained and bulk samples prepared for despatch to "the firms mentioned below." In ordering machinery for the manufacture of cement it is necessary to send along a few tons of the material to be treated, so that the machinery makers may determine the particular kind of mill that is required to grind it. The "firms mentioned below" were Fried. Krupp, of Magdeburg, and Smidth's, of Copenhagen, and the Director-General recommended that they should be asked through their Melbourne agents if they were prepared to quote for the supply of the requisite machinery. He recommended further that, in the event of a reply being received in the affirmative, the specifications be sent to those firms. Apart from the provision of this machinery, the work would be done by ourselves in accordance with Mr. Gibson's direction. We should erect the necessary buildings, but the actual machinery —the mills for grinding—would be supplied by one of these firms, who would undertake that the machinery supplied would do the work required of it. This, recommendation was dealt with by the Minister of the day in 1913-14 as the following minute shows—"Re-submit in connexion with the establishment of Federal Capital Commission. —W. H. Kelly." Mr. Gibson, in his later report of 9th October, 1913, stated—

The financial aspect of this proposition is now somewhat modified by the fact that Mr. Christie now estimates the cost of power from the Central Station at ¾d. per kilowatt delivered, instead of 1d. This will reduce the estimated manufacturing cost at the Federal Territory site by 8.4d. per cask, and permits of a more favorable consideration of the proposal (designated "C") to manufacture cement to be used for the requirement of the Federal Capital only. This proposal covers a production of 50,000 casks per annum, and if a like consumption can be reasonably maintained, and having regard to the present purchase value of cement at Queanbeyan, which Mr. Hill states to be 14s. 6d. per cask, unquestionably very considerable savings are to be made by manufacturing cement on the spot. The assumption is that 500,000 casks will be used within the next ten years, and again assuming that the works will be kept going more or less continuously, also a delivered cost of 16s. 7d. per cask, a saving of something like 4s. per cask will be made, or £10,000 per annum.

That is to say, a saving of £100,000 for the ten years' period. In that time we should wipe off the whole cost of our plant—

The value of this saving is, moreover, accentuated by the fact that the estimated manufacturing costs not only cover the interest upon invested capital, but also provide for the redemption of the whole of the capital outlay within ten years.

Mr. Gibson went on to say that with respect to the machinery he could not advise that this be manufactured at least in the first instance in Australia. He reported—

It is the usual custom of cement manufacturers to get quotations from well known makers of cement plants, such as Fried Krupp, Magdeburg (Australian agents, Messrs. Noyes Bros., Bourke-street), or Messrs. F. L. Smidth & Co., Copenhagen, for the whole outfit.

51. *To Mr. Sampson.*—The estimated cost of the factory in complete running order is £50,000.

52. *To Mr. Fenton.*—There are patents and special knowledge involved in the manufacture of this machinery. There is no cement factory in Australia, and practically not one in England in which grinding machinery, made either in Copenhagen or in Germany is not employed. In the United States the position is much the same. The plant made in America is not of the same quality. We fought this question very keenly because we were very anxious that the requisite plant should, if possible, be made in Australia, but we were confronted with the difficulties I have mentioned. Mr. Gibson, in his report of 8th August, went on to say—

To summarize the foregoing, it would appear that the cost of cement manufactured at site "D" would be, delivered at the Federal Capital, 8s. 10.3d. . . .

He proceeded to set out the different items upon which his estimate was based, and it was decided that, having regard to the cost of labour and other items, the estimated cost should be increased to 10s. per cask. We preferred to have a bigger plant.

53. *To the Chairman.*—The question of the possibility of a "cut out" in regard to the raw material available in the district has been considered. Two deposits have been taken into account. The first of these consists of a comparatively small deposit at White Cliffs on the Queanbeyan River, and distant about 2 miles from Queanbeyan. We have driven shafts through the deposit there, and it has not turned out very well. As a matter of fact, we did not anticipate very good results being obtained there. A really extensive deposit exists at Fairy Meadow. It is estimated that on the basis of the consumption of 50,000 casks per annum the raw material there would last for 150 years The site is within a mile of the siding at Fairy Meadow station It is not within Federal Territory, but could be acquired, I think, at a very moderate price. The deposit is a remarkably large one. Geologists have reported that they can sight 30,000,000 tons there.

54. *To Mr. Finlayson.*—Allowance has to be made in the estimate for the purchase of that site. With a bigger plant at Fairy Meadow we should be able to get our cement at a still lower rate. We thought first of all of dealing with the deposit on the Queanbeyan River, and which is on a New South Wales common which the State has offered to us, but it has not proved to be altogether satisfactory The deposit is laminated with shale which would render driving difficult. It would be necessary to convey the limestone a distance of from 30 miles, but silicate is available alongside the Fairy Meadow site, and water is also available Fairy Meadow is private property.

55. *To Mr. Sampson.*—So far there has been no communication between the owners and the Commonwealth Government as to the acquisition of that property. The preliminaries have not yet reached that stage. I do not think the price at which it could be obtained would be high. The area, of course, would be acquired compulsorily, and the price would then be settled. The owners could not work this deposit profitably at the present time. There are splendid limestone deposits at Goulburn, and this deposit at Fairy Meadow therefore would be of no value to the present owners unless a local demand were created for the cement which they could manufacture there.

56. *To Senator Lynch.*—Various laboratory tests have been made of the deposits at Fairy Meadow, but we have had no opportunity to make other tests. The geologists have reported favorably upon it, and Mr. Gibson is satisfied as to its extent and thickness. We were from the first a little doubtful regarding the value of White Cliffs deposits, and we have, therefore, driven three shafts through it in order to test it.

57 *To Mr. Fenton.*—There is a deposit of limestone at Canberra, but we do not desire to touch it, since it is in the very heart of the Capital, and the working of it would mean an unsightly cutting It is much harder than that at Fairy Meadow, and it would pay better to carry the limestone by rail from Fairy Meadow. Big deposits at Paddy's River have also been considered, but the cost of carriage by road or tramway would be more than the cost of carriage by rail from Fairy Meadow, which is undoubtedly the best proposition of all. Fairy Meadow is near Queanbeyan, and is about 30 miles from the Federal boundary.

58. *To Mr. Finlayson.*—There are no other deposits of any magnitude in the Territory as compared with that of Fairy Meadow. There are numerous deposits in the Federal Territory itself, but they are broken up and lack the requisite volume.

59. *To the Chairman.*—Coal would be an important factor in the cost of manufacturing the cement. Mr. Gibson gives the ratio in his list of costs. He deals with the cost at several different depôts, but we may take his estimate for any one of them as being typical of the whole. Let me take the least favorable estimate by Mr. Gibson, which, omitting fractions, is as follows:—Cost of raw materials and gypsum, 10d. per cask; labour, 3s.; coal for burning, 1s. 3d.; power, 1s. 9d.; bags, 9d.; repairs and stores, 8d.; management, &c., 6d.; interest on capital at 4 per cent., 9d.; and depreciation on permanent outlay at 10 per cent., 1s. 6d.; or a total of 10s. 11d. per cask.

60. *To Mr. Finlayson.*—The item of bags in the estimate of costs could, if desired, be eliminated. We proposed that the cement should be placed in large bins, but bags could be used and re-used again and again.

61. *To Senator Lynch.*—Six casks or eighteen bags of cement go to the ton.

62 *To Mr. Finlayson.*—The cask is used only as a means of calculation in making this estimate. It is not proposed to cask the cement; our intention is that it shall be bagged.

63. *To the Chairman.*—All imported cement is put up in casks, but the cost of manufacturing casks in Australia is very heavy, and we think that bags would provide a cheaper method of distribution. We prefer them also because they may be more readily handled than casks.

64. *To Senator Lynch.*—Cement can be stored well in bags. Whether casks or bags be employed it is simply a question of cover.

65 *To Mr Finlayson.*—As to your suggestion that the bagging of cement is a very unhealthy occupation because of the dust from cement bags entering the lungs of the workers, I may say that when a truck of cement arrives at the Federal Capital the men who have to handle it are paid at the rate of 12s. 6d. per day after the first fifteen minutes have elapsed. That increase in the wage ordinarily received by them is granted because the occupation is regarded as a special one For the purpose of making a comparison reference has been made in our reports to bags of cement; but our idea is to use bins of half a cubic yard or a cubic yard capacity for the cement. Whatever the receptacle used, the moment you handle cement or proceed to pour it into a concrete mixer dust rises. It is only in the manufacture of cement that the use of casks instead of bags would avoid the dust trouble.

66. *To the Chairman.*—On the basis of Mr. Gibson's estimate which I have just read, these works would consume about £3,000 worth of coal per annum. We are at present obtaining mountain coal from Lithgow. Until recently the price was 6s. per ton placed in the trucks, but it has now been raised to 7s. per ton. The freight is a little over 12s. per ton, so that the cost per ton delivered is about 19s. 1d. or 19s. 2d. We find this mountain coal excellent and better for our purposes than the Maitland coal. You may assume that coal in the Federal Capital to-day is worth about 19s. per ton.

67. *To Mr. Finlayson.*—The deposit of coal nearest the Federal Capital is some 90 miles distant, and lies along the suggested route of railway from the Federal Capital to Jervis Bay. Mountain coal deposits between Goulburn and Sydney are now being developed, and we are hopeful, in consequence, of a reduction in price. The estimate of the cost of manufacturing cement, which Mr. Gibson made, was based on the supply of coal at from 18s. to 19s. per ton delivered at the works in the Territory. Mr. Gibson writes as follows in his report in regard to the Fairy Meadow deposits—

> The first deposits visited are at Fairy Meadow, about 30 miles from Queanbeyan. Here limestone in large quantities, and of apparently high $CaCO_3$ value exists about 2 miles from the present railway line. This deposit appears to extend from the line itself, at which point, however, the stone does not outcrop, and apparently dips, also the ground rises, which would necessitate the removal of large quantities of overburden. At the point first mentioned the limestone outcrops in three distinct formations, the central of which being apparently the largest. The formation rises boldly from the bed of a creek to a height of, perhaps, 60 feet. The large block alone contains, on a rough estimate, quite three-quarters of a million cubic yards of stone. I note from Mr. Mahony's report that the estimated content of the whole deposit is at least 2,000,000 yards. Shale of more or less suitable quality is to be found all over the ground. A sufficiency of apparently good water is obtainable from an adjacent creek.

We are rather doubtful as to the correctness of the last statement. Mr. Gibson goes on to refer to the deposits at White Cliffs, about 2 miles from Queanbeyan, and says that he notes that Mr. Mahony estimates the whole of those deposits at 168,000 cubic yards, which is small compared with the deposits at Fairy Meadow. One of these Blocks at White Cliffs Mr. Gibson roughly estimated to contain 90,000 cubic yards. He states that the limestone could be brought by a ropeway from White Cliffs, about 4 miles away, and that apparently suitable shale appears to exist in very considerable quantities practically on the proposed site where I am now putting down a shaft. We have in the locality all the necessary ingredients for making cement, lacking only coal. We have a fine power supply, and the cost of coal represents only 1s. 3d. per cask.

68. *To Senator Lynch.*—This estimate was on the basis of the quantity of cement required for the Federal Capital. The Director-General of Works took into account all the works there in connexion with which we should need to use cement, and formed the estimate that it would require 500,000 casks during the next ten years. In that estimate he did not take into consideration the cement that will be required for the Naval Bases. As this cement delivered at Sydney would cost over 11s. per cask, he thought that was getting rather high, and that it was better to confine it to the Federal Capital proposition. The Director-General is now preparing for the information of the present Ministry an estimate of cost of manufacturing cement based on the supply of all the cement required by the Commonwealth. If it were determined to erect cement works to meet the whole requirements of the Commonwealth, the centre of manufacture would probably be changed; it is probable Portland in New South Wales would win. Coal is obtainable there at about 9s. per ton, and there are also enormous deposits of limestone and shale. Queanbeyan is 196 miles from Sydney, and the proposed cement factory site would be 197 miles distant, so that the freight to that city would be considerable. It is quite true that an enormous quantity of cement will be required in connexion with the Naval Bases and Sub-Bases, but if we were building a Naval Base in Western Australia, for instance, it might be found cheaper to obtain cement from the works in South Australia than to take it from Portland.

69. *To Mr. Gregory.*—Even if the war were not in existence, we should be fortunate if we could erect the plant and have it running within two years. Having regard to the existence of the war, it would take quite two years and a half to have the factory ready and in running order.

70. *To Mr. Finlayson.*—The reports to the Minister show that there are no less than eight deposits of limestone within the Territory, but they are small and patchy, and a long distance away from any manufacturing centre, so that the carting of the limestone by means of drays or ordinary plant, having regard to the difficulties of the country to be traversed, would make the working of some of those deposits too expensive. They are valuable, however, as possible reserve supplies. There is some very fine marble among these deposits, and we do not wish to burn up these deposits to make cement if they can be used as marble.

71. *To Mr. Sampson.*—Even if we were able to obtain the machinery without any delay, the difficulty to be overcome in obtaining the exact chemical mixture necessary and determining upon the particular grinding that was requisite would involve delay. Six months would elapse after we had the machinery in running order before we should be able to turn out cement that would stand the test. We should quickly obtain cement that was very good for mortar, but some months would elapse before we were producing cement fit to use, for instance, in the construction of a weir. I think that, under ordinary conditions, two years would elapse before we would be producing standard cement. Even if the erection of these works were authorized to-morrow, I do not know that we should be able to obtain the requisite machinery at the present time. We certainly could not obtain it from Krupp; and I do not know whether Smidth, of Copenhagen, could supply us just now. We are advised that in the United States high-grade cement-making machinery is not produced. Cement manufacturers there have been importing their machinery for the most part, and I think it will be found that nearly all the cement produced in Australia at present is made largely by machinery manufactured either by Krupp or Smidth. The ball mills, kilns and special machinery come from those works. In the United States Krupp and Smidth's machinery is used to a large extent, and the position is the same in New Zealand. Mr. Gibson recently visited the Old Country in connexion with this very matter, and has considered it carefully. The very design of the machinery varies according to the character of the material to be dealt with. You may get in your limestone minute layers of shale, and the ball mills have to be varied accordingly. Samples of the limestone and shale to be treated need to be sent to the machinery manufacturers, and upon their expert knowledge they undertake to provide a mill which will grind the material. We have not yet sent samples to any machinery manufacturers. The proposition had reached a certain stage when a change of policy came about. The limestone in different localites is of varying density. As to our possible consumption of cement at the present time, I would point out that the very dam which we have been discussing to-day will involve the use of at least 60,000 casks It will take about a year and a half to complete that work. Then, again, in order to complete the Cotter scheme, it will require about 20,000 casks

of cement during the next twelve months; and if we proceed with the Queanbeyan dam we shall want about 40,000 casks. Five thousand casks will be required for the construction of brick-works and kilns; the reservoirs at Red Hill and at Mount Stromlo will each take about 5,000 casks, and the main sewer will involve the use of about 15,000 casks. For the construction of culverts, roads, and various other works, we may allow another 10,000 casks, which gives us a total of 100,000 to be used during the next twelve months. We consume about 50,000 casks per annum. I think that we shall certainly continue to use about 50,000 casks per annum during the next two years in connexion with the erection of the main buildings of the Capital and the construction of streets.

72. *To Mr. Laird Smith.*—At the present time we are doing a lot of solid mass ed concrete work. We are using 500 casks per week on the Cotter works. I think our consumption of cement for the next eight or ten years would be met by an output of 50,000 casks per annum. Our average consumption of cement at the present time is about two trucks per day.

73. *To Mr. Gregory.*—A great deal of cement will be used in the heavy foundations of Parliament House and other Government buildings in the Capital, while a large quantity will also be used on the main sewer.

74. *To Mr. Sampson.*—After the first main sewer has been constructed no great expansion of the sewerage system will be required unless the population materially increases. I have already presented to the Committee, however, plans of sewers in one case 4¼ miles long, and in another 2¼ miles long, in addition to the main sewer. There are at least 7 or 8 miles of main sewers yet to be constructed. The subsidiary pipe sewers have also to be laid. We are making our own cement pipes at the Federal Capital at the present time in order to avoid the heavy freights on stoneware. We have a machine which turns out about 5 miles of cement pipes per annum, and have already made about 15 miles of such pipes. We have constructed pipes up to 24 inches in diameter with cement and the gravel obtainable from the river.

75 *To Mr Laird Smith.*—Our standard for concrete varies from three parts sand and gravel to one of cement, to nine or ten parts gravel and sand to one of cement. In the Cotter dam, for instance, 2 feet of concrete on the face and 2 feet on the back is a very rich mixture, but the filling consists of a mixture of about nine parts sand and gravel to one part of cement.

76. *To Mr. Fenton.*—We sometimes put the gravel used for making concrete through a crusher in order to give it a rough face. That course is followed in the making of pipes

77. *To the Chairman.*—I present to the Committee a tracing showing a section of the regulating weir across the Queanbeyan, and a section of the site on which the weir is proposed to be constructed. It must be regarded as only approximate, since we have not yet completed our explorations. The dotted lines show where we expect to strike the rock foundations. There will be a simple discharge of 2-feet pipes worked with an ordinary winch at the top of the dam. We shall have a notch for the floods to go over. It is curved in form, so that the water will hit the back right down. In this way we get rid of any impact of the water—it will glide over, following a wave action. The weir will be about 100 feet high from the bedrock. The weight is so distributed that the pressures lie, as the experts describe it, within the middle third, and also to insure that the pressure of the mass of concrete forming weir will not crush the rock on which it rests, whilst to insure that it shall not slide, we leave the base very rough. Half-way down, the weir will be about 48 feet wide, and at its base it will be nearly 100 feet wide. The concrete on each side will be carried into the rock for 6 or 8 feet.

78. *To Mr. Sampson.*—So far we have not had to go down more than about 10 feet to get our foundations.

79. *To Senator Lynch.*—We "root" the dam, so to speak, into the solid rock on either side, so as to insure that it will not slide.

80. *To Mr. Finlayson.*—The filling-in consists of weak concrete, say, in the proportion of nine to one; but the faces are of very strong concrete. Stones, or what are known as "plums," are sometimes used for the filling. They are wedged in if they are available, but very little saving is gained by using them. Their use has been discontinued at Burrenjuck.

The witness withdrew.

(Taken at Canberra).

WEDNESDAY, 10TH FEBRUARY, 1915.

Present:

Mr. RILEY, Chairman;

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

Colonel David Miller, C.M.G., V.D., I.S.O., Administrator of the Federal Territory, sworn and examined.

81. *To the Chairman.*—I know where it is proposed to construct a storage and regulating reservoir on the Queanbeyan River. Full information concerning the rainfall in that locality is given in a map which I hand in. I have had experience of floods in this district. On two occasions within the last two years there has been a flood. On one occasion the Murrumbidgee River came down in flood to a depth of about 18 feet in three hours. That was owing to very heavy rainfall on the upper parts of the Murrumbidgee River, which has a catchment of 5,000 square miles. On several occasions the Molonglo River has been in flood. The Queanbeyan River is a branch of the Molonglo River; the former junctions with the latter at the town of Queanbeyan, and it is the rainfall on the upper reaches of those two rivers which creates the floods at Canberra. On several occasions the Molonglo River has been over the temporary bridge at Canberra. As the Molonglo River traverses the very heart of the Federal Capital city, the construction of a storage reservoir is required to prevent inundation of the best part of the city. The flood waters must be controlled, and the only way to do that is to intercept them in the higher reaches of the rivers. Another reason in favour of a storage dam is that, no matter what shape the ornamental water may take, that water must be maintained at a constant level, otherwise there would be a great risk of a menace to health, and a nuisance owing to the deposits of mud. I have a record of the number of gallons which flow over the gauge weir. I did not bring the record with me, but I will see that it

is furnished to the Committee. It has been demonstrated that if a dam were constructed there will be sufficient water to fill the dam. There is a gauge at the weir at Studdy's, and also on the Molonglo River, close to Yarrolumla dairy. A daily record is taken at each gauge, and from these records the Committee can see at once that the volume of water will be more than sufficient for the purposes for which they are proposed to be used These records, I might mention, have been taken in three of the driest years on record. The water which comes down the Molonglo River inside the Federal Territory is polluted, and is unfit for human consumption, owing to the contamination at Queanbeyan. The water in the Queanbeyan River above that town is perfectly good potable water. At the point which the members of the Committee visited yesterday it is absolutely pure, wholesome water.

82. *To Senator Lynch.*—I have had no idea of utilizing the water to be stored in the proposed dam for irrigating purposes in the Federal Territory. But I have formed an idea of establishing irrigation in the Territory. I believe that the waters of the Murrumbidgee, over which the Commonwealth has first right, under the agreement made under the Seat of Government Acceptance Act, will provide ample water for all purposes of irrigation in the Territory. A scheme is now under examination for irrigating two valleys, namely, Duntroon Valley and Gungahlin Valley, with the object of inducing people to profitably occupy small areas of land for orchards and similar purposes. I think it is quite unnecessary to utilize the surplus water of the Molonglo or the Queanbeyan Rivers for irrigation purposes. Those waters will be used to preserve a constant level in the ornamental water, whatever form it may take, in the city area. Our supply of vegetables and fruit mostly comes from Sydney, and are of inferior quality. Very few vegetables and but little fruit are grown in the Territory, but I feel quite sure that the demand will become so great that the business will be entered into by a considerable number of persons, and become a very remunerative one. To a limited extent that form of production could be profitably engaged in, but, of course, with a proper scheme of irrigation it would be much more profitable. The absence of water from the Queanbeyan River is not retarding the carrying out of the preparatory works, and the presence of water would not expedite matters. It has yet to be settled when a weir will be erected on the Molonglo River for the conservation of water for ornamental purposes. It might not be erected for many years. We regard the town of Queanbeyan as being in a very insanitary condition. It is not sewered, and the result is that, with every rainfall, the whole of the filth of the town goes into the river. We have had analyses of the water made, and they are of a most alarming character. The water is unfit for human consumption, and when the Molonglo gets low during the hot summer months, the smell from it is most objectionable. That is due to the town of Queanbeyan polluting the stream outside the Federal Territory. It is such a serious handicap that, until it is overcome, I do not see how the Capital of Australia can be occupied. It would be a menace to the health of the community; it must be overcome. As the Chairman of the first Board which reported on the Federal Capital site, I was then of the opinion, and see no reason to depart from the opinion, that the catchment areas of the Molonglo and the Queanbeyan Rivers should be in the Federal Territory. The effect of dual control over that area is most unsatisfactory, and that condition of things will continue as long as dual control exists. Without the slightest doubt the whole of that area should be under Commonwealth jurisdiction.

83. *To Mr. Laird Smith.*—There is no question as to the capability of the proposed dam on the Queanbeyan River to conserve enough water to maintain a continual flow in the Molonglo River

84. *To Mr Gregory.*—What I said the other day was that the Federal Territory should be self-supporting Many matters have to be settled before the construction of the artificial lake can be started. At present we have not in the Department a plan for the lay-out of the city. Nothing can be done until a plan has been approved, and then, before any conservation of water for ornamental purposes can be undertaken, there are many other works which will have to be started and completed. In my opinion, it will be many years before the water is conserved for ornamental purposes in the city. The construction of a reservoir at Studdys must precede the formation of any lakes, and that work will take time. The estimated cost of the Queanbeyan weir is £100,000. The interest on that sum, at 5 per cent., would, in ten years, amount to £50,000 In one way it would be justifiable to expend that sum in constructing a weir for the purpose of containing water which might not be needed for four, five, or even seven years. In my opinion, it is an indispensable work in connexion with the establishment of the Seat of Government here. It will have to be done now or in the near future. One reason for my making that statement is that the flood waters must be controlled. I ask honorable members to consider the amount of damage which would be done by a flood coming through here after we had started to beautify the banks of the Molonglo River. All the work done to produce ornamental grounds might be swept away in a night, unless some steps were taken to control the flood waters; and I am advised that the erection of a weir at Queanbeyan is the only effective means of achieving that object. I consider it wise to get all the necessary work outside the city done before any work in the city is taken in hand. I think that the expenditure of this £100,000 now rather than at the end of a few years is justified By flood waters, bridges would be swept away, the erosion of the banks would increase; tree planting for garden work would be swept away, and the whole of the flats might be inundated at any moment The known flood-level is up to the 1,825 feet contour.

85. *To Mr. Sampson.*—The realization of the estimate of population depends on the adoption of a plan for the lay-out of the city. That is the starting point. No work has been undertaken in the Territory that will be interfered with by any design which may be adopted. The storage dam is not a part of the plan for the city, but it is part of the scheme for controlling the flood waters. The creation of artificial lakes is a part of the design for the city, and one reason for putting a weir on the Queanbeyan River is to control the flood water of the Molonglo River which pass through the centre of the city site. The maximum cessation of flow in the river is thirty-five days in the year. I cannot say whether, if the water were controlled otherwise than by a dam there would be a sufficient general flow to maintain a freshness of water in the ornamental lakes. A dam would control the river without doubt, and maintain its water at a constant level. I am unable to say what control the dam would exercise over flood waters once it was filled. That is an engineering

problem upon which the Director-General of Works has advised, and he could give information to the Committee. The question of controlling the upper reaches of the Molonglo River has been investigated, and I am advised that the water does not require to be controlled.

86. *To Mr. Finlayson.*—The records of flood levels follow the 1825-feet contour level. I am not aware of the level of the proposed ornamental lakes, and I have no knowledge of a plan being in existence. It is not proposed to carry on any works below that level. There is no danger to be feared above the 1,825-feet level. If the works were confined to the levels above that contour there would be no fear of damage by flood waters. At the present time the departmental engineers are taking gravel and sand from the river beds. Mr. Griffin has suggested that the alluvial flats along the banks of the river would be suitable for the formation of gardens and public parks on the upper contours; but there would still be the wasting away of the banks to be considered. I think it would be a most excellent thing to supply the town of Queanbeyan with domestic water from the proposed storage dam, and to install a sewerage system for the town. If that country were under the jurisdiction of the Commonwealth I am certain that the suggestion would be carried out. I have received no suggestion from the people of Queanbeyan with regard to the proposed weir, but a request has been received from the Mayor of Queanbeyan that the Commonwealth might supply that town with water from the Cotter dam, and that question is under consideration. There could be no free service of water from the proposed weir to the town of Queanbeyan. It is indispensable that for any service rendered to the town a fair remuneration must be paid to the Commonwealth. I am not aware that there is any other way than by means of a dam to preserve the flow of the river through the city, without any reference to a future development in lake formation. I am not aware that it could be done by a succession of weirs or anything of that kind.

87. *To Senator Keating.*—The reasons for erecting a storage dam on the Queanbeyan River are to preserve the banks of the Molonglo River through the Federal Capital, and to control the flood waters in order to maintain the level of the river and the ornamental lakes in the city. I do not think that, in the course of the Molonglo River through the city, the flood waters would affect anything which is likely to be done in the nature of work at any measurable period of the immediate future. Under any scheme there will be no works constructed below the 1,825-feet level. It is quite impossible to forecast when it is likely that steps will be taken to establish ornamental waters. In the city proper there is no population. In the area which has been delineated as the area of the intended city the population approximately is 700 souls. Mr. Knibbs did not give an estimate of the population of the city at this period. He gave an estimate of the population for some calendar years, but that was given some time ago on the assumption that the works would then proceed with regular sequence; that sequence has been interfered with. Mr. Knibbs estimated the population of the city area in 1915 at 20,150. That included 11,158 persons who were dependent upon the presence of Parliament and the Public Service at Canberra. It also included 10,090 workmen inclusive of dependents, and an associated subsidiary population which does not exist. These estimates are not worth consideration at present, because they were based upon conditions which do not exist, and the reason for this is that the work has not been proceeded with in the absence of a plan for the lay-out of the city. No works in the city area can be proceeded with until after a plan has been approved of by the Government. I can give no reason for proceeding at once with the proposed dam on the Queanbeyan River, beyond those which I have already given. I cannot give the Committee any information as to the present or prospective value of a weir there beyond that which I have given, and that is to control the flood waters. The actual revenue from a weir would be very small indeed. The only revenue we could hope to derive would be from a small service rendered to the town of Queanbeyan. From the service rendered to the city of Canberra there would be no revenue.

88. *To Senator Story.*—I do not consider that the volume of water in the proposed dam would be sufficient to permit of irrigation works being carried on profitably in the Federal Territory. I think that its primary use could not be interfered with without involving an element of risk which it would be unwise to take. I believe that it is most desirable to carry out the work, and to carry to completion works outside the city which will not interfere with the design for lay-out of the city. This is one of them. I think that the present is an opportune time to do work of that sort. In my opinion, it would be unwise to have more men engaged in the city than could be economically employed. As regards the establishment of a cement factory on a site within the Capital area, I think that the investigation which was made into the potentialities of the site resulted in a failure. I know that the Director-General of Works has other places under his consideration at the present moment, that is, places just outside the Federal Territory. Should cement works be established by the Commonwealth in the near future, and in such a position that the freight on the cement to the capital would not be exorbitant, I think that by delaying the construction of the dam to a later period a large saving in its cost could be effected.

89. *To Mr. Fenton.*—I am advised by the Director-General of Works that this is the only way in which the flood waters may be controlled. In addition to that question the engineers had also to consider the necessary measures to be taken to maintain at a constant level the ornamental waters which will undoubtedly be in the city area, and that may only be done, so I am advised by the Director-General, by the construction of a weir on the Queanbeyan River. If the weir were started within a period of six months it would take from eighteen months to two years to complete its construction. The weir would at once become useful in controlling the flood waters. It would also be valuable in a secondary manner for the purposes of the town of Queanbeyan. It is a fact that its townspeople desire to obtain a water supply from the Cotter River, instead of from the Queanbeyan River. The proposed dam is indispensable to the provision of ornamental waters. We would not think of planting or doing anything on the lower levels which might be flooded. For planting and afforestation any area except that below the 1,825-foot level would be used.

90. *To Mr. Sampson.*—I think that the ornamental lakes are indispensable. A nice, broad stream of water would not, in my opinion, be sufficient to supply all the requirements of a city. I believe that for the beautification of the city a broad expense of water is indispensable. Whether two parts or cities will grow up in competition with one another will depend upon the plan for the lay-out of the Capital. If it provides for the growth of two separate cities, it will be a very peculiar plan.

91. *To Mr. Laird Smith.*—The construction of the storage dam on the Queanbeyan River might prevent a cessation of flow in the Molonglo River. At the present time the waters of the Queanbeyan River within the Federal Territory are considerably polluted. It is a most unhealthy condition, and I that is one of the reasons why I suggest the immediate construction of a dam on the Queanbeyan River.

Arthur Henry Collett, Alderman, Queanbeyan, sworn and examined.

92. *To the Chairman.*—The question of providing a water supply for the town of Queanbeyan has come before the Municipal Council. Two years ago a deputation from the Municipal Council waited upon Mr. McGowen, who was then Premier of New South Wales, to ask the Government to supply the municipality with what we termed a small pumping plant, particularly for fighting fire. Mr. McGowen acceded to the request, and sent an officer to the town to inspect the site. He reported that the site was not suitable, and that if the Council were desirous of having a water supply he would advise the municipal authorities to go for a gravitation scheme or a supply drawn from wells to be sunk some distance in from the river through the shingle. We adopted the suggestion, and asked the State Government to send an officer to make trial tests of the shafts, which they did. They spent £150, and found that the water was not suitable. We then asked the State Government if they would send an officer to give us an estimate of the cost of a gravitation scheme, and that is before you at the present time. The question was a burning one with the aldermen. They thought that they would seize the opportunity of asking the Commonwealth Government to prepare an estimate of the cost of a connexion with the Cotter scheme. There was a resolution unanimously passed by the Municipal Council to try to have that scheme placed before them, so that they could compare the two schemes, as the aldermen are only representatives of the people whose preference would have to be ascertained in the event of the Commonwealth Government acceding to the suggestion. Four months ago we got word from the Federal Government that they had received our communication, and that is as far as the matter has gone. From the Public Works Department of New South Wales we received an estimate of the cost, which reads as follows:—

QUEANBEYAN WATER SUPPLY: PROPOSED WORKS.

On 2nd January, 1914, the Town Clerk of Queanbeyan wrote, asking that "reports and estimates of two schemes, viz., one for a gravitation scheme, and another for pumping, should be furnished to the Council," previously promised by the Premier.

Further correspondence is now proceeding with the Federal Government as to the terms on which the town could be supplied with water from the Federal Capital scheme.

Pending result of this correspondence, the Council might be furnished with a copy of the following report upon the pumping and gravitation proposals from the Queanbeyan River.

Pumping Scheme.

A proposal to pump water from a well sunk in the drift on the right bank of the Queanbeyan River, about 32 chains upstream of the existing weir, has been investigated, and the necessary tests as to quantity and quality carried out.

With regard to the quality, two samples taken showed the water to be unsuitable for domestic purposes, and,

though a further sample taken in May last was satisfactory, the general quality of the water appears open to suspicion.

To ascertain the quantity available, a test was made in the shaft with disappointing results, the rate of infiltration being insufficient to maintain a constant and efficient supply.

Under these circumstances a pumping scheme of naturally filtered water from the site selected cannot be recommended.

Gravitation Scheme.

Surveys have been made for a gravitation scheme from a storage reservoir proposed on the Queanbeyan River, 5½ miles above the town; a description and detail estimate is given herein, and a helio showing the general scheme and reticulation is being forwarded under separate cover.

It will be observed that the total cost amounts to £28,030. It will, therefore, be necessary to submit the matter for inquiry by the Public Works Committee and for parliamentary sanction before construction can be decided upon.

The annual charges amount to £1,353.

The valuations for the municipality in 1913 were as follows:—

Unimproved capital value	£50,922
Improved capital value	104,693
Assessed annual value	7,614

In 1914 the unimproved capital value increased to £52,697.

It would, therefore, be safe to assume that the assessed annual value has increased to over £9,000.

The maximum rate of 2s. in the £1 on the assessed annual value for the whole municipality would be £900.

From this revenue the rating of those portions of the municipality not supplied under the proposed reticulation would have to be deducted, and an estimation made, as to the probable revenue to be derived from the sale of water for gardens and commercial purposes, by an adequate system of metering.

The general description of the proposal is as follows:—

Population.

The present population has been taken at 1,650, and the future population to be provided for at 3,000 persons.

CONSUMPTION OF WATER (GALLONS PER DAY).

Maximum.

	Present Population.		Future Population.
For domestic purposes, at 50 gallons per head	83,000	...	150,000
For gardening, commercial purposes, &c.	10,000	...	30,000
	93,000	...	180,000

Average.

	Present Population.		Future Population.
For domestic purposes, at 40 gallons per head	66,400	...	120,000
For gardens, commercial purposes, &c.	10,000	...	30,000
	76,400	...	150,000

Catchment.

The catchment above the dam site is 335 square miles in area, and composed principally of silurian formation, with eruptive rocks on the upper portion.

The population numbers 300, most of whom reside at the head of the river towards Teranglo.

The average rainfall at Queanbeyan is 22.60 inches, and the minimum 10.49 inches, in 1902. During exceptionally dry periods the river ceases to flow, as, for instance, during last summer, when no flow was recorded for thirty-six days. For this reason it has been necessary to provide a substantial storage.

The water has been analyzed and pronounced fit for domestic purposes by the Department of Public Health.

Storage Reservoir.

This will be formed by the construction of a dam in the Queanbeyan River, at a point distant 5½ miles in a direct line from the Queanbeyan Railway Station. The capacity of the reservoir will be 12,845,000 gallons to R.L.2018, with a maximum depth of 32 feet. The available storage to R.L.2000, after allowing for evaporation, will be approximately 111 days for present, or sixty-two days for future requirements, on the assumption of no inflow. The evaporation has been taken as 4 feet per

annum, with the monthly rate for the periods in question, supposed to be in midsummer, increased above the mean. The dam will be constructed of concrete, curved in plan to a radius of 120 feet. The outlet pipe will be arranged similarly to that in the existing Cordeaux Dam, but the hoisting winch will be placed on the bank.

Gravitation Main.

This will be of cast iron, of approximately 5.4 miles x 8 inches diameter.

The discharging capacity of the pipe, reckoned from R.L.2600 to R.L.1960 is 180,000 gallons in twenty-four hours.

Service Reservoir.

This will be excavated and concrete lined, with a capacity of 150,000 gallons, the reduced level of off-take being 1,963; the gravitation main discharging into the reservoir at this level.

The location is such as to allow for sufficient fall from the storage reservoir to supply maximum requirements. A greater height of the service reservoir is not obtainable without pumping. There will be about twelve houses that cannot be reached by gravitation. The additional cost and charges for serving these few houses are not considered as warranted at the present juncture, but should settlement eventually increase on the higher ground around the town, it may become desirable, in view of the additional revenue obtainable, to install a pumping plant and a second reservoir of 150,000 gallons on a higher elevation than that now proposed under this scheme.

Service Main and Reticulation.

These will be of cast iron, as follows:—

50 chains,	8-in.	diameter.
155¼ "	6 in.	"
274¾ "	4 in.	"
164¼ "	3-in.	"

The location of these pipes is shown on helio.

Estimate of Cost.

1. Storage reservoir	£4,020
2. Gravitation main	11,730
3. Service reservoir	1,220
4. Reticulation	7,180
5. Fencing	100
6. Land resumption and easements	300
7. Engineering and contingencies, 10 per cent.	2,455
8. Expenditure to date as per accountant's statement of 10th October, 1914	200
9. Interest during construction	810
Total	£28,030

Estimate Annual Charge.

1. Annual repayment to provide for interest and sinking fund on £28,030 for fifty years at 3½ per cent.—4.2634 per cent. per annum	£1,195
2. Renewal fund to provide for replacing item 5 in twenty-five years at 3 per cent., £110 at 2.7429 per cent. per annum	3
3. Administrative expenses	100
4. Wages of turncock part time	35
5. Repairs and stores	20
Total	£1,353

I hardly think that the Municipal Council would be prepared to pay the interest on £28,000 if the Federal Government could give Queanbeyan a water supply from the Queanbeyan River. We as laymen seem to think that the estimate is loaded rather heavily. I cannot speak definitely as to the will of the people. I think that they would be prepared to pay a percentage for the use of the water. I believe that, in the event of the Commonwealth constructing a dam for the storage of water, the people of Queanbeyan would be prepared to lay down their own pipe line and distribute the water. I think that the State Government would be willing to come to the rescue of the people in the municipality—that is to say, they would be prepared to advance the money on loan for a period of, say, twenty years.

93. *To Mr. Sampson.*—I suppose that if the Commonwealth Government would allow us to draw a supply from the proposed reservoir, the saving on the present estimate would be about £4,000.

94. *To Mr. Gregory.*—The site of the reservoir would not be in exactly the same place. It would be ten or twelve chains farther up the stream. I think that we might be able to put in cheaper mains than are set forth in the engineer's estimate.

95. *To Mr. Sampson.*—With a saving of £4,000 we think that the Commonwealth scheme would be a satisfactory one to the residents of Queanbeyan. We would require to make terms with the Commonwealth Government for the right to use their water. There is no question that the water from the Cotter River is preferable to the water from the Queanbeyan River. If the Commonwealth construct a reservoir such as is now proposed on the Queanbeyan River, in my opinion the water from that source would not be equal in quality to the water which would be drawn from the Cotter. According to the analyses, the water in the Queanbeyan is pronounced to be pure for domestic purposes, but the other would be more acceptable to the people.

96. *To Mr. Laird Smith.*—We would have, I think, a little difficulty in rating ourselves to the amount of £960 a year—that is, if we could raise the money at 4 per cent.—but I believe that we could educate the people up to the advantages of the scheme. I think that they are clamouring for a water supply. During the 36 days that the river was not flowing we did not experience any trouble through stagnant water. We are fortunate in having a weir constructed in the town just below the bridge which spans the river; a very substantial work at that point impounds a great body of water, but in the big drought of 1902 there was a water famine from what we term "below the bridge," and a communication was sent to the Municipal Council to notify the people to draw the water from above the bridge I do not know what the motive was. That is the only water which the people have for domestic purposes other than rain water. We have experienced no outbreak of typhoid.

97. *To Mr. Fenton.*—The number of ratepayers in Queanbeyan is about 300, while the population is about 1,600. I cannot, of course, voice the opinion of the people, but I should say that if we did arrange with the State Government to provide the money at 4½ per cent., it would mean a big tax on the people. A tax of from £3 10s. to £4 per ratepayer would be a pretty heavy tax to pay for the scheme. We levy the rates on the unimproved value of land. There is no pollution of the river from the township, but I have heard people express surprise in midsummer that there had not been an outbreak of typhoid fever from the impounding of the water.

98. *To Mr. Finlayson.*—The combination of a sewerage scheme with a water supply scheme has not been considered by the Municipal Council. The aldermen have been under the impression that there is a compact between the Federal Government and the State Government to sewer the town of Queanbeyan. I would say that the town could scarcely stand the expense of both a water and a sewerage scheme—it would be too great.

99. *To Senator Lynch.*—I think that the Municipal Council view a rate of 2s. in the pound on the unimproved value as rather high. I understand that the people in other municipalities in the State are paying very nearly the same in interest on their water supply schemes, at Cooma it is about the same. I do not expect to get a very much lower rate on my property than on other properties similarly situated. A rate of 2s. in the pound would yield £900, and that is what the people would have to provide every year for a water supply. The Municipal Council has not turned down the scheme on the score of the high cost. They have been waiting in the hope that they would get from the Federal Government an estimate of the cost of a service from the Cotter dam. We anticipate that the cost would be considerably less if we could get a supply from that source. As to when a population of 3,000 persons will be living in Queanbeyan, I should say that it will considerably depend upon the progress of the Federal Capital. I do not look forward to an increase of the population from the development of mining or from an extension of agriculture, seeing that the best portion of the land is included in the Federal Territory. It took in a small part of the municipality, and thereby deprived the Municipal Council of some revenue. The height of the dam in the scheme I have given particulars of would be 30 feet, and the dam would fall short of supplying the town to the extent of twelve houses. I understand that the height of the proposed dam on the river will be 100 feet. Speaking from what I know, the water impounded by the Commonwealth dam would more than supply the highest point in our town. From the stand-point of adequately serving the town, there is no comparison between the two schemes, especially when it is remembered that we would have to put in a pumping plant in the event of people building on the few high points round the town. There is still a great deal of land on the high points available for settlement. I might go so far as to say that people are subdividing a portion of the land right in the municipality. I think that the Commonwealth dam would supply the whole of the municipal area. It would be worth a bit more to Queanbeyan to obtain a supply from the dam than to install our own scheme and have imperfect results. According to the report, the Federal scheme appears to be infinitely better.

James George Harris, Alderman, Queanbeyan, sworn and examined.

100. *To the Chairman.*—I wish to make a statement regarding the effect of the Federal Territory on Queanbeyan as a town. The provision of a water supply would give the Municipal Council the opportunity of installing a sewerage scheme. That, I take it, is a most important adjunct to the Federal Capital, because an unsewered town with a population of 1,500 persons situated on the banks of a river running through the Federal Capital must be an intolerable nuisance. The provision of a water system assisting the municipality to establish a sewerage scheme must have an important effect upon the Federal Capital. The town of Queanbeyan has grown more during the last three years than during the previous twenty years, and that, of course, has been due to the works in progress in the Capital territory. The estimated cost from the State Department was based upon a population of 3,000 persons. It is, I think, an under-estimate, because I know that during the last six months the sales of lands in Queanbeyan have been exceptionally large, and that to-day there is not a house vacant in the town—in fact, a person would be able to let any place with a roof. The number of allotments which have been sold during the past six months has been sufficient to lead any one to think that the estimate of the State Department is an under-estimate. That, in my opinion, is principally why the Municipal Council asked the Commonwealth Government that the Cotter River scheme should be extended to Queanbeyan. It is recognised by the Council that a water supply from the Queanbeyan River is beyond the financial capacity of the ratepayers. In fact, under the present Local Government Act it would be impossible for the ratepayers to provide the interest and sinking fund in connexion with that estimate. The people of Queanbeyan are most anxious that the Federal Government should see their way clear to accede to the request of the town. We recognise that it would be a magnificent water supply. Some of the oldest residents of Queanbeyan are persons who have lived nearly the whole of their lives on the banks of the Cotter River, and can give substantial evidence that the flow in that river has always been normal. This matter was brought before the Minister during last December, through Mr. Austin Chapman, by a deputation which waited upon him at Melbourne. The Minister informed the deputation that the question would be referred to the Public Works Committee, but he thought that if the Cotter scheme could not supply a town of the size of Queanbeyan, it would not be worth having for the Capital of Australia. The residents of Queanbeyan would be very glad, indeed, to be supplied at the earliest possible moment, by this Committee, with the information which was sought of our Premier, for the reason that during the last three years we have been in a state of great uncertainty as to our position. If the information was made available, whether it was favorable to supplying Queanbeyan or not, it would give the Municipal Council an opportunity of perhaps entering into other negotiations for a scheme. The growth of Queanbeyan is abnormal, and until the Commonwealth can localize its workmen in the Federal Territory the town must go ahead to a very much larger extent in the future than it has done in the past. For that reason I ask the Committee to consider a water scheme in connexion with the sewerage of the town, which is essential to the well-being of the Federal Territory.

Charles Tebbutt Campbell, Alderman, Queanbeyan, sworn and examined.

101. *To the Chairman.*—As Mr. Collett has stated, we have a scheme for supplying Queanbeyan with water, but another proposition came up, and that was to get a connexion with the Cotter scheme. We were of the opinion that we could obtain a water supply from the Federal Government at a cheaper rate than we could do by means of the scheme proposed by the Public Works Department of the State. We thought that by getting a supply from the Commonwealth it would obviate the necessity of constructing a dam, a reservoir, and a pumping plant, and thus reduce the cost of the scheme considerably. The cost of the State Department's scheme is estimated at £28,000 odd, and its acceptance would involve the levying of a water rate of 2s. in the £1. I think that the people of Queanbeyan would be prepared to pay that amount. Other towns in New South Wales have been provided with a water supply, and their rates are as high as the rate at Queanbeyan would be. They would not give up the supply now, if they had to pay double the money.

102. *To Mr. Sampson.*—The position at the present time is that the ratepayers of Queanbeyan are prepared to take a water supply from a reservoir on the Queanbeyan River if erected by the Commonwealth up to 2s in the £1, but before entering into a pledge with the Commonwealth they desire to know whether a more satisfactory supply could not be provided from the Cotter River. I think that if the Commonwealth Government

are not prepared to supply Queanbeyan from that source the residents of that town will be prepared to enter into an arrangement to pay up to 2s in the £1 to be supplied with water from the Queanbeyan River. Of course, I am only expressing my opinion of their feeling; the matter would have to be placed before the ratepayers for their decision.

103. *To Mr. Gregory.*—An annual payment of £1,440 to the Commonwealth Government would be a very high rate for the town of Queanbeyan to pay for a water supply.

104. *To Mr Sampson.*—The service reservoir would be built on one of the hills adjacent to the town.

105. *To Mr. Laird Smith.*—I am unable to say how much revenue the municipality lost when the Commonwealth took over a portion of its area.

106. *To Mr. Fenton.*—The length of the pipe line would depend upon whether the Commonwealth took the pipes from the boundary, or whether we would have to put in pipes from the Red Hill reservoir. The distance would be rather more in the case of a supply from the Cotter, that is, if we had to put in the pipes from the Red Hill. The Queanbeyan scheme would be the more costly of the two.

107. *To Mr. Sampson.*—I do not think we could get sufficient storage, if it were proposed to pump the water with a small plant from the running stream into an elevated tank.

108. *To Mr. Finlayson.*—The municipal council has not considered at all the question of getting a water supply from the proposed Commonwealth dam on the Queanbeyan River.

109. *To Mr. Sampson.*—The question has not been considered in the light of building a dam. The first time we heard of the Commonwealth scheme was to-night.

110. *To Senator Lynch.*—Amongst the residents of the town the Cotter scheme is favoured. They say that the quality of the water is very much superior to the quality of the water which we would get from the Queanbeyan scheme. We have received an analysis of the water from the Public Works Department for the State. I think that the analysis as to the quality of the water is fairly correct. The preference amongst the townspeople is in favour of the Cotter scheme on the score of both the quality of the water and the cheapness of construction.

The witness withdrew.

(*Taken at Sydney.*)

MONDAY, 15TH FEBRUARY, 1915.

Present:

Mr. RILEY, Chairman;

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

Joseph Davis, M.Inst. C.E., Director-General of Public Works, New South Wales, recalled and examined.

111. *To the Chairman.*—Regarding the proposed reservoir for compensation water on the Queanbeyan River I have prepared some notes as regards the Federal site and the town of Queanbeyan. The notes read:—

PROPOSED RESERVOIR FOR COMPENSATION WATER ON THE QUEANBEYAN RIVER.

As the result of a visit which I made with the Committee on Tuesday last, and owing to the favour of being supplied with certain notes prepared by Colonel Owen, Director-General of Public Works to the Commonwealth, I have gathered that the objects to be attained by the construction of the dam on the Queanbeyan River in conjunction with the scheme of the Federal Capital are as follow:—

1. The maintaining of the flow from the Molonglo River throughout the year.
2. The provision of water throughout the year to compensate for evaporation in the ornamental waters at the City site.
3. To provide a uniform flow so that circulating water will be assured for the power station.
4. The regulation of the flood waters of the Queanbeyan River.

It is, furthermore, understood that the following data may be relied upon, and that therefore an opinion may be based thereon, viz.:—

Contents of reservoir, 7,500,000,000 gallons.
Level of river bed approximately 2,000 feet above sea level.
Height of dam, 100 feet.
Surface of water in reservoir, 1 square mile.
Ultimate capacity of generating plant, 3,500 k.w.
Area of ornamental lakes, 3,145 acres.
Annual evaporation from the storage on the Queanbeyan River, 318,000,000 gallons.

I gather, also, that it is thought that the reservoir, when constructed, will supply a uniform flow of 9,000,000 gallons per diem. The quantity approximately which would be required for the circulating water is 6,000,000 gallons per diem; but it is understood that this will be returned to the lakes. The surface evaporation in the lakes, which have an area of 3,145 acres, would average about 9,450,000 gallons per diem.

On the figures of gaugings, supplied to me by Colonel Owen, extending over three years, the reservoir in question could easily supply a volume of 15,000,000 gallons per diem of twenty-four hours. Taking, however, the behaviour of the storage in the drought years 1903, 1901, and 1902, and assuming that the storage was full in 1900, during the years 1901 and 1902 the storage would be depleted to, approximately, 1,417,000,000 gallons, or, say, three months' supply at the end of 1902; but this is exclusive of the discharge from the Molonglo River, where the gaugings show very similar results to those of the Queanbeyan. If the Molonglo is taken into consideration, then there can be little question that the stability of the proposal would be vastly improved—even in periods of drought such as 1900-1902.

Having regard to the conditions stated herein relatively to the Molonglo, the proposed volume of 15,000,000 gallons per diem would be sufficient to attain the objects set forth.

I have another note relating to the Queanbeyan water supply and sewerage, which I will put before the Committee, because one of the obligations which the State Government undertook, in the Federal Territory Surrender Act, was to maintain as far as practicable the purity of the water in the Molonglo and the Queanbeyan rivers. If the water is to be kept from being polluted, not only must the town of Queanbeyan be provided with a water supply, but it must also be provided with a sewerage scheme. I have, therefore, prepared the following statement:—

QUEANBEYAN WATER SUPPLY AND SEWERAGE.

The proposal for the water supply of Queanbeyan provided a dam 32 feet in height at approximately the same place on the Queanbeyan River as the dam now proposed by the Federal Government. The requirements for the future consumption of Queanbeyan were 150,000 gallons a day, on a basis of 40 gallons per day per head. This quantity could readily be supplied from the proposed Federal dam without militating against the requirements of the Federal City. The additional head of the larger reservoir would be a distinct advantage. The scheme as laid before the Queanbeyan Council involved a capital expenditure of £28,030 and an annual charge of £1,353 on a 3½ per cent. basis, against an income of £900 on the 1913 valuations, leaving a deficit of £453.

If the storage reservoir in the departmental scheme be omitted, and water supplied free by the Federal Government, the capital cost to Queanbeyan would be £23,466, the annual charges, £1,248, on a 4 per cent. basis.

The estimated revenue on the 1914 valuations, with the maximum rating, would amount to £1,626. The town would thus be able to carry the burden.

Coming to the sewerage, and assuming it to be a condition attached to the free supply of water, that the town of Queanbeyan be sewered, it would be necessary

to carry out sewerage works at a rough estimate of £25,600, which would involve an annual charge of £2,137, against an income of £1,626. This would mean a deficit of £511.

I have given these details about the Queanbeyan water supply, and sewerage, not because the Committee are directly concerned with those questions, but because I thought that they ought to know what would be the effect of getting water from the proposed dam on the Queanbeyan River for the use of Queanbeyan, and also the effect of constructing sewerage works so that pollution, as far as Queanbeyan is concerned, would be out of the question. As regards the dam, it is not possible for me to give an opinion beyond saying that I understand that it is estimated to cost £100,000. No one can say what the exact cost will be until the trial holes which are now being put down are completed. I need not say anything regarding the stability of the dam. There is no question that the site is an excellent one. As regards the necessity for the dam, I say that it is absolutely necessary if the ornamental lakes are to be carried out. Until that is the case, except for the regulation of flood waters and the provision of water for the power plant, the necessity is not pressing.

112. *To Mr. Gregory.*—I think it would be a very good idea not to start the construction of the Queanbeyan dam until the weir on the Cotter River is finished. We generally move a plant from one place to another. We did that in the case of the Cataract dam. When that work was finished, we put the Burrinjuck in hand, and the plant which was used at Cataract was transferred to the second dam and used there. I do not think it is of any use to put in a dam at the western end of the ornamental lakes, until you take into serious consideration the dam on the Queanbeyan River; because the evaporation would be so great that you would have lakes without water. As an engineer, I think that the Queanbeyan reservoir would probably take longer to construct than the one at the western end of the lakes. You would then have the water stored in the Queanbeyan River for the purpose of maintaining the lakes when the dam was constructed at the western end of the ornamental waters.

113. *To Senator Lynch.*—It would anticipate trouble to structures which might be erected on the flats near the Molonglo River, unless you had the flood waters regulated. I am inclined to think that without the flood waters being regulated, and possibly in the Molonglo, you would have trouble on the flats round the lakes. I could not say positively that the trouble would be sufficiently averted by putting a dam on one river alone, without the data being gone into in relation to the Molonglo, as well as the Queanbeyan. I have not had time to do that. I do not think that any erosion which might take place above the Capital would materially affect matters until you got a dam at the western end of the proposed lakes, and there was water for the sedimentation to take place.

114. *To Mr. Laird Smith.*—It would be a great advantage to prevent the periodical flooding of the Molonglo. A dam on the Queanbeyan River would be a great advantage, even at the present time, seeing that Queanbeyan is in rather an insanitary condition owing to the absence of a sewerage scheme. It would give us a water supply for Queanbeyan, and enable us to carry out a sewerage system, which is really very imperative.

115. *To the Chairman.*—The water which is polluted at Queanbeyan goes through Federal Territory. The charge for a water service would be a matter for arrangement between the Federal and State Governments, but we have assumed that the quantity of water which would be required by the town of Queanbeyan would be so small that it would not affect matters, and if the Commonwealth Government put up the dam in order to facilitate the carrying out of water supply and sewerage systems they might very well allow us to put in a small pipe. It would save £4,000 on the original scheme.

116. *To Mr. Sampson.*—After the dam was once filled it would have no effect in the matter of preventing flood waters from doing serious damage on the Molonglo, but that does not often happen. It is the only check I can think of as being possible. Until the dam was erected they would have the same floods as they had before, but part of the flood waters would be held up by the dam and stored in the reservoir. After the dam was first filled, in an ordinary year it would be lowered for the purpose of conserving water in the lakes. In an exceptional year like that of 1902, it would be depleted, but even in an ordinary year the water would be lowered to a very large extent. While the dam was filling up again, it would prevent a flood to that extent, and only to that extent. I was not aware that the Committee received at Canberra some evidence from the Municipal Council of Queanbeyan in connexion with the question of getting a water supply from the Cotter or the Queanbeyan. We have gone very carefully into the question of providing a cheaper water supply for Queanbeyan. Our object has been to give the Municipal Council a scheme which they could afford to carry out as regards interest and working expenses, and the conclusion we have reached is that the only possible way to give them a safe, reliable, and adequate supply is to take the water from the Queanbeyan River. In the present condition of the river the water on certain days is possibly not absolutely wholesome, but with the construction of a dam the flow of water all the year round would be good. If the Commonwealth decides to carry out a regulating reservoir by the construction of a dam at the place indicated on the Queanbeyan River, the cheapest, the best, and in every respect the most satisfactory way would be to get a supply of water for the town from the dam.

The witness withdrew.

(*Taken at Melbourne.*)

TUESDAY, 16TH FEBRUARY, 1915.

Present:

Mr. RILEY, Chairman;

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

Walter Burley Griffin, Federal Capital Director of Design and Construction, sworn and examined.

117. *To the Chairman.*—I have seen the proposed site of a weir on the Queanbeyan, and I consider it a very favorable location. I think there would be enough water stored in the dam to supply the lake. Half of the average rainfall extending over two years will meet the evaporation. I do not think that this dam will protect the bank of the Molonglo in the city from being destroyed by flood waters, because it includes only half the

watershed that is tributary to the Molonglo there, but it will minimize the danger somewhat. It is, of course, better than any expedient taken locally. Its primary function is to insure the replenishment of the water taken up by evaporation. I do not consider that it is to prevent floods in the bottom lands, because I have provided that those lands shall never be occupied by habitation. My idea is that those areas will be best utilized by being flooded.

118. *To Mr. Gregory.*—My plan of the lakes is complete, though, of course, I might desire to change the levels a foot or two. The area of water is about 5 square miles, and to put that area under water will require two weirs—the weir in the gorge at the point indicated at Yarrolumla homestead, or one nearer (there are two or three alternatives that might be investigated), and the one at the railway crossing. These two weirs are independent of the Queanbeyan weir. The height of the main weir will be about 50 feet. The intermediate weir will not be expensive; most of it will be earthwork. No borings have been made to test the country, to give an idea of the expense, but pending these there is the alternative of an entirely earthen bank. The Queanbeyan weir is to be erected for the purpose of giving a regular supply of water, and also to regulate the flood water. We could never have full assurance of protecting the city flats from flood waters without a weir also on the upper Molonglo. I would rather not try to utilize those lands than depend on a work that only took in one valley. I propose mostly to utilize the country as it is, and not dredge in connexion with the formation of the lakes. In any case, however, the silt is too valuable to cover up. It is the only available soil in the vicinity; and it is for that reason that the completion of the lakes will have to be deferred until after settlement takes place. The greater portion of the lake will not be exceedingly shallow without dredging—not sufficiently so to augment evaporation beyond the danger point. Scarcely any walls will be necessary around the lake. I do not know that we shall need them in any case. I do not consider that any general scheme of dredging will be necessary unless it is to rescue soil that is valuable. We shall want all the soil from the bottom lands for the garden sites in the city. Naturally the Queanbeyan weir should precede the Molonglo weirs. I should also say that there are useful gravel deposits at the site of the lake.

119. *To Mr. Fenton.*—As to the length of time required to bring the lakes into existence, this supplies one of the reasons I desire a consulting board of engineers—to work out a financial policy. I do not think the lakes could be completed before ten years. I would not say that that is the very shortest period, but I have allowed for a good deal of construction to take place, and the utilization of material at the bottom before the water is put in.

120. *To Senator Keating.*—As to the depth of water in the lakes, I have not any data with me, but I shall hand it to the Committee. I should say there would be a minimum of 10 feet. I raised the water-level so as to get a better shore line when I saw the surface finally.

121. *To Senator Lynch.*—On general principles I do not see any special reason for making the dam across the Queanbeyan until the time the weirs are to be constructed across the Molonglo River, though there may be considerations of engineering economy. I was assured by Mr. Christie that the local dam, already in, was sufficient to provide for any emergency for the power plant. There are no visible grounds of economy for constructing a dam now. I cannot see any necessity for the construction of this dam for the sake of preserving the bank before the bank construction is undertaken. I do not regard that as a serious ground for the construction of the dam. As to the anticipation of any damage from flood waters to the structures erected in the meantime across the river flat to give communication, the present temporary and inexpensive work has already withstood a record flood, so that a more substantial one would be so much the better off. I do not see any more difficulty in undertaking these constructions on the river here than at the railroad crossing at Queanbeyan, or at a point above or below. I do not think that a dam on the Queanbeyan is a necessary precedent to tree-planting or other work, because the Cotter River supply is supposed to take care of all that, especially in the early stages. Once the weirs are in position, and the ornamental lakes a reality, the Queanbeyan dam is one of the necessities. I have not investigated the question of the supposed nuisance caused in the Queanbeyan River by the town of Queanbeyan.

122. *To Mr. Laird Smith.*—The Queanbeyan dam will be necessary to assure uniform flow of water in the Molonglo River, but whether that would be an advantage representing the interest on £100,000 is a question of engineering. I do not think that, in the preliminary stages of construction, it would be justified. In using the word "engineering," the idea I have is the maximum economy based on a policy extending over a considerable period with a well-defined system of expenditure.

123. *By Mr. Sampson.*—When it comes to the construction of the lakes, the dam at the Queanbeyan should precede. We keep away from the lake bottom in all our civic improvements until the Queanbeyan is protected. The absence of a dam would not interfere with the construction of the weirs. The question of how long it would take to construct the weirs if Parliament were prepared to vote the money is one of policy, and I cannot say. I have not had an estimate of the Department as to one weir. I should construct the works simultaneously, or take the Queanbeyan dam as the first of three weirs. I should construct the dam before I constructed the weirs to form the lake. I am excepting one subsidiary feature, namely, the construction of a railway crossing, which is combined with the weir there. The construction of the dam is thus only a prelude to the construction of the lakes. I anticipate covering about a square mile net with a population of 20,000. The lakes, as I have said, cover 5 square miles. I have always understood that sovereign riparian rights in the Queanbeyan valley were involved with the original grant of the Federal Territory to the Commonwealth, and that sovereign rights over the whole watershed were contingent. The question whether it would be preferable to have sovereign or proprietary rights over the whole Territory, including the watershed, is a legal one that I cannot answer. I do happen to know, from Miles Franklin, who was born within 30 miles of the Capital site, that in her childhood the Molonglo River was a very different stream—that it then used to flow clear and pure. It is said that the grazing and deforestation of the watershed accounts for the present turbid state of the river. The region was at one time a favorite resort for fishing, and was full of all kinds of wild life.

The witness withdrew.

(Taken at Melbourne.)

TUESDAY, 23RD FEBRUARY, 1915.

Present:

Mr. RILEY, Chairman;

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

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

124. *To the Chairman.*—With the members of the Committee, I have visited the site of the proposed dam on the Queanbeyan River. I have drafted the following notes dealing generally with the question of its construction:—

NOTES REGARDING QUEANBEYAN DAM.

1. The construction of a dam on the Queanbeyan River is one of the works laid down in the progressive scheme of Federal Capital construction.

2. The objects to be attained by the work are:—

(a) Maintain the flow of the Molonglo River.
(b) Maintain a circulation of water and compensate for evaporation of the ornamental waters at the city site.
(c) Reduce the volume of flood waters at the Canberra Plains (during heavy rainfall on the Queanbeyan River catchment area).

The Catchment Area.

3. The catchment area of the Queanbeyan watershed above the dam site is approximately 333 square miles. The geological formation is generally silurian; and there are eruption occurrences in the upper portion.

4. The average rainfall over the watershed may be taken at 22 inches per annum, but minimum rainfalls have been recorded at Queanbeyan (10.42 inches).

5. The country has been much denuded of timber. There is a population of about 300, mostly graziers, residing within the upper catchment area.

Volume of Flow.

6. Gaugings have been taken since the middle of 1912. A gauge weir was constructed as soon as survey and other investigations had disclosed the most suitable site for a dam.

7. The diagrams compiled upon the gauging disclose that during 1912 the flow recorded by the gauge was approximately 6,000,000,000 gallons; during 1913, 10,000,000,000 gallons; and during 1914, 9,000,000,000 gallons. There is, however, an unrecorded discharge above the gauge capacity during floods.

Course of River and Junction with Molonglo.

8. The course of river is in a general north-westerly direction to Queanbeyan; the remotest source being near the Bald Mountain. At about 6 miles (river course) below the proposed dam site the river flows through Queanbeyan, where there is a dam, which impounds a small reach of water. At about a mile below (north-west) of Queanbeyan the Queanbeyan River junctions with the Molonglo River, and the river is known by the latter name in its course through the Canberra Plains and the city site. The flow from the junction is generally westward about 6 miles to the city site, and thence about another 16 miles to the Murrumbidgee River.

9. During its course through the Canberra Plains and city site the river slope is small, but above the junction of the Queanbeyan and Molonglo and below Yarrolumla, the slopes are steeper.

10. The observations of river flow and the nature of the river bed and banks in the reaches below the Queanbeyan dam site indicate considerable loss from seepage and other causes. The Canberra flats through which it flows are alluvial deposits of an absorbent nature.

Investigations (Survey and Engineering).

11. Early attention was given to the selection of a suitable basin and site for dam. Preliminary reconnaissance was made, and the most promising basin (affording largest catchment area) was contour surveyed (*vide* plan of contour survey 400 feet = 1 inch).

12. The investigations of flow were then undertaken by means of a concrete gauge weir, and daily records of flow and rainfall have been recorded on the diagram of river discharges.

13 Trials of the geological formations of the abutments and river bed at the dam site have been undertaken by sinking shafts and excavations. These works have so far borne out the anticipation formed during the preliminary investigation.

Storage Capacity of the Basin.

14. The contour survey has disclosed that a dam 100 feet high will impound a sheet of water with a surface area of about one square mile, reaching upstream about 7 miles, and a volume of about 6,400,000,000 gallons.

15. The dam proposed would have a gravity section and a length along the crest of approximately 560 feet. The investigations as to solid rock in abutments and bed so far indicate a structural section which would involve a cost of £100,000 for the dam (based upon current costs).

16. From the available information and diagrams, and on a basis of the gaugings made, the forecast is that the dam would have received about 3,000,000,000 gallons in three days' heavy rainfall during July, 1912. There were subsequent rainfalls which would have caused over flow during that year.

17. The gaugings have been made for only three years; but taking the year 1912—the lowest gaugings—the storage effected by a dam and basin as proposed would have met the demand for a discharge of 17,000,000 gallons per diem, combined with evaporation on the bare of 30 inches per annum over the basin area. The gaugings have not, however, been taken over a sufficient number of years to warrant a definite forecast that during a series of dry years a volume of 15,000,000 gallons per diem could be run off from this reservoir.

Objects to be Attained.

(a) Maintain the flow of the Molonglo.

18. Experience since occupation of the Federal Territory by the Commonwealth discloses that during part of each summer the river ceases to flow through the Canberra Plains and city site. For instance, there was no measurable flow from 14th January, 1912, to 31st January, 1912; from 25th January, 1913, to 6th February, 1913; and from 10th February, 1914, to 29th March, 1914. The cessation of flow has led to disabilities.

(b) Maintain a Circulation of Water and Compensate for Evaporation of the Ornamental Waters at the City Site.

19. The city design provides for two ornamental waters or lakes, the areas of which will be—a lower lake (most western), 80,000,000 square feet; and an upper lake, 60,000,000 square feet. The evaporation, based on 36 inches during the year, may be estimated at 1,160,000,000 gallons per annum from the lower lake and 1,160,000,000 gallons per annum from the upper lake. In addition to compensating for evaporation, it will be necessary to afford a perennial flow through these waters, towards which the flow from the Molonglo catchment will contribute.

(c) Reduce the Volume of Flood Waters at the Canberra Plains (during Heavy Rainfalls on the Queanbeyan River Catchment Area).

20. Floods have occurred each year when the ground has become soaked and there are prolonged rains. The heaviest floods arise from simultaneous rainfalls on both the Molonglo and the Queanbeyan Rivers' catchment areas.

21. The precipitous nature of the country causes a rapid and large percentage of run-off during prolonged rains.

22. The effects of flood at present are:—

(a) The water holds much mud in suspension.
(b) Inundations occur on the low-lying parts.
(c) There is a deposition of a certain amount of silt.

What would be the effects of sedimentation within the ornamental waters, when they are created, is a difficult forecast, but there is no doubt that the effect of an impounding basin on the Queanbeyan River will assist in reducing the alluvial deposit.

23. The question of an impounding basin on the Molonglo is not dealt with in these notes.

P. T. OWEN,
Director-General of Works.

25th January, 1915.

Without the construction of this dam, I should be anxious concerning the supply of circulating water for the condensers for the engines. A storage dam is the only means by which we can provide for a constant flow of water. I should otherwise be afraid of the possibility of a fall in the level, and a consequent rise in the temperature of the water which would make it unsuitable for the

power plant. We shall use this water as soon as the engines are running. It is to be used for engine condenser purposes, and on that account we do not wish the temperature of the water to rise. If, during a dry season, there were no water in the Molonglo River, we should have to fall back upon non-condensing running, which would be less efficient. Without this dam it would be difficult to provide circulating water after the occupation of the city. We have been using water from lower down the river for steam boilers and brick-works, but we hope within a few months' time to be able to get the water for this purpose from the Cotter River supply.

125. *To Senator Story.*—I do not think it would be seriously detrimental to the progress of the Capital City if the completion of this work were deferred for a year or two, but it should be completed before the aggregation of, say, 8,000 or 10,000 people in the city. Until this work is accomplished we must look for periods when the river will not be running, and should consider the disabilities that may arise from that. We must remember that manure and debris from the land will be washed into the river, and in view of the absence of a sewerage system at Queanbeyan the water in this reach becomes rather objection-able. I estimate that the dam could be constructed within eighteen months or two years. It will require 60,000 cubic yards of concrete, which would include 10,000 tons of Portland cement, estimating a little over six barrels to the ton. If the construction of this work were delayed until the Commonwealth was manufacturing cement at the capital site it would, of course, provide a good market for that cement. If these dams are all completed in the meantime the advantages of erect-ing a cement plant at Canberra will, of course, be-gin to disappear It is true that I recommended the establishment of cement works at the capital site two years ago. The recommendation was not adopted, nor was it cancelled. It would be better, perhaps, to say that the proposal did not bear fruit. Subject to the rate of progress of the city which we have always anticipated, I consider that, from an engineering point of view, the establishment of cement works for the manufac-turer of cement to be used in the large works contemplated at Canberra would be a good propo-sition, and from a commercial point of view it should also be a good proposition, though I will not say it would be a gilt-edged one. On the subject of the difficulty of procuring the necessary machinery owing to the war, I may say that I originally suggested that we should get the neces-sary plant from Krupps. That, of course, is now out of the question. My reason for the suggestion was that Krupps have large experimental works, and make a specialty of this kind of plant. It is possible to send materials to them, and have them put through, and experimental cement made from them on a commercial scale. Smidth, of Copen-hagen, has works for the manufacture of cement plant. There are some English and some Ameri-can firms, which, from what I have been able to gather on the subject generally, would be prepared to supply a plant. My advice to the Government in the matter is that, whoever might be asked to supply the plant should be expected to complete the works for the manufacture from beginning to end, and be responsible for providing the plant, and making cement at the Capital Site. We anti-cipated that the rotary kilns and a great deal of the necessary machinery could be made in Aus-tralia. I should like an opportunity to look up the figures again, but I believe the estimate was that the expenditure for erecting the works might be divided—half upon importations and half locally.

126-7. *To Mr. Gregory.*—I have said that the question of an impounding dam on the Molonglo is not dealt with in the notes I have just sub-mitted, that is for a basin on the upper reaches of the Molonglo at Burbong. I have in my notes dealt with the Queanbeyan dam on its own merits as a means of conserving water for the purposes of the city. I think that, eventually, it will be found absolutely essential to have a dam also on the Molonglo if large areas of ornamental waters are to form a part of the city design. In con-nexion with the artificial lakes we shall require a dam to cost £75,000 at the western end of the city, and the Queanbeyan dam will cost £100,000. These may have to be supplemented by another dam on the Molonglo, which cannot be constructed for less than £100,000. It should be explained that the construction of a dam and a Molonglo basin will submerge a considerable area of good country. I think that the Cotter River dam can be constructed in from six to nine months from now. As between the dam on the western portion im-pounding the water of the Molonglo, which is estimated to cost £75,000, and the Queanbeyan dam, I should give precedence in construction to the Queanbeyan dam. If the Queanbeyan dam were constructed first, we should have the advan-tage of the water thus provided, and would be able, to a certain extent, to control the flow of the Molonglo, which would assist us in the con-struction of the dam on that river. If the Go-vernment for reasons of policy desired to proceed with the construction of the Queanbeyan dam be-fore the completion of the dam on the Cotter River, I should be prepared to adopt that course, although it would involve the purchase of addi-tional plant. The steam plant could, however, be used for the Queanbeyan dam, and we could use the electric current in the construction of the dam on the Cotter River. I have used as an argu-ment for the construction of the Queanbeyan dam the necessity for a fairly full supply of water for the power plant. It may be unnecessarily appre-hensive, but if we have a couple of dry years, we find that the Molongo stops running, and there is the possibility of the water level coming down, which would result in a rise of temperature in the circulating water with a consequent loss of effi-ciency in the engines. The power required in the city for some years will not be a very small item. I hope that the continuous kiln brickworks will be a going concern within much less than twelve months, and they will mean a load of up to 500 h.p. We hope also that we shall be pumping water; the pumps will be kept going at their full rate, and from 400 to 500 h.p. will be required for that purpose. Water will be got from the Cotter as soon as possible, so as to have a reserve. The position last year and the year before was quite critical. There was a fear that there would be no potable water for the Military College. I would take water from the Cotter for brickworks, because the cost of getting a supply from the Molonglo by pumping it up to the brickyards would not be warranted if water could be gravitated in pipes from the Cotter supply. I recommended that the Government should start their own cement works. Cement is costing the Government now 14s. 7d. a cask on the railway line at the city. I have never been able to find a definite offer said to have been made to supply the Commonwealth with cement at 11s. a cask, provided that a continuous contract was given. There is no such offer in the file, although I have searched for it since I came down. I have seen no definite offer to supply at 11s.

128. *To the Chairman.*—The point as to whether cement will go up in price is one which

I touched on in my report. I believe a new com-pany has started at Rylstone, New South Wales, and that, I think, may bring down the price, but it is hard to say how long it will be before the price is put up again. The great danger I put forward about Canberra in my report was that we might be confronted with a sudden rise in price which would constrain us either to pay heavily for our concrete or stop work, neither of which the Commonwealth would like to do. One of the advantages of making our own cement would be to keep our works constantly going. To connect the city with the place where there is a big deposit of limestone would require a branch railway of about 1¼ miles in length from Fairy Meadows. That would junction with the pro-posed railway to Jervis Bay, which has been sur-veyed right through the city, and which goes through one limestone hill that we would work on. With regard to the question of giving a good con-tinuous contract for the supply of cement, Mr. Hill has been constantly on the *qui vive* to get the best price he can, and has secured more favor-able terms than the ordinary current rates.

129. *To Mr. Gregory.*—I was casually aware that there was something in the nature of a tenta-tive offer to supply cement at 11s., but this was made long after my report was put in. It evi-dently passed through my office, although it was not minuted, and I took no action on it. Mr. Hill has communicated with the Portland Cement Company with regard to the supply of cement in large quantities for the dam, but not for the whole of the work at the capital site. As to the amount of cement that we shall require annually when we get into full swing, there are two pro-positions in connexion with the establishment of our own cement works, one for a 50,000 barrel, and the other for a 100,000 barrel plant. This means from 10,000 to 20,000 tons of cement per annum. The 50,000 barrel plant would, of course, result in a more expensive cement than the plant with the larger capacity. No measures were possible to induce private enterprise to bring their prices to such a basis as would give us a cheap supply for the enormous quantity that we shall require, because we were not in a position to enter into any undertaking for a large supply, and it would be a bad thing to gamble on possible markets. Mr. Edward Noyes, who is connected with the Rylstone works, and who knows all about the Commonwealth project, told me that they would be prepared to reduce the price of cement to the Commonwealth, subject to their being given a big order. It would have been a bad business to negotiate for a contract extending over three years for a large amount of cement, seeing that at pre-sent we have not got the uses for it there, and no storage. We do not want to be saddled with large supplies of cement up there before we know that we are going on with the construction Of course, there is plenty of time for the public to come in and tender for the supply. I think the concern at Rylstone offers a better prospect. I have heard of this project for over a year, and think we would be likely to get the lower prices from them. Whether they will raise their prices afterwards re-mains to be seen As to the risk of the cement works getting out of order, cement manufacture is not the difficult process it was a few years ago when the Medway mud and marls were made into cement by men in whose families the manipulation had been almost handed down from generation to generation. The process has now become one of mechanical handling of materials. The great thing is to get consistent limestone and consistent shale. Even when you have them the chemist is kept constantly going, but with improved machinery there is not the same difficulty or risk in undertaking cement manufacture that there was a few years ago. When the works are started they must, of course, be kept continuously going, and any stoppage will involve serious loss. If the furnaces cool they have to be relined, a process which costs some hundreds of pounds. There would, however, be no reason why the work should be stopped. At any rate, there is not a great risk of stoppage, unless we could not use all the cement we were producing, and had to stop. The exami-nation of the site for the Queanbeyan dam is of a tentative nature up to the present. In ordinary circumstances, we could do our preliminary examination, and get to work at stripping and opening out for weir construction within three months. If no question of policy were involved, and Par-liament approved of the work going on as soon as possible, I would start the construction in about four or five months, but to start it even earlier would not involve any serious disability or dis-advantage. It is not proposed to have by-washes in this dam, and in that at the township. The discharge would be over the weir.

130. *To Senator Lynch.*—The benefits we ex-pect to obtain from maintaining the flow of the Molonglo River are those which must naturally result from doing away with a dry water course with occasional pools of still water. Under pre-sent conditions the flow of the Molonglo River is very small at times. In fact, you just about know that it is running A flowing stream with a fair volume of water giving 9,000,000 or 10,000,000 gallons a day will be a better propo-sition for Queanbeyan and the reaches immediately below it than we have at the present time, where there is a possibility of water coming from this dam, and being held in pools a little way down owing to the absence of sufficient flow. It will be an advantage to maintain the flow because the water is kept purer in that way. The Molonglo, when it has stopped running, is unsavoury, and an eyesore, and when there are a few thousand people at Canberra, it will be necessary that water should be continually flowing in that stream. It will be healthier. The bed of a dry stream is likely to be used for various purposes, and there is a likelihood of dead animals, &c., accumulating. I cannot give the Committee any figures at this moment as to the saving to be effected by waiting for a supply of cement from Commonwealth works instead of using cement now available. I should have to revise the figures I made originally. We have partly built one dam, and have used a good deal of cement, and I would need to revise my estimate in view of the modified price that we might get from the new industry at Rylstone. At current prices the estimate of the saving of 4s. a cask through the Commonwealth undertaking to manufacture its own cement is about correct, but if a new industry starts, and delivers cement cheaper in Sydney, the estimated saving will be reduced proportionately, although what might happen later on if the price were put up again would be another matter I should be afraid to say at this stage that the saving on the 60,000 casks required to build the dam would be £12,000. I should like to verify those figures, and look into the actual position, I believe that even now we are getting cement at a little lower price than when I made my original estimate If we are going to have a smaller output for Canberra, it involves a very big question with regard to cement manufac-ture, namely, whether we should establish the ce-ment works at Fairy Meadow, or somewhere nearer Sydney. The cost of moving coal, shale, and lime-stone at varying rates must be considered. It might pay the Commonwealth better to move the works

nearer to Sydney. Of course, if we can increase our output of cement for Commonwealth consumption, the price goes down in a marked degree. I think the scheme I put forward two years ago would have to be recast if the Commonwealth intended to go on with it now. It might go on quite different lines. In view of the fact that the importation of German cement has ceased, a shortage has already been created, and we are likely to have a shortage for some years. It might, therefore, pay us to put up a *bigger plant for* ourselves, and make cement for all our works in a central position. I do not think it would ever pay us to make cement for our Western Australian works: it might pay us to make it for our Victorian works, and I certainly think it would pay us to make it for the whole of our New South Wales works. Although there is not a very serious handicap in the point of distance in bringing cement from the Federal Capital to Sydney, as compared with bringing it from Portland to Sydney, they have the marked advantage at Portland in the fact that they *have coal, shale, and* limestone together. Wherever we go, we shall have to train one of these materials. I would rather reconsider the whole project than indorse at this stage my original estimate of saving. We get our cement at present on quotation year by year. There is a coincidence in price amongst the cement agents, but I do not know what the reason is. Some years ago, it seemed to me that the price of Australian cement was always 3d. below that at which we could obtain the imported article, somewhat of a coincidence, and once or twice they have tried to put it 3d. or 6d. above, but I do not think that worked. Still the fact remained that it always kept about the same price as the imported article. I have noticed that tendency for about ten years—since the Commonwealth Portland Cement Company really gained the market. At first they were inclined to let one have cement at a very much lower rate, but as soon as they got their foot well into the market, their price came up to about that of the imported.

131 *To Mr Laird Smith.*—I have not seen a return submitted to the Committee by Mr. Davis in Sydney stating that the contents of the reservoir will be 7,500,000,000 gallons, and that the ultimate capacity of the generating plant would be 3,500 kilowatts. That would be approximately 4,691 horse-power, which is a very big amount. I think there must be some mistake there. I do not think we can generate 4,600 horse-power by passing the available flow of water of that river through a turbine. I think that item has got into the wrong place in Mr. Davis' notes which he took from us. The question of providing sufficient water flow has received *consideration*, but in working it out for the last two years I have found that if we had been running off 15,000,000 gallons we should have had the level of the dam down to 35 feet.

132 *To Mr. Finlayson.*—The disabilities referred to by me in my statement, as caused by the cessation of flow, were a shortage in the water supply for Acton, and for the Military College at Duntroon. The bacteriologist said we were getting polluted water at the college. We had 50,000 gallons of roof water stored there in tanks, but the situation was getting so serious that I did not know what we were going to do for water for the college. Colonel Miller also kept on writing to me asking me what I was going to do to provide water at Acton. It was suggested, although not by Colonel Miller, that we should put in a 6-inch temporary pipe from the Cotter, but that was impracticable. We made extra wells. In his last letter Colonel Miller said he refused to take any responsibility because of the absence of water. That letter came to me partly obliterated, because the mail coach had got turned over when trying to cross the river in flood. The position, nevertheless, had been very serious there. It looked as if we were going to have a water famine, the effect of which on Canberra would have been bad. The disabilities can be best overcome by pushing on with the Cotter River supply, and getting the reticulation *from that supply completed* rather than by pushing on with the Queanbeyan dam. If a temporary pipe were laid we could, within six months, supply Acton and Duntroon with the Cotter River water. If, on the other hand, we are to lay the pipe underground, as we should do, the time will depend upon when the city plan will be ready. As soon as the plan is prepared, approved, and surveyed, we should go on with the reticulation to make the Cotter River supply available. I have quoted the years 1912, 1913, and 1914 in referring to the Molonglo River supply, and I *think they were* average years. The Molonglo goes dry, or, at least, stops running each year. I have said that, in 1912, the natural flow of the Molonglo stopped for seventeen days, in 1913 for ten days, and 1914 for thirty-eight days. These cannot be considered abnormally dry years, and we should not close our eyes to the fact that we have reason to apprehend years of more severe drought. I believe that Mr. Griffin's latest figure for the highest level of the artificial lakes is 1,845 feet. I should hesitate to say that one dam on the Queanbeyan would alone be sufficient to keep the lakes *going. There would* be no very decided advantage in having a heavy flow of water through the city area during the next two or three years. Even if these lakes were not constructed "reaches" of water could be provided by the construction of small and easily-built dams or locks across the river, until such time as the ornamental lakes were formed. Though it may be near an encroachment upon the functions of Mr. Griffin, my personal view is that it would be an advantage during the next few years to build a series of small weirs or locks so as to *avoid the inter*ruption of works being carried out at the Capital which might be caused by a heavy pressure of water at the city. I do not think we should make any heavy water pressure in the way of lakes or sheets of water until we get the main sewer right through that country. There are beds of gravel in the river which it would be of advantage to be able to use for concrete. Though we could supply Acton and Duntroon with water from the Cotter River, and by the construction of a series of small weirs along the Molonglo could store water without disadvantage to the progress of works at the Capital Site, I am of opinion that eventually the building of the Queanbeyan dam will become an absolute necessity, and that a somewhat similar dam on the Molonglo River will also be found to be necessary. Estimating the increase of population at the Capital Site at 1,000 a year I consider that five years hence this Queanbeyan water supply will be a necessity. With a population of 5,000 at the Capital the position would not be satisfactory unless the supply were provided for. The construction of the dam is not a work of immediate urgency, but it should be completed within the time I have stated.

133. *To Mr. Sampson.*—The area covered by the square including the boundaries of the Federal Capital was originally 9 square miles, but I think it is now 16 square miles. The area covered by the proposed lower lake would be 3 square miles and by the upper lake about 2½ square miles. A portion of the area covered

by the lakes would be outside the square referred to, but the lake area within the square would stretch from boundary to boundary of the city site with an average width of about half a mile. I think that unless they were forced to do so people would not build on both sides of the lakes, but if they did so the effect would be, as you have suggested, to have two cities, one on each side of the lakes growing up in competition with each other, but *I do not regard that as* a very likely development. You are not considering the construction of the proposed lakes now, but the Queanbeyan dam will be necessary to maintain the flow of the Molonglo River.

134. *To Senator Keating.*—In answer to Mr. Finlayson I said that I would not use the Molonglo water as it is at present for drinking, but I would use the Cotter River water for that purpose. To use the Queanbeyan water as potable water would mean a survey at once of the catchment area, and the prohibition of pastoral occupation *within that area. I believe that* some years ago the Director of Lands and Survey reported unfavorably upon such a proposal. It was pointed out that the catchment area was partly pastoral country, that a good deal of it was cleared, and that owing to the nature of the soil making the water from it very muddy it would be necessary to provide for sedimentation in conjunction with any scheme for a potable supply from that river. Though I have not seen their representations I have heard that residents of Queanbeyan have suggested the desirableness of providing, by the construction of the proposed dam, a water supply for that town. If that were decided upon the protection of the catchment area from pollution and responsibility for the purity of the water would, I think, be a matter for the consideration of the State Government. In its present condition the water is certainly not potable. I have said that one of the objects to be attained by the construction of the Queanbeyan dam is to reduce the volume of flood waters at the Canberra plains during heavy rainfalls on the Queanbeyan River catchment area. I doubt whether it will be possible to *prevent flooding*, but it is important to reduce it as much as possible. We may get rains on the Queanbeyan River catchment area which would fill the basin in a few days, and if we had another two or three days' heavy rain on that area combined with heavy rain on the Molonglo River catchment area we should certainly have floods. I cannot say that the dam would entirely prevent floods, but until it was full it would prevent small floods. This is not a consideration of immediately pressing importance, nor is it of pressing importance to maintain the circulation of water *and compensate for evapora*tion of the ornamental waters at the city site. As an immediate proposition within the next five years I regard the first object mentioned in my notes—to maintain the flow of the Molonglo River—as the most important consideration. Lakes, or no lakes, I consider the attainment of this object of sufficient importance to warrant the construction of the dam within the next five years. I fix that period by our estimate of the growth of the population at the Capital Site. In my notes I have set down the three objects to be attained by the construction of the dam in the order of their relative importance. When the Molonglo River ceased to flow the water became smelly. One could smell it in the bath, even after it was filtered. The bed of the stream became dry with debris in it which is a thing to avoid where there is any large population. A dry river is objectionable in any locality close to population. One of the main reasons at present for increasing the flow in the Molonglo is to supply circulating water for the power-house condensers. It would hardly serve the same purpose simply to raise the present weir. There is only an earth dam at present, with a puddled core. The water used for power-house purposes is returned again into the river so as to get cooled. When it has been cooled it can be used again. When it gets warm it does not give the same efficiency in the condensers. We have returned the circulating water to low down near the dam so as not to return it to the same spot, as by that means it would have a tendency to come down to the ordinary atmospheric temperature. We have a fine volume of water there now. I have said that no serious delay would take place in the work, and no serious hurt would come to the Federal city if the dam were not completed within five years, and that from the time of starting the work it would take about eighteen months to two years to complete the Queanbeyan dam. As to the question of whether it will be a safe thing to leave the commencement of the work over for another three years, there is another attribute which cannot be disregarded from an engineering point of view. That is the question of maintaining a constant flow of work so as not to have high peaks of employment followed by periods of depression of employment. If we had all these big works going on at once we should have a period with an enormous amount of employment falling away to nothing. But if we could have a *dam like this to follow* on the Cotter dam, or in conjunction with other current works, it would be the best proposition. It would also be the best policy to maintain a constant rate of expenditure for the Commonwealth per month or per annum. From that point of view it would be better to start this dam just before we are going to tail off with the Cotter dam. Of course, the construction of a branch line of railway, or the starting of the cement works, might possibly take the place of this work for the time as a factor in giving employment. Other works might be introduced *which would vary the rotation* in which different undertakings were begun. We could divert labour from one project to the other, and give it precedence in a great series of works.

135. *To Mr. Sampson.*—It would not be a better method to supply Queanbeyan with water by constructing a cheap weir just above the town, and having a pumping plant. I am not at all sure about the catchment area. There are roads passing quite near within the catchment area, and you will not get a suitable basin for impounding water. It would not be a better proposition than to *run a main down from the dam.* The pipe from the dam is only a small proposition. I believe it is estimated that it will cost about £11,000, but I do not think your idea of constructing a cheap dam near the town and pumping water would do. You would get an unfortunate proposition in the way of a basin—a large, shallow area with the great possibility of pollution. I do not think your suggestion would be satisfactory, even if it were cheaper.

136. *To Mr. Laird Smith.*—With regard to Mr. Finlayson's suggestion to build a number of small weirs, there would be *great danger* of the weirs being washed away, in view of the existence of alluvial flats there. The water did get round the corner and outflanked one of the wings of the existing weir. That difficulty can be overcome by protecting the banks.

The witness withdrew.

Appendix.

COMMONWEALTH OF AUSTRALIA.

Attorney-General's Department.

Opinion.

The Secretary to the Parliamentary Standing Committee on Public Works has forwarded the following memorandum for advice:—

"Whilst investigating the question of the proposed construction of a dam on the Queanbeyan River to control flood waters, &c., the suggestion was made by the Queanbeyan Municipal Council that an arrangement might be made whereby the Commonwealth would supply from the dam, water for the use of the inhabitants of Queanbeyan.

Will you be good enough to favor me with your advice and opinion as to whether there would be any constitutional objection to the Commonwealth entering into an arrangement of this kind and making a charge for the water supplied?"

The Commonwealth has absolute control over the Territory for the seat of Government, but I do not think that under that power the Commonwealth can undertake the supply of water to towns in a State, even though the towns are adjacent to the Capital Territory. I do not think, however, that there would be any constitutional objection to the Commonwealth and the local government authority of Queanbeyan jointly entering into a scheme for the carrying out of the water supply for the Territory and Queanbeyan.

R. R. GARRAN,
Secretary, Attorney-General's Department,
5th March, 1915.

The Secretary,
Parliamentary Standing Committee on Public Works,
120 King-street,
Melbourne.

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