ASSESSMENT REPORT NO.12

ALICE SPRINGS FLOOD MITIGATION DAM

A report on the assessment of potential environmental impacts

Environment Unit

Conservation Commission of the NT

October 1990

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1. INTRODUCTION

This report assesses the environmental impact of the Alice Springs Flood Mitigation Dam proposal at Junction Waterhole on the Todd River, as presented in the draft and final Environmental Impact Statement (EIS). The report also reviews the proponent's response to comments received on the proposal during the public review period.

Included in the report is a discussion of potential impacts both beneficial and adverse on the bio-physical and socio-economic environment. Recommendations are made on how adverse effects should be minimised or avoided.

The report forms the basis of advice to the Minister for Conservation on the overall environmental acceptability of the proposal.

1.1 Environmental Assessment History

The proposal is to provide for flood mitigation in Alice Springs by constructing a dam on the Todd River. Following the 1988 floods the Chairman of the Power and Water Authority (PAWA) notified the Minister for Conservation in accordance with the Environmental Assessment Act 1982 of the intention to construct a flood mitigation dam on the Todd River at the Alice Springs Telegraph Station Historic Reserve. PAWA was directed to prepare a draft EIS as required under the Act. Guidelines for the preparation of the draft EIS were compiled by the Conservation Commission of the NT (CCNT).

During investigations for the draft EIS and the engineering feasibility study, a number of constraints emerged which affected the feasibility and acceptability of the Telegraph Station site. PAWA therefore commissioned investigations further upstream at Wigley and Junction Waterholes.

Junction Waterhole was subsequently determined to be the more suitable site and detailed investigations for the draft EIS commenced, using the original guidelines but with site specific amendments where relevant.

The draft EIS was released by the Chief Minister on 7 June 1990 and placed on public display for 28 days until 6 July 1990 with an invitation to the public to comment on the proposal. (See Appendix 1 - advertisement). Copies of the draft EIS were also provided to NT Government advisory bodies.

During the display period, the Central Australian Conservation Council (CACC) held a public meeting chaired by the Mayor of Alice Springs. There were speakers representing PAWA, CACC and Aboriginal people at the meeting as well as two individuals speaking about levee banks and concerns about the dam proposal. The meeting

was very well attended with 300-400 people present. Numerous questions were asked of the speakers. At the end of the meeting with less than 100 people present and the Chairman having left, a number of resolutions were passed. The resolutions related to the limited public review period, were against a recreation lake, questioned PAWA's ability to consider all the issues and the manner in which the Government dealt with Aboriginal people. These matters are covered elsewhere in this report.

A total of 66 submissions were received on the draft EIS. These were made available to PAWA to be taken into account in the preparation of the final EIS. As a result of the issues raised by the respondents PAWA carried out additional, detailed analyses into various aspects of the proposal.

1.2 Objective of the Proposal

The objective of the proposal is to protect the town of Alice Springs from floods of an intensity up to the Australian Standard of 1% (100 year) probability, that is, a flood which might be expected to occur once every 100 years. This is the flood event adopted throughout Australia as the design standard for land use planning and flood plain management.

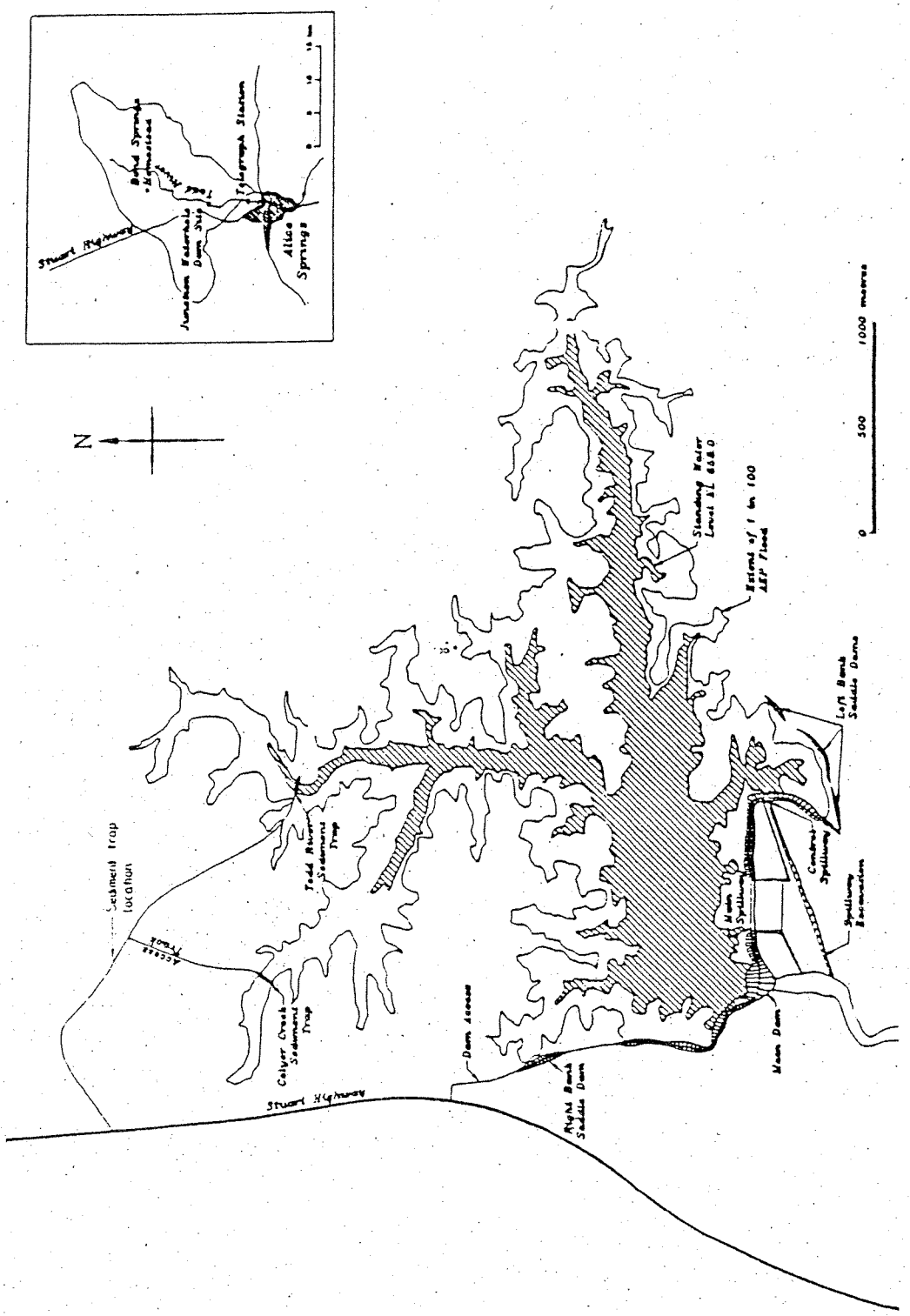
1.3 Description of the Proposal

For a detailed description, refer to Section 4,"Project Description" and Appendix A of the final EIS.

To achieve the objective it is proposed to construct a dam near Junction Waterhole on the Todd River some 9 km upstream from Alice Springs. The main dam wall will be located in a steep sided valley about 800m downstream from the waterhole. It will be of zoned earth and rock fill construction with a top bank 36m above the river bed.

The embankment will extend both to the left and right of the main dam wall, about 1300m to the left and 900m to the right. The total length is about 2300m and the embankment varies in height from 0m to 14m. Because of the topography it is necessary to construct saddle dams across ridges on both banks.

There will be two spillways at different levels, both on the left bank and discharging into a valley to the south of the bank. The control spillway will be 22m above the river bed in the left embankment through a saddle 900m east of the river and main dam. This spillway will throttle floods up to the 1% (100 years) floods to within bank capacity of the river through the town. The main spillway 250m wide, is located 350m east of the river. The main spillway level is 29m above river bed level. It only operates for floods greater than the 1% (100 year) flood.



TODD RIVER
FLOOD MITIGATION DAM
JUNCTION WATERHOLE

GHD

FIG. 2.2

GENERAL ARRANGEMENT OF PROPOSED DAM.

A spillway channel will be excavated in the valley south of the left bank. This channel discharges into the river about 150m downstream of the main dam. The excavated material will be the main source of fill for the dam. A small diameter outlet will be located in the main dam at bed level capable of draining the dam. With the control spillway 22m above the river bed there will be standing water in the dam with a surface area of up to 150ha depending on the season.

There will be two sediment traps upstream of the dam, one in the Todd River and one in Colyer Creek, a tributary to the Todd. Because the dam will affect the sediment carrying capacity of the rivers and is expected to induce scouring downstream, sediment and sand will be excavated from the traps and placed in the spillway channel to recharge the river with sand and gravel.

Approximately 1400ha of land will be purchased from Bond Springs Station to accommodate the dam, the area likely to be inundated and including a buffer area.

1.4 Major issues and impacts

The assessment of the EIS and the submissions raised the following major issues and potential impacts.

- inadequate assessment of some of the alternatives to the preferred dam at Junction Waterhole e.g. levee banks and smaller dams;
- potential degradation of the Todd River bed due to the dam interfering with sediment movement when the river flows;
- potential loss of river red gums from the river, in particular from the section through the town;
- the flood warning time available with the various options;
- potential for additional uses of a flood mitigation dam, e.g. recreation and/or water supply;
- impact on sacred and significant Aboriginal sites;
- potential for the loss of habitats of two rare species: water pimpernel (plant) and Quartz Gecko (reptile);
- effect of a dam on small flows in the river.

2. THE NEED FOR THE PROPOSED DAM

The guidelines for the EIS required that the need for flood mitigation in Alice Springs be examined. PAWA has addressed this issue in Section 3, "Project Substantiation" of the EIS. In addressing this issue the EIS considers the history and potential damage of flooding, a dam at Junction Waterhole and alternatives to the dam. This part of the assessment report summarises and reviews the information in the EIS and the submissions.

2.1 Flood History and Damages

Between 1910 and 1988 there have been 13 floods of varying magnitude in Alice Springs with the largest occurring in 1910 (80 year flood), 1921 (40 year flood), 1983 (20 year flood) and 1988 (50 year flood). In 1979 it was realised that there was potential for severe flooding based on rainfall recordings since 1874 and river flow recordings from 1952. Current assessment is that the river through the town can be expected to burst its banks once every 6 years.

There are three catchments contributing to flow in the river above Heavitree Gap, the Todd River, Charles River and the town drainage system. The Todd River catchment is by far the largest catchment, being four-fifths of the total catchment of 512 km^2 and therefore the prime contribution to flooding.

Typically it takes about 4 hours from the peak of heavy rain in the Todd River catchment for the river to reach its peak through the town and about 12 to 18 hours to subside. Peaks from the town drainage system generally reach the town earlier, thus contributing less to peak flows through town. An analysis of the flood peaks from the Charles River revealed there is no consistent trend in when the flood peak reaches the Todd River. PAWA therefore assumes that it rides on top of the Todd River peak.

Following the 1988 flood, the Centre for Resource and Environmental Studies (CRES) at the Australian National University was commissioned to assess damages caused by that flood. CRES estimated that about 250 residential and commercial properties were flooded with water entering 225 buildings with water reaching a level of several centimetres only in most buildings. Total tangible damages (direct and indirect) were assessed at $3.5 million (Appendix F of the EIS).

The cost of damages caused by floods of various magnitudes are estimated in some detail in Appendix N of the EIS. PAWA estimates that there are 1068 residential and 572 commercial properties in the 1% (100 year) flood prone area of the town. A total of 1057 of these properties are

likely to be flooded above floor level in a 1% (100 year) flood. Flood damages are estimated to total $25.5 million. Flood damages for a 0.2% (500 year) flood are estimated at $47.6 million.

An estimate is also given of the Annual Average Preventable Damage (AAPD) for the various alternatives under consideration. A dam at Junction Waterhole has an AAPD of $0.54 million whilst full height levee banks through the town have an AAPD of $0.25 million. Combinations of dams and levee banks have AAPD values between these two values.

The proponent then describes the intangible damages which it contends cannot be expressed in monetary terms. There are the deaths such as 3 people in each of the 1983 and 1988 floods. There are emotional and stress related health problems of householders who suffered overflow flooding. Some racial tension developed between black and white people.

2.2 Junction Waterhole Dam

As mentioned in Section 1.1 a dam at the Telegraph Station was considered after the 1988 flood. However, due to constraints at this site, investigations commenced at two sites further upstream. A dam in the Junction Waterhole area emerged as the preferred proposal.

Since 1979, estimates of flood peaks in the Todd River have increased. This increased estimate is due to further rainfall and river flow records, improvements in computer modelling and an upgrading of rainfall intensity statistics Australia wide.

The 1984 Board of Inquiry into the Telegraph Station recreation lake considered Junction Waterhole as an alternative site but with limited flood mitigation potential. Due to the increased flood peak estimates a higher dam wall was considered in the re-evaluation of this site. With the higher dam the valley widens considerably, providing a greater storage volume and it appeared that Junction Waterhole had potential as a flood mitigation dam comparable to a dam at the Telegraph Station.

Further investigations showed that a 36m high dam at Junction Waterhole in the Todd River would reduce peak flows at the Charles River junction from 1450m^3/s to 540 m^3/s. This achieves the objective to mitigate the 1% (100 year) flood so that it does not cause flooding in the town. The within bank capacity of the Todd River through the town is 675 m^3/s. It thus has sufficient capacity to take the mitigated flow as well as the flows from Charles River and the town's drainage system.

2.3 Alternative Flood Mitigation Measures

Section 3.03 of the EIS examines various alternatives to a flood mitigation dam at Junction Waterhole. The section also lists the existing flood plain management measures implemented since 1979. These measures are:

- zoning of flood affected land and development controls.
- building controls.
- flood proofing of buildings.
- flood insurance.
- public information brochure and education.
- remotely controlled flood warning stations in the catchment.
- counter-disaster planning.
- levees (limited extent).
- river channel improvements including sand extraction.
- incorporation of retarding basins into subdivision drainage design.

Even in total these measures are limited in the extent to which they reduce, rather than prevent, damage from general river flooding.

The alternatives considered are:

- levee banks along the river sections through the town.
- two dams on the Todd River upstream of the Junction Waterhole, either separate or combined.
- dam at Wigley Gorge below Junction Waterhole.
- diversion channel from Wigley Gorge to Emily Creek east of the town.
- further river channel improvements.
- replacement of the Casino Causeway with a bridge.
- catchment management and revegetation.

The main criteria are that the objective is achieved, that it is achieved at an acceptable cost and with the minimum environmental impact. As stated above the objective is to contain the 1% (100 year) flood to within the river banks through the town.

The two dams upstream and the dam at Wigley Gorge below the preferred site were rejected by the proponent because they did not achieve the objective and/or were too costly. Similarly, the diversion channel to Emily Creek was also rejected as it would cost $44 million to achieve the objective.

Minor river channel improvements and replacing the Casino Causeway were rejected because the flood mitigation provided would be minimal. Major channel improvements such as deepening and widening were also rejected by the proponent because the environmental impacts would be unacceptable.

Catchment management and revegetation is not considered by the proponent to be likely to cause any reduction in flood flows in the river. (See Section 3.3 of this report and Appendix E of the EIS).

Levee banks were rejected by the proponent because the disadvantages were considered to be greater than the cost advantage. Levee banks would be cheaper than the dam. However, levee banks provide flood protection only to the design level, in this case the 1% (100 year) flood. Not all areas would be protected as the river would run slightly above normal peak, ie there is no reduction or delay in the peak. Local drainage would back up as a result and flood waters would escape at levee discontinuities. The potential for scouring in the river is greater as flow velocities will be higher. Maintenance costs are estimated to be higher than for the dam. The risk of levee failure could not be totally removed without expensive protection work. It was also estimated that about 290 trees would be adversely affected by the banks. The proponent also suggested that the levee banks would not be aesthetically acceptable as they would be up to 1.5m high thus interfering with views of the river.

The levee banks were originally proposed by a local resident in June 1989. His submission to PAWA was included in the EIS as appendix H.

The Central Land Council (CLC) employed a consultant to review PAWA's proposal. The consultant agreed that levee banks rarely are a complete solution to flood mitigation. However, it was suggested that at a smaller scale they could be used to complement a smaller dam.

Many other respondents considered that the levee banks had merit and warranted further consideration. In particular it was suggested that levee banks combined with a number of smaller dams throughout the catchment would achieve the objective at a reasonable cost with a minimal environmental impact. There were no comments on the other options rejected by the proponent.

In its review of the draft EIS and the submissions PAWA further analysed the levee banks, multiple dams in the catchment and combinations of the two. The levee bank option is further developed in Appendix I of the EIS by considering various heights of the levee banks. The river banks have been surveyed to determine the area available for levee banks, to establish the number of trees that must be removed and to determine more precise earthwork quantities. Concrete block walls will be used in some confined locations and to avoid significant trees. 130 trees will have to be removed even for lower levee banks in combination with one or more smaller dams.

In Appendix P the proponent assessed whether a number of 6m high and 12m high dams throughout the catchment will provide the necessary flood mitigation. 6m is the minimum height necessary to provide any effective flood mitigation. The topography of the catchment limits the number of 12m dams that can be constructed. PAWA concludes that as many as fifteen 6m dams or five 12m dams are insufficient to achieve the objective. It appears, however, that a combination of dams and levee banks will provide the required flood mitigation.

The other main issue raised by many respondents was whether the dam at Junction Waterhole should be a "full" or "empty" dam. The full dam has a standing water level of 22m with a surface area of 150 ha. The empty dam has no standing water but empties out after each flood. In terms of structural differences the empty dam has an outlet tunnel at river bed level whilst the full dam has a control spillway 22m above river bed level and its dam wall is 1m higher.

In its review PAWA has further analysed the full and empty dam options (Appendix A of the EIS). The analysis shows that the full dam performs better than the empty dam. The rate of rise of the flood peak is less for the full dam thus providing a longer flood warning time. The reason is that flood flows entering the full dam have to cause a rise in some 150ha of water surface for the water to flow over the control spillway whereas for the empty dam no such water surface is available for the initial flows.

Another advantage of the full dam is that it would take 400-450 years for the dam to silt up to its standing water level (9500ml volume). During the same period it is estimated the empty dam would lose 60-70% of its initial 9500ml storage capacity due to siltation. To compensate for this loss in volume the dam embankment would have to be raised another 1.0m thus adding to its costs.

PAWA's preferred option is therefore the full dam. PAWA also suggests that a full dam has added advantages as it could be used for recreational and/or water supply purposes.

2.4 Costs

Many respondents, including CLC's consultant suggested that the empty dam will cost less than the full dam. PAWA's revised estimates in the final EIS are $19.4 million and $19.9 million respectively. The full height levee banks are the cheapest option at $7.0 million.

Annual costs for operations and environmental protection and monitoring have also been estimated. For the dam these costs are $69,000 pa which includes $36,000 for the carting of sediment around the dam. The remainder is for regular inspections. There appear to be no provisions for

work required as a result of the inspections. Annual maintenance of the full levee banks is estimated to cost $181,000. The main components are watering, mowing and upkeep of the watering systems. It is essential to maintain the grass on the levee banks so that their stability is not impaired.

Capital costs for the multiple dams and combinations of levees and dams range up to $22.5 million. Operation and maintenance costs are higher than for the dam or the levee banks alone.

Using these costs and the AAPD, a benefit/cost ratio has been determined for each of the options considered. The dam at Junction Waterhole, full height levee banks and a combination (four 6m high dams and medium levee banks) have about the same benefit/cost ratio. The other options or variations are not as good as these three options. It should be noted that the estimates for the multiple dams do not include a number of studies that would be required to further determine their feasibility.

Not considered in the cost estimates is the purchase of land from Bond Springs Station which would be required for all the various dams.

If in the future it was decided to change the empty dam to a full dam PAWA estimates this would cost about $5.0 million. If it is decided to use either dam for recreational and/or water supply purposes then there will be additional costs to provide the facilities and infrastructure. Operational and maintenance costs will also increase.

2.5 Conclusion

For the purpose of flood mitigation and protection in Alice Springs, it is concluded that this will be achieved by a dam at Junction Waterhole, full height levee banks only or four 6m high dams in combination with medium height levee banks. The other alternatives do not achieve the objective or are too costly in achieving the objective.

The advantages and disadvantages of the three options are further considered in the following sections of this report.

3. BIOPHYSICAL ENVIRONMENT, IMPACTS AND SAFEGUARDS

This section reviews the descriptions of the biological and physical environments affected by the flood mitigation proposal, the predicted impacts and the proposed safeguards to alleviate the impacts. Included is the catchment area above the town as this influences flows and floods in the Todd River.

The environment affected by the dam includes the area to be inundated, the dam wall and spillway channels, the river downstream of the dam through the town and Heavitree Gap to the floodout area south of the town, and the township of Alice Springs.

The levee banks affect the river through the town to Heavitree Gap and south towards the floodout area, as well as the town.

Both the draft and the final EIS describe in varying detail the different components of the environment at the Junction Waterhole site. The river downstream of the site and the town is described as part of the project substantiation and project description.

There are no specific descriptions of the sites considered for the multiple dams apart from the general description of the catchment in the EIS and in Appendix E. The sites have not been inspected.

3.1 Flora and Fauna

Local consultants were commissioned by the proponent to survey and report on the flora and fauna of the dam site and the area to be inundated at Junction Waterhole. The report adequately describes the area considering the limited time available from the field survey (10 days in February 1990) and the time of year it was conducted. The report also relies on local knowledge.

Four habitats were identified, only one of which is relatively uncommon in the region. The report notes that the Alice Springs Telegraph Station Historical Reserve and its northern extension immediately south of the dam site have been extensively surveyed over the years whilst little work has been done in the Junction Waterhole area.

Although many plant species are common to both areas there are also many species that occur in one area but not in the other. The difference in habitat is attributed to the underlying geology. It was also observed that the Junction Waterhole area had fewer introduced species and weeds than the Telegraph Station. This difference is attributed to the greater use that the Telegraph Station has been subject to.

One rare plant species, a water pimpernel (Samolus eremaeus), was identified at Junction Waterhole. This plant is known to occur elsewhere in the region.

Two fish species are known to occur in the Todd River.

Little reptilian and amphibian activity was observed during the survey because of unsuitable conditions at the time. However, based on the similarity between the Telegraph Station and the Junction Waterhole habitats it is expected that many species known to occur at the Telegraph Station will also occur at the Junction Waterhole. The rare Quartz Gecko (Diplodactylus galeatus) is expected to occur in the Junction Waterhole area although it was not observed there during the survey. It has been recorded at the Telegraph Station Reserve which provides protection for its habitat.

The birds and mammals observed or expected to be in the Junction Waterhole area are neither uncommon or rare. Inundation is likely to displace many species but none are threatened overall. The presence of a dam is likely to attract many birds that presently do not utilise the area.

In describing the Todd River below the dam site both the EIS and most of the submissions focus on the river red gums that line the watercourse. PAWA has estimated that there are about 2000 trees in the river reach through the town.

Potential Impacts

The main potential impact of a dam at Junction Waterhole is the loss of vegetation in the area to be inundated, and the loss of river red gums downstream of the dam due to scouring in the river bed. The old gum trees provide an important habitat for many birds and bats. This habitat will be lost if the trees are lost.

The construction and operation of the dam is expected to increase the number of introduced plant species and weeds to the surrounding area because of the increased activities there.

Some flora and fauna habitats will be lost at the dam and damwall as well as in the inundated area. The habitat of the rare water pimpernel will be lost as it is at the main dam site.

Using aerial photographs PAWA has estimated the number of trees likely to be affected by the various options under consideration. This information is given in table X of Appendix Y.

Trees and shrubs must be removed from the area above the dam affected by the standing water of the full dam option. This loss of flora and fauna will be permanent if the full dam is constructed.

Less vegetation will be affected by the empty dam as clearing will not be necessary in the flood water storage area as inundation will only be temporary. Some long term effects can, however, be expected because of sedimentation. This situation is the same for the multiple dam option.

The trees immediately below the main dam but above the outlet of the spillway channel into the river will not be affected to any great extent. It is, however, possible that as the outlet from the empty dam bypass this area the trees may get insufficient water.

PAWA estimates that about 130 trees must be removed for the levee banks.

A few of the respondents pointed out that a permanent waterbody will attract birds and animals that are not native to the Central Australian environment. They were concerned that birds and animals would displace the native birds and animals. There are two points to note in this regard. Firstly there is a large existing waterbody located south of the town that has become a well established habitat for waterbirds, many of them not common to the area. This is the sewage ponds at the Commonage which have in recent years become a recognised bird observation area. The other point is that feral animals are already a problem in Central Australia.

Most respondents have raised the loss of river red gums from the river as one of the most important issues. The river with its river red gums is seen as one of the town's most important natural features and assets. Any changes to the river, including the loss of the trees, are seen as a loss of that asset. The loss of the trees along the river would severely and adversely change the town's landscape and amenity. This is a reason why many of the respondents are opposed to the flood mitigation dam and some are opposed to any flood mitigation.

With a dam on the river it is expected that scouring will increase downstream as sediment and sand are trapped in the dam (see later section). As the supply of sand and gravel is restricted, increased scouring is expected. The increased scouring will remove sand and other sediment from around the trees in the river, eventually leading to their death and loss from the river. The same will occur with the multiple dam options.

With the levee banks the proponent makes the point that flow velocities will be greater if the water is confined within the levee banks than with no levee banks. The greater velocities are expected to increase scouring in the river, leading to loss of sand and other sediment and thus causing the eventual death and loss of trees from the river.

Safeguards

The main safeguard proposed by the proponent to protect the river red gums downstream of the dam is to remove the sand and gravel (bed load) from the two sediment traps above the dam. This bed load will be transported to and placed in the spillway channel below the dam. When the river flows over the control spillway the bed load will be mobilised and transported downstream as if the dam had not interrupted this normal process. This transport of sand and gravel will counteract the expected increase in scouring and loss of trees downstream of the dam, and will be necessary whether the dam is full or empty. Transport of sand will also be necessary for the multiple dams option.

As the habitat of the rare water pimpernel in the area will disappear, root stock and seeds will be collected for propagation. The Conservation Commission will be approached to carry out the collection and propagation. It is hoped that a suitable habitat will be formed once the dam is completed and that the plant can re-establish itself there.

Similarly, seeds will be collected from the river red gums in the area to be inundated by the standing water of the full dam option. These will be propagated and eventually transplanted in suitable habitats established around the full dam. Again, the Conservation Commission will be approached to carry out this work.

3.2 Geology

The EIS describes in sufficient detail the regional geology and the geology at the Junction Waterhole dam site. More detailed information is given in Appendix A which outlines the engineering feasibility studies carried out for the dam. Included in these studies were investigations into the bearing capacity of the ground and rock formations at the dam site to establish earth and rockfill dam. The permeability of the site was also tested. In both cases the dam site was found suitable but excavation to solid rock and grouting will be necessary.

The submissions made few references to this aspect of the proposal.

Potential Impact:

The main impact will be at the dam site where excavations will be necessary to form a solid foundation for the dam wall. Excavation will also be necessary for the spillway channel which will in fact be the main source of rock and earth for the dam wall.

Safeguards:

Construction activities will be confined to the dam site, dam wall and spillway channel and to the two sediment traps to be constructed upstream of the dam and to borrow pits. Access to the construction areas and borrow pits will be strictly controlled. Important areas requiring protection will be fenced off.

When construction is completed all disturbed areas, access tracks and borrow areas no longer required will be rehabilitated. Rehabilitation will be carried out under the supervision of the Conservation Commission.

3.3 Sedimentation and Scouring:

Sedimentation and scouring are perhaps the most important aspect of the flood mitigation proposal whether it be a dam (full or empty) or levee banks, and was raised in one form or another by most respondents.

The EIS gives detailed consideration to this issue both in the sections on the project description and the environment as well as in two of the appendices. Earlier studies referred to in the EIS have shown that there is a significant transport of sediment by the Todd River, both as suspended load (principally clay and silt) and bed load (principally sand and fine gravel).

Appendix E is a situation report on the catchment of the river dealing specifically with sedimentation. Appendix G is a report on a degradation study of the river downstream of the dam. Appendix E concludes that high soil loss will occur from the Todd River catchment in its natural state. Relevant factors include rainfall, soil, relief, slope and vegetation. The catchment falls within the climatic zone in which soil loss from a landscape is maximised. The Todd River is the only river within a reasonable distance of Alice Springs which has a significant source of fine sediment in the catchment. This factor must be considered in the design and costing. The Todd River throughout its length is a river whose nature and morphology is dependent of high sediment loads.

Appendix G reported on a degradation study of the river section downstream of the dam to the confluence with the Charles River. A simulation program designed to analyse scour and deposition in a river was used. Predictions are difficult to make because of the difficulty in modelling the process. However, it is estimated that there will be a drop in the river bed level in the section studied if there is no replenishment of suspended load and bed load below the dam. Although no simulation has been carried out for the multiple dams it is expected that scouring will occur downstream of each dam.

As mentioned above, most respondents raised the issue of scouring and potential changes to the river downstream of the dam. They are concerned that any changes to or interference with the flow of water will deteriorate and permanently change the river's natural state. Comments were also made about the state of the catchment.

It is contended by some respondents that cattle grazing in the catchment is the main cause of the erosion problem and therefore the high sediment load in the Todd River. It is suggested that grazing should be prohibited and that the catchment should be rehabilitated.

Studies referred to in Appendix E found that only about 4% (about 1500 ha) of the catchment is suitable for rangeland reclamation. A study of aerial photographs indicate that few changes have occurred over the last forty years (Appendix E). Following the rain in recent years regeneration of native vegetation has reached its full potential. Appendix E also states that wildfire in the catchment contribute greatly to the loss of vegetation and consequently to the sediment load in the river.

Prohibiting grazing is unlikely to lead to reduced erosion as it is the nature of the catchment that causes the high sediment load in the river.

With full height levee banks and no dams there will be no interference or interruption to the movement of suspended load and bed load when the river is flowing. Upstream of the levee banks there should therefore not be any changes to the river. However, through the town, where the levee banks will be located, changes can be expected.

Appendix I addresses the levee bank option and states that by confining the flood flow to the river channel, velocities and scour would be increased. Depth of scour would increase and would be greatest during the flood peak.

Potential Impacts

Any dam on the river will greatly reduce the movement of suspended load and bed load when the river is flowing. In particular, the bed load, the coarser material, will settle out while the water is confined behind the dam. New load will be mobilised below the dam and scouring will result as the supply of bed load and suspended load diminishes over time. River bed level will be lowered. It is likely that the course of the river channel(s) will change and that it will become narrower. The effect will be greatest immediately below the dam and reduce as the distance from the dam increases. However, with time, the bed degradation can be expected to reach further and further downstream and at some stage affect the section through the town and below.

The catchment below the dam, including Charles River, can be expected to provide some replenishment of sediment load but not sufficient to compensate for the depletion caused by the dam.

With levee banks the main impact will be on the services located in the river as the depth of scour is increased during flood flows. It is also possible that the levee banks themselves could be endangered. There could also be some changes to the river channels.

Safeguards

Previous studies on the catchment have recommended that sediment traps be constructed above the dam. Appendix E reiterates this recommendation and recommends that there be some means of supply of sediment to the Todd River below the dam so that it can maintain its integrity.

There will be two sediment traps above the dam, one in the Todd River and one in Colyer Creek. As part of the operation and maintenance of the dam sediment from the traps will be taken by truck to below the dam. The sediment will be placed in the spillway channel where it will be picked up by any water flowing through the control spillway of the full dam. Access tracks will be maintained to the sediment traps and there will be an access track along the dam wall to the spillway channel. A similar arrangement will be necessary for the empty dam option. In this case the sediment should be placed in the channel to be excavated below the outlet tunnel.

To overcome the initial scouring of the first flow after the dam has been completed it is proposed to place a quantity of bed load in the spillway channel. This should overcome any initial interruption to sediment movement in the river. The same operation will be necessary for the multiple dams option.

Many respondents questioned the viability and the continuing commitment of future governments to the proposed transport of sediment from the traps to the spillway channel. Many also questioned the estimated costs of this operation. It was contended that costs would be much greater during wet years when large quantities of sediment or bed load will be required.

It should also be noted that this operation can only be carried out when there are no flows in the river. Sediment in the traps can only be removed after the flows have stopped.

The proposed transport of sediment is the only effective means of overcoming what is considered to be the main impact of the dam options - downstream river bed degradation. Any decision to construct a dam in the Todd River commits the present and future governments to an operation, the costs of which could vary significantly from year to year.

The increased depth of scouring caused by the levee banks is likely to affect the services located in the river, eg gas and water pipelines. To overcome this, it will be necessary to relocate the services at greater depth or remove them from the river. Removal is unrealistic because the services are required on both sides of the river. Relocation has been included in the cost estimates.

It should be noted that the water mains crossing the river south of Heavitree Gap recently had to be buried deeper in the river as a result of the 1988 and 1989 floods. These mains had been lifted (floated) by the floods.

3.4 Hydrology

Extensive information on the river's hydrology is provided throughout the draft and final EIS. The feasibility study for the dam at Junction Waterhole is based on earlier studies for other dam proposals, data from stream gauging stations going back to 1970 and rainfall records extending back to 1874.

One issue raised in many submissions and not covered in the draft EIS was the effect the dam, whether full or empty, would have on the smaller seasonal flows in the river. The respondents were concerned that these flows would be stopped altogether. This aspect of the proposed dam has been analysed in detail by PAWA since the release of the draft EIS and is presented in Appendix O of the final EIS.

The conclusion from the analysis is that the dam will only have a negligible effect on the smaller flows. With the full dam, the effect would be to extend the interval between flows after long dry periods. This is because of the evaporation losses during such periods.

The effect of multiple dams on small flows has not been considered in the analysis of combined dams and levee banks. Although the dams are designed to empty after each flood the effect of dams in series on small flows is not known.

Potential impact

Loss of or reduction in the number of small flows in the Todd River.

Safeguards

Both dams are designed to throttle any flood to the 1% (100 year) flood to within the river banks through the town. Both the control spillway and outlet tunnel are designed to allow smaller flows through with no impedance. In the case of the full dam option, there will be a small outlet in the main dam at bed level. This outlet can be used to provide downstream flows during long, dry periods.

The Environmental Management Plan will include monitoring of the state of the river bed after floods and at regular intervals.

3.5 Groundwater and water quality.

The effect of the dam on groundwater in the region is addressed to a limited extent in both the draft and final EIS. The effect on water quality, in particular salinity has only been addressed in the final EIS (Appendix J). Both these issues were raised by some respondents. Some also raised concerns about the floodout area south of town.

Potential impact:

Increased recharging of groundwater above the dam and changes to the recharging regime below the dam.

Possible increase in salinity of water flowing from the dam causing increased salinity in the Town Basin and adversely affecting the river red gums.

There are no significant groundwater environments above the dam.

There are no large scale groundwater systems in the river between the dam and Alice Springs. The impact would be limited to river based vegetation.

Recharge of the Town Basin is dependent upon the duration of flow through the town area. As the dam will generally prolong flows recharge could increase. However, as there may be some reduction in small flows, recharge would, in this instance, be reduced. Water could in this situation be released from the full dam to artificially charge the Town Basin and thus enhance its usefulness. The levee banks could not be used for this purpose.

South of the town it is believe that the Mereenie aquifer is recharged from the Todd River floodout area. The volume of recharge from the Todd is unknown so it is not possible to estimate the effect of any changes caused by the dam. PAWA points out that the catchment controlled by the dam is 360km^2, only 15% of the 2500km^2 catchment of the floodout area. Any changes to the flow regime of the Todd River should have minimal impact on the floodout area.

Safeguards

The environmental Management Plan will incorporate water quality monitoring and monitoring of the river vegetation. Monitoring of the Town Basin will continue.

3.6 Entomology

The main concern is with insects of public health importance. In early 1990 the Department of Health and Community Services' Senior Medical Entomologist conducted a survey of the dam site and the river above and below the dam. The report of the survey is at Appendix D of the draft and final EIS. It concluded that there were only limited numbers and relatively low abundance of mosquitoes in the area. It also concluded that with the fluctuating water levels of the dam sizeable and stable mosquito habitats are not likely to develop. Recommendations were made on measures to prevent additional mosquito breeding. If the measures are implemented then mosquito borne disease should not increase in the area.

Potential impacts

Establishment of mosquito breeding habitats following the construction of the dam leading to increased mosquito breeding and a subsequent increase in mosquito borne disease.

A few of the respondents raised this issue particularly in relation to Encephalitis. One respondent, a speaker at the public meeting, suggested that the dam would induce by cooling, katabatic winds in the evenings. These winds would flow down the river valley bringing with them mosquitoes to the town.

Safeguards

Implement the recommendations made by the Senior Medical Entomologist. The Senior Medical Entomologist considers the dam will be less of a problem than the sewage ponds at the Commonage which is much closer to the town's population.

3.7 Conclusions

The draft EIS was inadequate in that it had not considered or adequately considered all of the potential impacts. The main impacts of river bed degradation and loss of river red gums were addressed in some detail.

The final EIS is adequate in that it addresses in varying detail all the issues raised by the respondents.

The options, full dam, empty dam, levee banks, and combined dams and levee banks all have adverse impacts on the biophysical environment. There is little difference between the full and empty dam options in this regard except the loss of flora and fauna from the permanently inundated area.

It is difficult to distinguish between the dam and the levee banks. The dam's impact will extend over a longer section of the river than the impacts of the levee banks, in particular upstream of the town. However, the impact of the levee banks on the river red gums in the town section of the river could be much greater than that of the dam. This is provided that the proposed transport of sediment around the dam is implemented and continued throughout the life of the dam.

The combined dams and levee banks will have the combined impact of each dam and the levee banks.

Many of the respondents were very much concerned that anything done to the river, whether for flood mitigation and/or recreation purposes, would have some unforeseen adverse impact that cannot be rectified. They contended that the river is best left alone and that the town would have to live with the threat of flooding. Some of the respondents who made this observation live in the flood prone areas and are well aware of the flooding problem.

4. SOCIAL ENVIRONMENT, IMPACTS AND SAFEGUARDS

This chapter reviews the examination in the EIS of the social environment, the predicted impacts and the proposed safeguards to overcome or avoid the adverse impacts. The various issues are dealt with under the following headings:

- visual impact, aesthetics and amenity
- landuse and development
- Aboriginal interests
- European history
- warning time - life and property
- dam break

The review is based on the draft EIS, the final EIS and the submissions received as a result of the public review process.

4.1 Visual impacts, aesthetics and amenity.

These qualities, all related, are subjective and therefore difficult to define and quantify. Very limited consideration was given in the EIS to the visual impact of the dam wall and associated structures at the Junction Waterhole. Equally, only one respondent commented on this aspect indicating that the dam will be seen from the Stuart Highway.

The visual impact and amenity of the levee banks are discussed in some more detail by the proponent. None of the respondents comment directly on the visual impact and amenity by the levee banks. Many, however, state that by appropriate landscaping, the levee banks can become an integral part of the river banks.

Potential impacts

The western part of the dam wall will be seen from the Stuart Highway. The dam structures will of course be seen by people visiting the area. The visual impact will be greatest when the dam wall is viewed from the river bed and river banks from downstream and upstream.

The levee banks will affect the view of the river from adjoining streets, roads and buildings. The proponent comments that views of the river from cars travelling on South Terrace will be affected as this is where the levee banks will be highest (1.5m). The proponent also comments that levee banks up to 1.5m high along the river, and the need to maintain their integrity, are likely to considerably reduce the amenity and constrain aesthetic development approaches of the central business district and river environs. Levees would cause the vista of the river to be regularised more towards a channel than a river, detracting from its natural attributes and

destroying some of the charm which the Todd gives to the town.

Many respondents are concerned that anything done to the river will change its present natural state and drastically reduce its contribution to the town and its amenity. The river is seen as a major feature in the town's landscape. The river red gums are seen as one of the main factors in this regard and their loss would have a significant adverse impact on the town. Potential deepening and narrowing of the river would also detract from its present amenity.

Safeguards

There are few safeguards or measures that will reduce the visual impact of the dam structures. The area will be fenced to prevent people from visiting or using the dam site.

Little can be done to minimise the view of the dam from the Stuart Highway. One option is to make it a feature in the approach to the town. A lookout could be provided from the highway overlooking the dam with interpretive information about the purpose of the dam.

Suitable landscaping could be utilised to make the levee banks an integral part of the river and town landscape. Supporters suggest that the levee banks could be used for cycle and foot paths. Concrete block walls in some sections will make landscaping difficult.

PAWA estimates that about 300 river red gums will be affected by the construction of levee banks, about 130 of which will have to be removed. A similar number of trees, mostly river red gums, will be removed from the dam site and the inundated area with the full dam option. However, once the dam is full to standing water level the vista of lost trees will be replaced by a water surface. The inundation area will not have to be cleared with the empty dam option, ie only a few trees will be removed from the dam site.

4.2 Landuse and development

This aspect of the flood mitigation proposal is dealt with in some detail both by the proponent and many of the respondents. As the aim of the proposal is to protect the town from flooding it will have a great impact on landuse and future development, in particular in the flood prone areas.

Potential impacts

Protection of buildings and properties from floods up to and including the 1% (100 year) flood and the associated costs and damages caused by flooding. The two dam options will also reduce the effect of floods greater in magnitude than the 1% (100 year) flood. This effect will reduce as the magnitude of the flood increases.

Apart from protecting buildings and properties the proponent states that the cost of buildings is likely to be less with flood protection in place. Presently the building code and town planning regulations require that the floor level of buildings be 350mm above the 1% (100 year) flood level. With flood mitigation in place costs associated with this requirement will not be incurred.

The proponent also suggests that low lying land which presently cannot be developed can be made available for development.

Land is required for the various dam options. All dam sites are located on Bond Springs Station, a pastoral lease immediately to the north of the town. For the full dam, about 1400ha is required, for the empty dam it is possible that less land will be required. The amount of land required for the multiple dams option is not known. The land must be purchased from the Station. Although it is only a very small portion of the Station, the lessee contends that the general area where the dams are located has a high carrying capacity for cattle grazing. Loss of the land will therefore reduce the carrying capacity to some extent. The levee banks will be located on land presently reserved under Section 103 of the Crown Lands Act and under the Trusteeship of the Alice Springs Town Council. The reserve status of this land would not be affected.

The proponent suggests that recreation and/or water supply are two additional, future advantages of the full dam option. A majority of the respondents are opposed to the full dam option. Many of these are opposed to a dam being used for recreation purposes on the grounds that there is no need for such a dam and it is not in keeping with the arid landscape of Central Australia.

Safeguards

Some of the respondents have suggested that any windfall profits from increased development opportunities on flood prone land should be taxed at a higher rate than normal or the land rates should be higher than elsewhere in town. These increased taxes or rates should be used to pay for the operation and maintenance of the flood mitigation measures, whether a dam or levees are adopted.

4.3 Aboriginal sites

Aboriginal people have two specific interests in the flood mitigation proposal apart from other issues covered elsewhere in this report. The two specific issues are flood warning time, which is dealt with in more detail in section 4.5, and the effect the proposed dam will have on sacred and significant sites.

Two sites and a number of mature white gums will be affected by the dam proposal. The two sites are Tnyere-Akerte, a sacred site about 900m upstream of the main dam site and Nyiltye, a small cave located on the western bank of the river at the main dam site.

The important white gums are located immediately downstream of the main dam site.

The final EIS describes how and what has been done to consult with Aboriginal people on the dam proposal. The terms of the certificate obtained from the Aboriginal Areas Protection Authority (AAPA) under the Aboriginal Sacred Sites Act (NT) 1989 are set out. The sites affected are described.

AAPA in its submission sets out in detail and explains the terms of the certificate issued under its Act. AAPA also comments on the dam proposal in general. The importance of the whole Todd River bed and the significance of the river red gums in the river to Aboriginal custodians are stressed. These people place a very high value on retaining the natural flow of the river.

The CLC in its submission covers in detail the manner in which consultations with the Aboriginal custodians have been carried out. CLC also employed a consultant to assess the dam proposal as described in the draft EIS. Many other respondents also commented on this issue but not in any detail.

Only AAPA and the proponent make any reference to Aboriginal interests that may be affected by the levee banks. As stated above, AAPA refers to the importance of the whole Todd River and its trees. The proponent, in reference to the levee banks notes, that the trees in the river are of cultural significance to Aboriginal people.

The Museum and Art Galleries of the NT observed that the draft EIS had not considered the effect of the proposal on Aboriginal archaeological material. The proponent, as a result, employed a consultant archaeologist to survey the area. The brief for this survey was prepared by the Museum and Art Galleries of the NT.

43 archaeological sites and 51 isolated stone artefacts were located. The sites comprise 41 stone artefacts scatters, one quarry site and a scarred tree. The survey only covered the areas behind the dam, at or below the standing waters level. The brief did not include the embankment which was therefore not covered in the survey. During the preparation of this report the CLC announced that its consultant archaeologist had found a number of archaeological sites in the dam embankment area. That consultant's report has not been seen yet. It is expected that PAWA's consultant archaeologist will be re-engaged to survey the same area.

No archaeological surveys have been carried out at the various multiple dam sites and along the levee bank sites in the town.

Potential Impacts

The sacred site Tnyere-Akerte will be permanently inundated by the full dam option and temporarily inundated by the empty dam option. In both cases it will be affected by siltation.

The cave, Nyiltye will be covered by the main dam wall.

The important white gums will not be damaged by the dam.

A number of the archaeological sites will be inundated by the full dam option. The remainder will be affected by floods that are retained behind the dam. All the sites will be affected to varying degrees by the empty dam option. Sites in the dam embankment area will be lost.

Safeguards

All construction crews will be clearly advised of the importance of the Tnyere-Akerte and the trees and that these are not to be disturbed. Fencing and flagging will be used to protect and identify the site and the trees.

The recommendations of the archaeologist will be implemented. These recommendations involve representative sampling, depositing samples with the Museum and Aboriginal custodians being consulted with regard to sites likely to be inundated.

For the full dam the proponent proposes to use a diver to inspect Tnyere-Akerte and a silt pump to remove silt when necessary. PAWA has also suggested that sites found in the embankment area could be moved if possible.

4.4 European History

A consultant historical archaeologist was employed by PAWA to survey the Junction Waterhole area for evidence of past European history. Some evidence was found but it was concluded that the area did not have any great heritage significance or value.

AAPA in its submission made reference to Olive Pink, an anthropologist and Central Australian "character" who had camped there for a period before the War.

AAPA also pointed out that the survey did not investigate Aboriginal contact history in the area as it had been used for camps.

As a result further investigations were carried out into the history of the area. It was concluded that if the proposal proceeds this will not result in the diminution of the historical heritage of the region.

Appendices C and R of the final EIS deal with the history of the area.

4.4 Warning time - life and property

An issue that has been dealt with in detail in both the draft EIS and final EIS is the time available for warning people in Alice Springs of potential flooding. The issue was also commented on by some respondents, but in particular by the CLC's consultant. The draft EIS stated that the warning time would be increased by the two dam options but not by the levee banks. The CLC's consultant strongly questioned that there would be an increase in the warning time for Aboriginal people camping in the river.

The proponent responded by providing a more detailed analysis of flood flow and time in the final EIS. There is no difference between the mitigated and unmitigated 1% (100 year) flood for the first hour and a half, as in both cases, flows of about $200m^3/s$ are reached. Then the effect of the dam is seen as the unmitigated flood breaks the banks after another half hour whilst it takes more than another two hours for the mitigated flood to reach the banks of the river. The peak of floods greater than the 1% (100 year) floods are also delayed, but not to the same extent.

There is no such delay in the peak of a flood with levee banks as the flowing water is only confined within the levees.

The combination of dams and levee banks provide some delay in the flood peak and thus improved warning time, but not to the same extent as the dam at Junction Waterhole.

Potential impacts

Loss of life is the most serious impact. Lives were lost in the floods in 1983 and 1988. Damage to property is also an impact but with flood mitigation (dam or levees) in place this should only occur with floods greater than the 1% (100 year flood).

Safeguards

At 200m^3/s water flows quite swiftly in the river channels and it would be difficult, if not impossible for people stranded on islands to get to the river banks and safety. The additional 2 hours provided by the dam gives more time available for help and rescue to take place.

For smaller floods but still with flows greater than 200m^3/s the river islands may not be breached and people stranded there should be safe until the flow subsides. This would have been the case with the 1988 flood, a 2% (50 Year) flood. With the dam in place the river banks would not have been breached and many islands would also have been above the flowing water. There would of course have been no property damage if a dam had been in place.

A dam provides improved protection for people in the river as it gives more time for the Emergency Services to mobilise. It also provides improved waring time to property owners in case of floods greater than the 1% (100 year) flood.

4.5 Dam breaks

The draft EIS did give an analysis of what would happen in case the dam breaks. It also stated that the dam is conservatively designed not to be overtopped by the Probable Maximum Flood (PMF), an estimate of the worst possible flood. The flow resulting from a break of the full dam in dry weather would stay within the river banks when it reaches the town. Dam burst coincidence with a 1% (100 year) flood would increase the flood peak through the town by some 20-30%. The CLC's consultant considered the analysis to be shallow. Although the proponent did not accept the criticism, a further analysis was carried out using more conservative data. The conclusions are still the same. As a result it is considered that dam break has been adequately dealt with.

The proponent notes that even under the most extreme conditions, the flood wave caused by dam break is no more than floods which could occur naturally within the river.

The proponent briefly considers levee failure. Grass would provide adequate protection but the risk of levee failure would not be completely removed without prohibitively expensive protection works. The consequence of levee failure, undermining or overtopping would need detailed examination before deciding on the option. No others commented on levee failure.

Dam break has not been considered for the combined option.

Potential impact

Loss of the intended protection due to failure of the flood mitigation works, dam or levee.

Safeguards

Part of the operational and maintenance program will be regular inspections of the structures and repairs when necessary. The dam is conservatively designed to withstand the PMF.

With the dam the risk of failure must be accepted if the town wants the protection against flooding. It should be noted that levees will only break during floods, there is no risk of failure during dry weather.

4.7 Conclusion

The draft EIS was somewhat inadequate in addressing potential social impacts. However, this was more than rectified in the final EIS where the issues raised by the respondents are analysed and addressed in some detail.

The potential weaknesses of the levee bank option are highlighted in the analysis of the social impact. It does not provide any improvement in the warning time and time available for mobilising the Emergency Services. There is no protection against floods greater than the 1% (100 year) flood. It is also likely to have a greater effect or impact on the amenity and aesthetics of the town. The levee banks, however, have no impact on the river upstream of the town.

The two dam options, full or empty, should have less impact on the amenity and aesthetics of the town provided the transport of sediment from the traps to below the dam is implemented and continued for the life of the dam.

The combined options of dams and levee banks provides some improved warning time but it does not give any protection against floods greater than the 1% (100 year) flood. There is also the impact of the levee banks on the amenity and aesthetics of the town. Transport of sediment around the dams will be necessary with this option.

5. THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

A majority of the respondents either requested an extension to the public review period or commented that the 28 day period was too short to adequately consider the proposal and prepare a submission. A telephone survey conducted by the local newspaper, the Centralian Advocate, asked 300 residents amongst other things, whether the 28 days were adequate. 70% said it was not adequate.

Another comment made by some respondents was that less literate members of the community and those who do not have English as their first language would have problems with preparing written submissions. There should be some means of accepting verbal submissions. This comment was particularly made by the Institute for Aboriginal Development and the CLC.

The environmental impact assessment of the proposal has been carried out in accordance with the requirements of the Environmental Assessment Act. The Act requires that a draft EIS be placed on public display and made available for public review for a minimum of 28 days. It also requires that the display and review be advertised including an address where written submissions can be lodged.

In responding to these comments the proponent quotes the Act in the final EIS.

These two issues are matters which the assessment authority, the Conservation Commission, will take into account in the current review of the Environmental Assessment Act.

Whether in this particular case the 28 day public review period was adequate is questionable. The proponent pointed out that flood mitigation in the Todd River had been investigated and under consideration since 1979 and residents were well aware of the various proposals made over the years. As it happened the period was extended for four days because the final day was a public holiday (Show Day) and the relevant committee of the Town Council did not meet until three days later. Late submissions were accepted until mid-August, 5-6 weeks after the closing date.

Independence of EIS preparation

A number of respondents including the Central Australian Conservation Council (CACC) questioned the independence of PAWA in preparing the EIS. It was suggested that it would be more appropriate for an independent agency such as the CCNT to prepare the EIS.

Standard practice throughout Australia is that the proponent or a consultant to the proponent prepares the EIS on a particular proposal. Guidelines for the matters to be included in an EIS are prepared by the assessment authority. Assessment of the EIS and the proposal as well as any submissions received as the result of a public review of the EIS, is then carried out by an independent assessment authority or determining authority. In the case of the NT, the CCNT is the assessment authority. It makes recommendations to the Minister for Conservation on the environmental acceptability of a proposal following the environmental impact assessment of the proposal. The Minister for Conservation then makes recommendations to the Minister responsible for making a determination on a proposal.

The main concern with the process is that any recommendations on environmental safeguards and/or conditions may not become part of the actual approval of a proposal. This is an issue which will be addressed in the current review of the Environmental Assessment Act.

Multi-purpose dam

Some respondents commented that the EIS should have addressed the full dam option as a multi-purpose dam by including the additional uses such as a recreation lake and/or a water source for Alice Springs. PAWA stresses in the draft and final EIS that it is the flood mitigation proposal that is under consideration. The full dam option is preferred because it is the better flood mitigation dam and it has the advantage that it can be used for other purposes such as recreation without costly structural alterations. Any such other uses will require further environmental impact assessment.

Publicity

Some respondents, including CACC, commented that the publicity campaign conducted by PAWA during the public display period represented scare tactics to make people favour the proposed dam. The publicity campaign comprised advertising in the local media; distribution to all residences in town of a pamphlet about flooding in Alice Springs; display of a model of the proposed dam at shopping centres, the Show and in PAWA's office; and a video on flooding in Alice Springs available for loan free of charge from the video outlets in the town. It is the author of this report's opinion that the publicity campaign was effective in making residents aware of the risks of flooding and the current proposal for a dam at Junction Waterhole. The aim of the campaign was to make people respond to the proposal and this was achieved. The local media took up the issue and ran with it for the period with interviews and stories for and against the proposal.

CACC contributed to the campaign by a leaflet it distributed advertising its public meeting. The leaflet made some unsubstantiated statements about the dam proposal. The meeting was well attended probably as a result of the publicity given to the draft EIS and the proposal.

6. DISCUSSION AND CONCLUSIONS

The advantages and disadvantages of the three options, levee banks, a dam at Junction Waterhole or a combination of dams and levee banks have been considered in the various sections of this report. Levee banks cost less to construct than the dam (full or empty) but costs more to maintain and operate. The combined option costs about 50% more than the levee banks but is the most expensive to maintain and operate.

Levee banks only provide protection up to the design flood, the 1% (100 year) flood. The dam (full or empty) reduces flood flows so that floods up to the 1% (100 year) flood are retained within the banks of the Todd River. The dam also reduces floods greater than the 1% (100 year) flood e.g. 25% reduction for the PMF. The combined option is no better than the levee banks in this regard.

There is no improvement in flood warning times with the levee banks. The dam (full or empty) does provide additional time for the Emergency Services to be mobilised and to rescue people stranded on islands or in trees and the river. The combined option performs better than the levee banks but not as well as the dam at Junction Waterhole.

The levee banks do not cause any impact on the river and its environs upstream of the town. Flora and fauna habitats will be lost at the dam site. These habitats include that of the rare water pimpernel (Sanolus enemalus) and probably that of the Quartz Gecko (Diplodactylus galentus) which has a very restricted range and considered rare by the World Wide Fund. The extent of impacts downstream of the dam will depend upon the success of the proposed sediment transport around the dam. If this is maintained for the life of the dam then there should be minimal impact on the river and its vegetation downstream of the dam. The transport of sediment should maintain the river's integrity. In this case the combined option is dependent on the dams as it will also require sediment transport around the various dams.

The Todd River and its vegetation, in particular the river red gums, is a major natural asset to the town. It is an important feature of the town and contributes greatly to the town's landscape and amenity. It would be a significant impact on the town, its residents and visitors if any adverse or detrimental changes occurred to the river.

With levee banks flow velocities will be greater than without levee banks. Increased velocities are expected to cause increased scour and increased depth of scour in the river. It is quite possible that the increased velocities and scour will cause the loss of river red gums from the river where it is confined within levee banks. There may also be changes to the river bed. However, these aspects of the levee banks require further studies to be ascertained. As the combined option includes levee banks the situation is similar for this option.

The dam (full or empty) will protect the historic buildings at the Telegraph Station from flooding whilst the levee banks will not do this. Also, the levee banks will not reduce flood levels through Heavitree Gap, the main southern access to the town, whereas the dam will.

Because of the limitations of the levee banks, mainly the limited flood protection and no improvement in the warning time it is agreed with the proponent that the dam (full or empty) is the preferred option. Reference is made to a paper delivered by Mr D Smith of the Australian National University's Centre for Resource and Environmental Studies at a recent national conference on damage prevention. Mr Smith warned of the "flood paradox" in which communities build levees and structures to protect themselves against flooding. Protection is never complete. Levees may offer protection up to the 1% (100 year) flood but do not protect against more severe flooding. The losses would be bigger when the flood finally break through the levees. There is a need for better flood warning based on rainfall and streamflow monitors.

For flood mitigation purposes a dam at Junction Waterhole is the preferred option. Whether it should be a full or empty dam is a vexed question. The costs are similar but the full dam is the better flood mitigation dam. The environmental impact will be about the same except that there should be no need to clear the area immediately upstream of the main dam wall if the empty dam option is chosen. Both options will require transport of sediment around the dam to maintain the river's integrity.

Both options will affect an Aboriginal sacred site, a small cave in the western abutment of the main dam wall. The empty dam will not permanently inundate a sacred site upstream of the main dam wall. The empty dam may, depending on the outlet configuration, affect a number of important gum trees immediately below the main dam wall.

An advantage of the full dam is that it can be used for additional purposes, without major capital outlays to change the dam structure to accommodate the additional purposes. If the full dam is to be used for recreation and/or water supply then there will be additional capital outlays to provide the necessary infrastructure. Maintenance and operational costs will also increase.

A majority of the respondents were against a full dam for flood mitigation and/or recreation purposes. Less than half the submissions were in favour of introducing flood mitigation measures, many of these respondents live in flood prone areas. Many respondents did not specifically state whether they were in favour of any particular option but rather that some of the alternatives warranted further consideration.

The results of the Centralian Advocate's telephone survey indicated that more than 60% of the 300 people surveyed favoured PAWA's proposal. More than 60% said no to the question "Would you prefer a flood mitigation dam which would not have permanent water?"

Conclusions

- Levee banks are not considered suitable for flood protection purposes in Alice Springs because of their limitations and disadvantages.

- The combined option of 4 dams and medium height levee banks is also not considered suitable for flood protection purposes in Alice Springs because of the limitations and disadvantages of levee banks. In addition, the environmental impacts of this option extend over a greater area (4 dam sites, the river and the river banks in town).

- A dam at Junction Waterhole provides the best flood protection for Alice Springs.

- The full dam performs better in mitigating floods than the empty dam but it has marginally greater adverse environmental impacts.

IMPACT STATEMENT

Proposal to build a flood mitigation dam at Junction Waterhole on the Todd River Alice Springs

PUBLIC COMMENT INVITED

The Power and Water Authority (PAWA) of the Northern Territory proposes to build a dam for the purposes of flood mitigation for Alice Springs (NT). The proposed dam is to be built about 10 km to the north of Alice Springs at Junction Waterhole on the Todd River.

Accordingly, environmental assessment of the project is being conducted.

In accordance with the Northern Territory Environmental Assessment Act 1982, a Draft Environmental Impact Statement (Draft EIS) which describes the proposal and its potential environmental effects, has been prepared by the Power and Water Authority.

Given the nature of the project and possible consequences it may have to the town and residents of Alice Springs, PAWA appreciates that the EIS process must operate effectively. For this to occur it is important that the proposal be subject to valid public comment and/or criticism. Accordingly, the Draft EIS on the proposed project is now available for public inspection and comment.

COPIES OF THE DRAFT EIS ARE AVAILABLE FOR PUBLIC REVIEW UNTIL FRIDAY 6TH JULY 1990 AND MAY BE EXAMINED UNTIL THEN AT:-

(A) PAWA Regional Office - Centrepoint Building, 12 Gregory Terrace, Alice Springs
(B) PAWA Water Resources Building, Stuart Highway, North Alice Springs
(C) PAWA Darwin Office, 5th floor Jape Building, Cavenagh Street, Darwin
(D) Conservation Commission (NT), Arid Zone Research Institute, South Stuart Highway, Alice Springs
(E) Arid Lands Environment Centre, Shop 5, Gregory Terrace, Alice Springs
(F) Alice Springs Town Council Public Library, Todd Street, Alice Springs
(G) Darwin City Council Public Libraries, Nightcliff, Casuarina and Centrepoint Building, Darwin.

Copies of volume 1, the descriptive statement, may be purchased for the sum of $5.00 and volume 2, the technical reports for the sum of $15.00 - (NOTE: vol. 1 & 2 comprise the total Draft Environmental Impact Statement) - total $20.00 (plus postage and packaging, if applicable) from PAWA offices as listed above.

Interested persons and organisations wishing to comment on the proposed flood mitigation dam as described in the Draft Envoironmental Impact Statement are invited to make a written submission by Friday 6th July 1990 to the Director, Conservation Commission of NT, PO Box 1046 Alice Springs, NT 0871 and marked to the attention of Mr H Pedersen.

Submissions will be treated as public documents unless confidentiality is requested. Copies of all submissions will be forwarded to PAWA and taken into account in the preparation of the Final Environmental Impact Statement. Submissions should preferably be on A4 sized paper and in typed black ink to facilitate copying.

A video concerning the proposed flood mitigation dam is available for free hire from these video outlets - Murray Neck Video World and the Plains Video. The video and model of the proposed dam will also be on display at PAWA Regional Office, Centrepoint Building, 12 Gregory Terrace, Alice Springs. The video and other material concerning the proposed dam project will also be on display at FORD PLAZA, Saturday 9th June 10.00 am to 1.00 pm and at YEPERENYE SHOPPING COMPLEX, Saturday 16th June, 10.00 am to 1.00 pm.

POWER AND WATER AUTHORITY

PAWA8451