

'The Tyranny of Distance' - Challenges of Infrastructure Delivery in Remote Indigenous Communities

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ABSTRACT: *There are 72 remote indigenous communities in the Northern Territory (NT) with populations ranging from 100 to 2,700 people that are serviced by NT Government infrastructure, including power and water supply and waste and sewer disposal under the Indigenous Essential Services Agreement. In 2017 the NT Government committed to \$1.1b funding for remote indigenous housing (over 10 years) which has also been matched by the Federal Government. With the construction of new housing, new and upgraded services and infrastructure are also required as communities grow. Some remote Local Councils in the NT manage infrastructure in an area larger than Tasmania, with very small populations.*

Design and delivery of Infrastructure in remote Indigenous communities is a very different process to delivery of urban infrastructure and has unique challenges including community 'remoteness', availability of project resources, materials and plant and the project environment and climate.

Some remote communities get cut off via road annually in the NT's wet season, reducing access to via air only (or sea if the community is on the coast) and severely limiting the possibility for development, construction and maintenance of infrastructure. Access limitations can also result in large costs to a project for contract management, inspections and testing (requiring charter flights), and with limited or no accommodation available for project staff, longer visits require significant forward planning.

Tonkin has been involved in the design and management of remote community infrastructure through our local Darwin office for the past ten years. This paper will give a background to infrastructure delivery in remote indigenous communities and discuss some of the unique challenges using real Tonkin project examples and the innovative ways that challenges have been overcome.

KEYWORDS: Northern Territory, Remote Indigenous Communities, Infrastructure and Service Delivery.

1 Introduction

There are 72 remote indigenous communities in the Northern Territory (NT) with populations ranging from 100 to 2,700 people that are serviced by NT Government infrastructure, including power and water supply and waste and sewer disposal under the Indigenous Essential Services Agreement. In 2017 the NT Government committed to \$1.1b funding for remote indigenous housing (over 10 years) which has also been matched by the Federal Government. With the construction of new housing, new and upgraded services and infrastructure are also required as communities grow. Some remote Local Councils in the NT manage infrastructure in an area larger than Tasmania, with very small populations.

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the unique challenges using real Tonkin project examples and the innovative ways that challenges have been overcome.

2 Remote Indigenous Communities

The NT makes up approximately one per cent of the Australian population, and of that one per cent approximately one in three people identify as indigenous. The Territory covers around 17.5 per cent of Australia's land mass, 50 per cent of which is Aboriginal freehold land and it has the highest proportion in Australia of its Indigenous population living in either remote areas (23 per cent) or very remote areas (54 per cent) (ABS 2016).

Approximately 57,000 of the Territory's Indigenous population live in more than 500 remote communities and homelands (or outstations) across the Northern Territory. Three quarters of these communities are permanent, with the rest seasonally or occasionally occupied.

Permanent communities vary in size from single families to over 2,500 at larger towns such as Maningrida and Galiwinku. Populations often fluctuate, sometimes more than doubling during cultural or law events.

Communities also range in remoteness, from very isolated sites on islands off the coast of Arnhem Land to those near regional centres like Alice Springs and Katherine. Access to remote communities is also varied, with some communities being cut off by road in the Northern Territory wet season, which typically lasts from December to March. Access to these communities during the wet season can be restricted to via sea or air.

There are twenty remote Local Government areas in the Northern Territory. Some remote Local Councils in the NT manage infrastructure in an area larger than Tasmania, with very small populations. For example, Roper Gulf Regional Council governs 11 remote communities (including indigenous communities) and covers a huge area of 186,000 kilometres. The total population of the Council area is around 7,100, which equates to approximately 1 person for every 26 square kilometres.

It has historically been more challenging to deliver the same level of infrastructure and essential services in remote NT communities than in more urban areas. Remote communities also often have poorer housing

outcomes and are subject to overcrowding and a harsher environment. These conditions can negatively impact on outcomes in health, education, employment and safety (Closing the Gap Report 2019).

3 Community Growth

The need for improved remote community housing and associated servicing and infrastructure is required primarily to address the existing issues of overcrowding in communities, as well as allowing for long term community population growth.

Overcrowding in remote communities can be a major problem for the health and wellbeing of the community. In remote communities in the NT, over 45 per cent of houses are overcrowded (ABS 2016).

The long term population growth for remote communities in the Northern Territory is approximately one percent to 1.5 per cent per annum (ICEG 2017). This is comparable to the total Northern Territory long term growth rate of 1.4 per cent per annum (ABS).

Economic opportunities in Remote Communities can be limited and unemployment rates are typically high. Therefore the triggers for community population growth can be variable and sporadic.

3 Government Initiatives

The Australian Government has been providing funding for Northern Territory Remote Community Housing since the 1960's and the NT Government has been working to provide services to 72 remote communities since 1988 through the Indigenous Essential Services Agreement.

The 2007 intervention by the Australian Government, the 'Northern Territory National Emergency Response' was a catalyst for significant changes to occur in NT Remote Communities with respect to improving the standard of infrastructure, servicing and community conditions.

There have been numerous Government projects that have played a part in improving the standards in remote communities since the 2007 intervention, including:

- Closing the GAP on Indigenous Disadvantage 2008-2019
- Stronger Futures in the Northern Territory / National Partnership on Northern Territory Remote Aboriginal Investment (2012-2018)
- Strategic Indigenous Housing and Infrastructure Program (2008-2013)
- National Partnership on Stronger Futures in the NT (2009-2018)
- National Partnership Remote Indigenous Housing (2008-2019)
- Our Community, Our Future, Our Homes (2017)
- Our North, Our Future: White Paper on Developing Northern Australia 2015
- NT 10 Year infrastructure Plan 2018-2027
- Planning for a vibrant future (2018)

The current National Partnership for Remote Housing for the NT (commencing in 2018), is an agreement between the Australian and Territory Government and will deliver up to a total of \$1.1 billion in remote housing jointly funded by the Commonwealth and Territory government over five years.

The partnership funding is being delivered under the NT Governments 'Our Community, Our Future, Our Homes' Program, which aims to improve housing in remote communities. The NT Government has committed to \$1.1 billion in funding over ten years for the program.

4 Service and Infrastructure Delivery

4.1 Management

Servicing and infrastructure delivery in remote communities is primarily managed through two levels of government, Territory and Local. Both levels of government are responsible for infrastructure development and are required to work closely together to develop and deliver remote community infrastructure.

4.1.1 NT Government

The Department of Housing and Community Development and Power and Water Corporation Remote Operations are the two primary Northern Territory Government Departments responsible for the delivery of services and infrastructure in remote indigenous communities.

The Department of Housing and Community Development's role is to provide services in affordable and accessible housing, local government and community development

across the Northern Territory. This is primarily in the development and delivery of residential subdivisions and infill development in remote communities.

The role of Power and Water Remote Operations is to provide essential services (water, sewerage disposal and electricity) to 72 remote indigenous communities. Part of their role is to facilitate service delivery to new infrastructure in remote communities.

Power and Water Corporation will typically have at least one Essential Services Officer (ESO) on site in remote communities to manage and maintain essential services within the community. Approximately 25 per cent of Power and Waters ESO's are indigenous (IES Annual Report 2018).

4.1.2 Local Government

Local Governments are the asset owners for remote community infrastructure such as roads, drainage, parks and buildings. The rates and funding base for Remote Local Council's in the NT are low due to their small and dispersive populations, and in many cases the local council rates base does not cover the budget required to maintain, upgrade and renew Council assets over the large areas they manage. Therefore, remote Local government in the NT is traditionally typically reliant on receipt of grant funding for any significant infrastructure development.

The NT Planning Scheme development process relies on NT Government approvals (NT Planning Scheme 2009) therefore Local Governments have not had a critical role in or primary control over infrastructure development and delivery within the communities they manage.

The primary role of NT local government in community infrastructure is in providing servicing, management and maintenance.

A site officer Council Representative will typically be located in remote communities to provide infrastructure management as part of the Council's core services. These site officers typically live in the community providing them with an 'on the ground' understanding of the challenges and existing issues within the community.

4.2 Procurement

There has historically been varied procurement strategies for development and delivery of remote community infrastructure projects due to government funding requirements and the

requirement for all levels of government to be aligned and work together.

Typically remote community infrastructure is procured and project managed by:

- The NT Department of Housing and Community Development for initial planning and development of infrastructure projects.
- The NT Department of Infrastructure, Planning and Logistics (DIPL) for detailed design and construction activities. DIPL typically works as the project delivery agency for NT Government.
- Power and Water Corporation Remote Operations for Essential Service Delivery
- Local Government for development and delivery of typically small-scale community projects.

All of the above entities engage private consultants and contractors through their procurement processes to deliver planning, design and construction of remote community infrastructure.

Generally, the ability of the agencies to develop and deliver design and construction services in-house is limited.

4.3 Standards and Guidelines

Government infrastructure standards and guidelines are also used in remote communities to develop civil infrastructure and essential servicing. However, in some cases it has been recognised that there is a need for specific guidelines for remote indigenous communities to provide guidance on the unique challenges in infrastructure delivery. The following specific standards and guidelines in relation to infrastructure and servicing delivery have been developed for infrastructure in remote indigenous communities.

4.3.1 Indigenous Community Engineering Guidelines (2017)

The NT Government developed Indigenous Community Engineering Guidelines (ICEG 2017), most recently revised in 2017. The guidelines outline the requirements for development activity to enable the efficient and safe connection of services in the 72 remote Aboriginal communities that the NT Government manages. The guidelines have been developed for use by engineers and other professionals involved in the

investigation and design of essential service assets in Northern Territory remote communities.

The guidelines provide guidance for investigation of essential service systems, water, sewerage and electricity.

The guidelines were developed due to historical evidence of overdesign of services in remote communities where project unknowns typically resulted in an overly conservative design approach, leading to inflated costs and project completion times.

4.3.2 Environmental Health Standards for Remote Communities in the Northern Territory (2001)

These standards were developed to address the gap in the Building Code of Australia (BCA). The BCA only applies to gazetted building areas, which exclude the majority of remote communities in the Northern Territory.

The resulting lack of standards and/or inappropriate standards has historically contributed to the difficulties encountered when addressing environmental health problems in remote communities in the Northern Territory.

5 Design Development

A large portion of the NT is Aboriginal land as determined by the Aboriginal Land Rights Act and most of the remaining land mass is subject to native title rights and interests. In December 2009, the NT Government instructed that all new and existing infrastructure on Aboriginal land in the 72 previously prescribed remote communities must be secured through long term leases appropriate to the economic life of the asset.

Development of civil infrastructure in remote indigenous communities can typically require additional forward planning in comparison to more urban development types due to the complexity and additional approvals required to be achieved as part of infrastructure development. This can lead to extended lead times for projects in both the development and construction stages.

The additional time required to obtain agreements can be significant. In Tonkin's experience, this may delay a project for

months or years, and sometimes indefinitely if an agreement cannot be reached.

In the planning stage, the following additional steps may be required to facilitate development:

- Land tenure agreement (agreement to secure long-term leases on Aboriginal Land)
- Aboriginal Areas Protection Authority (AAPA) Certificate (Agreement under the Northern Territory Aboriginal Sacred Sites Act, and indemnifies the holder against prosecution under the Act for damage to sacred sites in the area of the Authority Certificate)
- Native Title / Indigenous Land Use Agreement (agreement between a native title group and others about the use of land and waters)

6 Tonkin's role

Tonkin has been involved in the design and management of remote community infrastructure primarily through our local Darwin office for the past ten years. Representatives from the local office have supported government in the following roles:

- Secondment roles within the Department of Housing Community Development and Infrastructure, Planning and Logistics
- Consultants developing the design of infrastructure and essential services projects on behalf of and managed by the NT Government
- Designing and managing projects on behalf of local councils

As part of our support to Government in remote community infrastructure delivery we provided project scoping and management services, participated in stakeholder and community engagement, completed detailed design and construction management.

7 The Challenges

There are many challenges in the design and delivery of remote community infrastructure. The key challenges are set out in the following section. Section 8 details some Tonkin project examples of remote community infrastructure delivery and the innovative ways challenges have been overcome.

7.1 Climate

The Northern Territory Climate can be challenging. In the north it is hot and wet and in the south the land is primarily desert. The wet season is from November to April and is characterised by higher humidity and monsoonal rains and storms. The average annual rainfall in Darwin during wet season is over 1700mm (BOM 2019). During the wet season access via road to some remote communities is cut and the only access is via air or sea.

Many NT remote communities are reliant on barge landings for supply of food, fuel (including fuel for power generation), construction materials, and other goods during the wet season when roads are closed for lengthy periods.

Construction activities during the wet season are typically difficult due to frequent and intense storms. Ideally, the NT Government tries to plan design and construction activities in remote communities such that construction is not undertaken in the wet season, or that works can be staged such that construction can be on hold during periods of intense rainfall.

However, this is not always possible due to unexpected delays, changes to the project scope or the early onset of an extreme rainfall period.

This is also likely to cause both commercial and mental stress in project delivery as designers may be required to fast track designs to enable construction in the dry season period, and contractors may feel pressure to complete construction prior to the wet season to avoid additional costs in establishment and demobilisation, as well as potential difficulties with delivery of materials to site.

7.2 Remoteness

The Northern Territory covers an area of 1.4 million square kilometres. Remote communities are spread across this landmass and the very remoteness of the community can present an enormous challenge to infrastructure delivery.

Due to the remote nature of the sites, it is exceedingly more difficult to visit a site for inspections, testing and verification that is required to be undertaken as part of design development and construction contracts. This can affect the ability to achieve tight quality control.

This also means that contractors are required to manage the project work schedule tightly and plan inspections and testing accurately to avoid the necessity to reinspect or retest, or delays in the schedule as typically the inspector or testing authority will have scheduled flights to and from site, and can not reschedule without considerable expense and delay to the project.

Therefore the NT Government has built some allowances into their construction specification for civil infrastructure, including extended notification periods for inspections, and return of compliance test results. However, this increases the risk of additional rework required if a test does not meet the required standards and works continue.

In addition to this, photos and video can also be used to provide a visual representation of the works undertaken, in the instances where advice from the superintendent is required at the site.

7.3 Availability of Accommodation

The availability of accommodation in remote communities is often limited. This means that site visits and inspections are generally required to be managed over a day trip. As discussed above, this means that the contractor must manage the work schedule tightly as the ability to extend a trip overnight is limited by lack of accommodation.

In some remote communities contractors may be required to set up temporary accommodation for site staff for the duration of the project works, which can be a significant cost to the project.

The Local Council may operate accommodation in some communities, although this may be of limited supply and primarily available to visiting local council staff.

7.4 Availability and cost of materials and plant

The availability of local materials is of key importance to the cost effective delivery of remote community infrastructure. If material is not available locally it must be barged or freighted to site and transport costs and delay times can be significant.

However, even if material is locally available it does not always mean that it can be used on a project due to requirements of native title. Agreements need to be in place to utilise material from the existing area outside of the

development footprint, including existing , water points, borrow pits and quarries.

7.5 Local Industry

The NT Government has traditionally had a strong focus on development of the local NT industry, including in remote communities where the local workforce and businesses are utilised wherever possible.

The NT Government provides incentives for industry development. There is a 30 per cent minimum local development weighting in all NT Government tenders. This generally means that the more local you are, the greater the chance of securing work. The NT Government has also in the past included specific commercial incentives for indigenous engagement on remote construction projects, for example the Indigenous Employment Provision Scheme which operated from 2014 to 2017. This scheme was established to incentivise local contractors to hire Indigenous workers by awarding them roughly 10 per cent of a project's total value to be used to pay Indigenous wages. However, the scheme was cancelled in 2017 due to a lack of oversight and accountability resulting in contractors taking advantage of the scheme.

However, the employment opportunities in remote indigenous communities in civil infrastructure development are limited and often sporadic. Therefore, the continuity of work can be limited and this can result in a largely unskilled local workforce.

Still, there are many cases of engagement and participation of the local community workforce through approaches such as Memorandums of Understanding with the Local Council (This approach was used on the Pickertaramoor Road Upgrade, discussed in further detail in the following section). Undertaking design with an understanding of the capability of the local industry, for example in the development of the Millingimbi Barge Ramp Design where concrete panels were included in the design that could be manufactured using local industry.

7 Case Studies

The following case studies provide specific examples of the unique challenges of remote community infrastructure delivery and how the projects were delivered with varying levels of success.

7.1 Pickertaramoor Road (Melville Island, Tiwi Islands)

7.1.1 The Project

Tonkin completed the detailed design, documentation and contract administration of 26 kilometers of Pickertaramoor Road upgrades on Melville Island (One of the Tiwi Islands) on behalf of the NT Department of Infrastructure, Planning and Logistics throughout 2014 to 2016.

The Tiwi Islands are located approximately 80 kilometers north of Darwin across the Timor Sea. Melville Island is Australia's second largest island after Tasmania, with a population of approximately 1,000 almost all of whom are aboriginal (ABS 2016). The primary industry on Melville Island is wood chipping, with plantations covering a significant portion of the island.

The objective of the road upgrade was to provide increased flood protection. The existing road was unsealed and largely informalised and was getting closed due to flood waters in wet season.

As the only road connection between Pickertaramoor and Pirlangimpi, this road is required as the only road access to the school at Pickertaramoor.

The road upgrades included formalising the existing unsealed formation and intersections, sealing the road and providing formalised drainage.

7.1.2 The Challenges

Design

The design of the project commenced in September 2014, corresponding closely to the beginning of the wet season, which typically commences in November. Due to project time constraints for construction (the first stage was budgeted for construction prior to the wet season) and restricted ability to access the existing road section to complete survey, the first stage of the design was completed using existing GPS co-ordinates of the existing roadway, aerial photography and a typical design cross section.

The following stages of the design that were not as time critical included a traditional on ground engineering survey. Aerial survey techniques could not be undertaken due to the level of vegetation and standing water in numerous locations along the existing road.

The remote location of the project required special consideration with respect to optimising earthworks balance along the upgrade section to minimise haulage across the site.

The location and treatment of floodways to manage wet season peak flows was also a key consideration. A site inspection was undertaken (via charter plane) in the project initiation stage to identify and locate existing floodways using handheld GPS.

Construction

Tonkin acted as the superintendent for the construction phase of the works. The construction phase of the project included numerous unique challenges including:

Sourcing a contractor

There are no existing civil contractors on Melville Island, however the utilisation of local industry is one of the key aims of the NT Government on remote projects. The primary industry on Melville Island is woodchipping, which is managed locally. The local Tiwi Islands Council which has a base on Melville Island has some experience in the construction and maintenance of local roads.

Therefore, to maximise the engagement of local industry, an Memorandum of Understanding between the NT Government, the chipping company and the Local Council was signed, to enable plant, operators and equipment from both the council and the chipping company to be utilised on the project. An experienced construction manager was also obtained externally to manage the works and the construction team.

Sourcing Materials

During the initiation phase of the project, investigations were required to be undertaken to establish local sources of water, fill and gravel for the works.

Several existing but disused bore sites developed to service the plantations were located within the general project area and generator powered tank farms set up to provide water for the project.

The extents and depth of an existing gravel pit that had been utilised historically for council local road maintenance was also investigated and it was found that enough suitable gravel material existed to enable the road base construction. However, the gravel pit was located at a significant distance from

the project site, meaning haulage was considerable.

Pavement seal materials and drainage infrastructure (ie culverts) was required to be sourced from Darwin and barged to site at considerable cost to the project. The amounts of non-local materials was required to be optimised, without a detrimental effect on the project objectives and providing a robust design.

Inspections and Testing

There are no testing facilities on Melville Island. All inspections and testing equipment and staff were required to be flown in from Darwin. This meant that the contractor was required to manage timeframes closely as inspections and testing could not be planned at short notice.

The contractor and the inspection and testing personnel were able to work closely with the chipping company to co-ordinate flights with their remote staff, regularly sharing charter flights and reducing the cost of travel.

The chipping company also maintained staff accommodation on site which was utilised for the project team during the construction phase.

Existing Roadway Requirements

The Pickertaramoor Road is the only road connection between Pirlangimpi and Pickertaramoor, therefore the road was required to remain open during the construction period to maintain access for local traffic.

However, the local traffic volumes were quite low and regular (eg morning and afternoon access to the school). The contractor was able to manage the traffic flows such that critical construction tasks (eg construction of culvert crossings) was during times of extremely low to nil traffic and as such keep the road open continuously.

7.2 Remote Community Barge Ramp Upgrades (Maningrida and Wadeye)

7.2.1 Wadeye

Wadeye is one of the largest indigenous communities in the NT with a population of 2,300 consisting primarily of five different indigenous tribal groups. The town is remote, situated on the western edge of the Daly River Reserve about 230 kilometers by air south-

west of Darwin. Wadeye gets cut off via road annually in the wet season.

Wadeye has three existing barge ramps that provide access into 'Sandfly Creek' approximately 20km upriver from the sea. The ramps provide access for different sized vessels. Close to the community there is a concrete combined use ramp and a gravel barge ramp (with a very steep slope) which is typically used for all barges, rangers and police rescue boats, commercial fishing and private boat launches. There is also a third gravel 'emergency' ramp approximately 20km from the community that can be used by small vessels (rangers and police) in the case that the primary ramp is in use. Since the ramps access via a creek, space is very limited. Vessels are required to access during the high tide otherwise they will get stuck in the creek system.

Tonkin was engaged in 2015 by the NT Government to develop designs of upgrades of the existing multi-use concrete ramp primarily to provide a robust design that would withstand the forces of the barges accessing the ramp. The lower section of the existing ramp was badly damaged and in some cases completely destroyed. This was likely due to the force of the barge on the ramp when docking, the effects of wave and tide action and the requirement of the barge to dock under power to 'push-up' against the ramp as the tide recedes.

Tonkin developed the design for a new post-tensioned modular pre-cast concrete ramp, including erosion protection for the site. The concrete precast design was used in this case to encourage local industry involvement. One of the largest local employers in Wadeye is the Thamarrurr Development Corporation who run a concrete batching plant in the community typically producing precast concrete house panels. The barge ramp pre-cast panels were also sized to allow for use of locally available plant for construction.

The contractor was heavily involved in the later stages of the design process, which resulted in some of the aspects of the design being modified. In particular, the post-tensioning of the ramp sections was changed to a steel rod and bolt arrangement so that the sections could be tensioned in stages.

The construction of the ramp was completed in late 2017 went largely as planned and resulted in a ramp that met the required specifications.

The outcomes of the project were met using a relatively simple and fit for purpose design. This type of pre-cast arrangement will now be used as a model for future remote community ramp design and construction. The future strategy proposed for additional remote barge ramps is to include as many pre-cast elements in the barge ramp design as possible so that the minimum cast in situ is required on site.

In summary a good outcome was achieved through considered design and early contractor involvement for the construction of the ramp and the constructed ramp is as an asset suitable for the community.

7.2.2 Maningrida

Maningrida is a remote NT indigenous community of approximately 2,000 people about 500km from Darwin. The community gets cut off by road every year during the wet season and the only access during this time is by sea and air. There is one barge ramp for the community that is required to support the combined and very different uses of: large 'Mega' barges supplying construction materials and equipment, commercial fishing boats, police off shore rescue boats and local tinnies being launched from the ramp. The ramp also operated in the NT's approximately 8m tide range.

Tonkin was engaged to design a formalised freight facility including upgrades (lengthening and widening) to the barge ramp in 2014, primarily to improve safety of operations for both commercial and local private users. Over the next three years the design was reduced in footprint, initially to meet budget demands but finally for the key reason of land title agreement. The NT Government was unable to gain permission from traditional owners to work outside of the existing barge ramp footprint (which can be covered under the NT Government existing land title agreement of repairs and maintenance). Therefore, the design finally became the replacement of the existing concrete ramp slab with a new slab

cast in-situ. The construction of the ramp was managed by NT Government and completed in late 2017.

The construction of the ramp is a good lesson learnt in regard to the need for remote site supervision. Key issues with the construction were as follows:

- The design engineers were not involved in the construction stage of the project.
- The required in-situ concrete strength was difficult to achieve at such a remote site.
- The construction was completed by a local contractor in Maningrida with a project manager in Darwin.
- Issues with securing flights to site to inspect the works meant that site inspections were delayed.
- A coffer dam was constructed by the contractor out of sand to protect the concrete ramp while curing. However, the coffer dam broke causing the wave action to affect the concrete finish.
- Aggregate for concrete was required to be barged to site from Darwin, causing the contractor to source aggregate locally in some cases. However, the local aggregate was unsuitable.

The above issues resulted in a ramp that has reduced concrete strength, reduced cover to reo, incorrect finish and ramp grooves cut the wrong direction, as well as signs of concrete degradation only a year after construction.

The learning that can be taken from this project example is the importance of construction management, where in this case the shortage of oversight resulted in a very high cost outcome.

8 Conclusions

Design and delivery of Infrastructure in remote Indigenous communities is a very different process to delivery of urban infrastructure and has unique challenges including community 'remoteness', availability of project resources, materials and plant and the project environment and climate.

In my experience designing civil infrastructure for, and working in remote communities I have found them wholly unique and varied across the Northern Territory, with specific individual challenges to infrastructure delivery that need well thought through but often simple solutions.

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