

# ACHIEVING SUSTAINABILITY IN BRT IMPLEMENTATION IN THE CITY OF JOHANNESBURG

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## ABSTRACT

This paper sets out the experience of the City of Johannesburg in trying to develop a more sustainable approach to the implementation of their Rea Vaya Bus Rapid Transit (BRT) system. It reports on a sustainability study that was conducted to determine the key features of the third phase of their roll out. It sets out the proposed sustainability criteria and shows how these criteria were used to evaluate the previous modes and how the criteria influenced proposed changes. The paper concludes by highlighting some additional issues relating to operational sustainability that the City has experienced and how sustainability is not a once off consideration but something to constantly be considered and strived for.

### *Key Words*

BRT, implementation, sustainability, Johannesburg

### **Introduction**

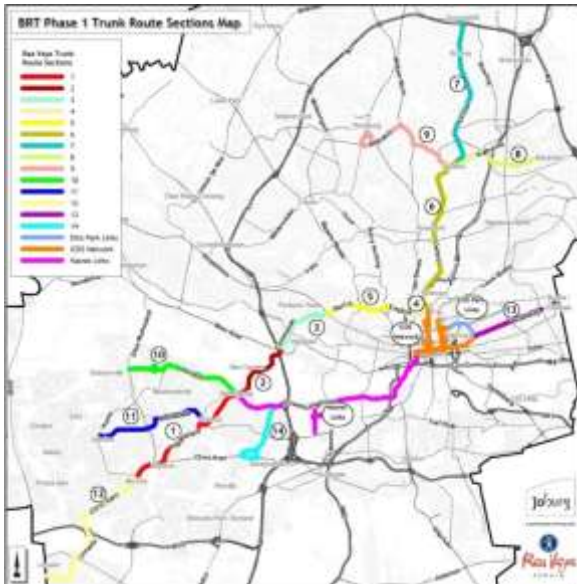
By the time this paper is presented, the City of Joburg will have been implementing Rea Vaya BRT for almost eight years. And if it is lucky the number of passengers trips per day will be around 40 000. The equivalent figure for the mini bus taxi industry in Johannesburg is over 1 million passengers per day (Strategic Integrated Transport Plan Framework, 2013). Gautrain transports 48,000 passengers on its train on an average weekday and 14,000 to 16,000 per day on weekends (Gautrain reports to City of Joburg: November 2013)

By the time this paper is presented, the City would have spent R4 billion of national grant money on the Rea Vaya BRT. Nationally, the various cities planning and implementing BRT would have spent 12 billion.

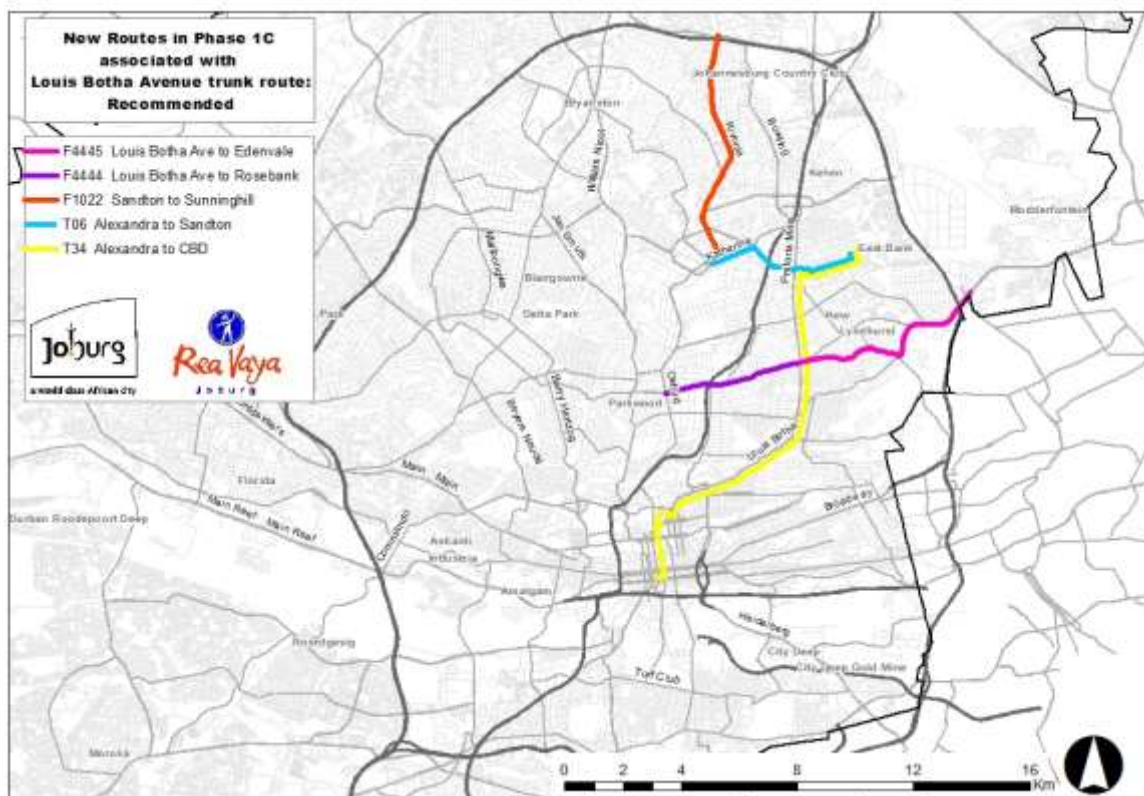
The sustainability of BRT systems has to be a central question for local government policy makers and transport planners alike. It is also a critical political question for politicians and officials who are striving to reshape cities and improve the quality of life of residents.

Bearing in mind the centrality of this question, it is surprising that so few studies have been done in this regard and that armies of monitoring and evaluation (M & E) specialists have not descended on Joburg and other cities.

In 2012 the City of Joburg initiated a sustainability study arising out of questions that were being asked about the viability of the BRT after the high transformational, operational and maintenance costs of the first phase (Rea Vaya BRT Phase 1A) became apparent. By then the first two phases were seen as ‘done deal’s’ but it was still possible to halt or differently shape the third phase which was planned to go from the CBD of Johannesburg to Alexandra and Sandton via Louis Botha Avenue (see maps below for description of phases and routes alignment)



Map 1: Originally proposed Route



Map 2: New Routes in Phase 1C along Louis Botha

The scope of the sustainability study was to consider the following modal choices for Phase 1C:

- Business as usual (a 'do nothing scenario');
- Public transport priority on the curb side lanes as was initially envisaged in the City's SPTN plan prior to 2006;
- BRT as rolled out in Phase 1A and 1B;
- Improved BRT (building on lessons of 1A and 1B); and
- Light rail.

The appropriate modal choice was required to be reviewed in terms of a number of criteria including:

- Growth and Development Strategy objectives;
- Transportation needs and desired capacity;
- Local road and urban environment conditions;
- Imperative of urban regeneration and potential for development of high density transit nodes around key Rea Vaya stations;
- Commitment of City to high quality public transport that is safe, affordable, reliable and convenient and the need to maintain the Rea Vaya BRT quality on new phases;
- Integration imperatives in respect of Gautrain, Metrobus, BRT in neighbouring municipalities and non-motorised transport including walking and cycling;
- Available funding;
- Environmental impacts; and
- Economic cost and benefits.

This paper will set out the results of the sustainability study as well as consider some of the key issues of defining sustainability that came up during the study. It will conclude by highlighting additional issues, on the basis of experience to date, that need to be considered in actually achieving the sustainability that the study promised.

### Defining sustainability

The City of Joburg contracted Arcus Gibb to conduct the sustainability study and they proposed a "three legged stool" approach to considering sustainability, where the fundamental principles of sustainability entails meeting human needs for the present and future while:

- Preserving and restoring environmental and ecological systems (environment)
- Fostering community health and vitality (Social)
- Promoting economic development and prosperity (Economic)
- Ensuring equity between and among population groups and over generations

See figure 2 below.

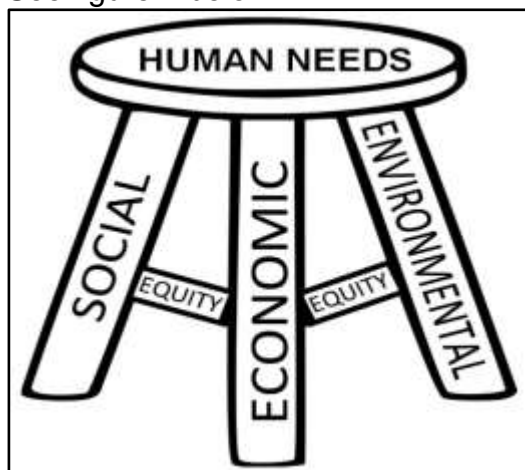


Figure 2: Source National Cooperative Highway Research Program (NCHRP) Report, 708

The consultants worked with the City and used the terms of reference provided by the City to determine the sustainability indicators as set out in Table 1.

Table 1: Initial Sustainability Indicators

| Sustainability Goal and Definition (NCHRP report 708) |   | COJ Objectives for Rea Vaya BRT as recorded in Terms of Reference   | Issues Highlighted in Terms of Reference for consideration   |
|---|---|---|--|
| Goal  | Definition  |   |  |
| 1. Safety   | Provide a safe transportation system for users and the general public   | <ul style="list-style-type: none"> <li>Road safety and improved health of City residents</li> <li>Poverty reduction through providing affordable transport</li> </ul>   | <ul style="list-style-type: none"> <li>Community and political expectations</li> </ul>   |
| 2. Basic accessibility                                | Provide a transportation system that offers accessibility that allows people to fulfil at least their basic needs |   |  |
| 3. Equity / equal mobility                            | Provide options that allow affordable and equitable transportation opportunities for all sections of society      | <ul style="list-style-type: none"> <li>Enabling public transport transformation</li> <li>Enable spatial restructuring and overcoming the City's apartheid legacy</li> <li>Taxi industry transformation – BBBEE</li> <li>Development of social cohesion through encouraging more collective means of travelling</li> </ul> |  |
| Sustainability Goal and Definition                    |   | COJ Objectives for Rea Vaya BRT as recorded in Terms of Reference   | Issues Highlighted in Terms of Reference for consideration   |
| Goal  | Definition  |   |  |
| 4. System efficiency                                  | Ensure that the transportation system's functionality and efficiency are maintained and enhanced                  | <ul style="list-style-type: none"> <li>Fast, save, reliable and affordable public transport</li> <li>Enable improved mobility and reduction of congestion – important for economic prosperity</li> <li>Job creation and the provision of economic opportunities</li> </ul>  | <ul style="list-style-type: none"> <li>Transportation needs along the corridor and thus desired capacity (in short and long term)</li> <li>Commitment of City to high quality public transport that is safe, affordable, reliable and convenient and the need to maintain the Rea Vaya BRT quality on new phases</li> <li>Integration imperatives in respect of Gautrain, Metrobus, BRT in neighboring municipalities and non-motorised transport including walking and cycling</li> <li>Potential for the development of high density transit nodes around key Rea Vaya stations</li> <li>Sufficient available funding (CAPEX and OPEX)</li> <li>Economic cost and benefits.</li> </ul> |
| 5. Security   | Ensure that the transportation system is secure from, ready for, and resilient to threats from all hazards        |   |  |
| 6. Prosperity   | Ensure that the transportation system's development and operation support economic development and prosperity     |   |  |
| 7. Economic viability                                 | Ensure the economic feasibility of transportation investments over time   |   |  |

| Sustainability Goal and Definition |  | COJ Objectives for Rea Vaya BRT as recorded in Terms of Reference  | Issues Highlighted in Terms of Reference for consideration  |
|------------------------------------|--|--|---|
| Goal                               | Definition   |  |   |
| 8 Ecosystem                        | Protect and enhance environmental and ecological systems while developing and operating transportation systems | <ul style="list-style-type: none"> <li>Reduce air pollution and the reduction of greenhouse gas emissions</li> </ul> | <ul style="list-style-type: none"> <li>Local road and urban environment conditions, constraints and future impact</li> <li>Environmental impacts</li> <li>Long term vision of the City and Growth and Development Strategy objectives</li> <li>Imperative of urban regeneration of the Louis Botha corridor and Alexandra and the need for Sandton CBD to remain a dynamic, accessible CBD</li> </ul> |
| 9. Waste generation                | Reduce waste generated by transportation-related activities  |  |   |
| 10.Resource consumption            | Reduce the use of nonrenewable resources and promote the use of renewable replacements                         |  |   |
| 11.Emissions and air quality       | Reduce transportation-related emissions of air pollutants and greenhouse gases                                 |  |   |
| 12. Built environment              | Ensure that the transportation system supports appropriate land use mix and densities                          |  |   |

Determining appropriate indicators is a strategic task, best determined for a specific context and conjuncture with due regard to international and academic benchmarks. Thus the above table was reviewed and City officials reduced the sustainability issues and a simplified scoring matrix was used. Table 2 sets out the key ways in which sustainability was considered.

Table 2: Kinds of sustainability

| Kind of sustainability             | Issues to be addressed?  |
|------------------------------------|--|
| Financial sustainability           | <p>Can the operating costs be reduced?</p> <p>Can and how can the operating costs be covered by fare revenue?</p> <p>If not, what other revenue sources are there to cover operating costs – including from land value capture</p>   |
| Economic and social sustainability | <p>How can the Rea Vaya contribute more effectively to inclusive economic growth, job creation and poverty reduction including in respect of bus manufacture, job creation in construction, local economic development, etc.? How can Rea Vaya help build the green economy?</p> |
| Land use sustainability            | <p>How can Rea Vaya contribute to the integration of the apartheid city, promote TOD and urban regeneration? Related to this, how can heritage buildings and existing land uses be incorporated into more sustainable urban forms</p>  |
| Public transport sustainability    | <p>How do we ensure safe, affordable, reliable public transport and cut the costs and time of commuting for the poor?</p> <p>How do we move private car users to walking, cycling and public transport?</p>  |

| Kind of sustainability       | Issues to be addressed?   |
|------------------------------|---|
|                              | <p>How can public transport transformation be made more inclusive?</p> <p>How can Rea Vaya be a more effective catalyst for public transport integration and restructuring?</p> |
| Environmental sustainability | <p>How can further phases of Rea Vaya contribute to reduced air pollution, carbon emissions etc.?</p>   |

To determine the appropriate mode and apply the criteria, an understanding needed to be developed on the nature of the study area including land uses, the local economy, social and environmental conditions, heritage issues as well as the more traditional transport issues relating to public transport demand and the existing state of accessibility and mobility. This was done by Gibb using a range of information sources including traffic counts, visual inspections and drawing on existing City studies. Some information, especially in respect of heritage was difficult to obtain.

One of the requirements of the service provider was to do a Cost Benefit Analysis (CBA). The Global Environment Fund (GEF) had funded some initial work for the Rea Vaya BRT and one of their requirements was also that a social and environmental study should be done.

This had been done by Strategic Economic Solutions in conjunction with ITS Engineers in 2012. They did a comprehensive economic evaluation/analysis of Phases 1A and 1B of Rea Vaya BRT that includes a broad range of costs and benefits to society, rather than the very narrow scope of the earlier evaluations. The first set of results included only the transport related benefits of vehicle operating costs savings, time savings and the reduction in accidents and CO2 equivalent emissions for both Phases 1A and 1B.

Phase 1A has a negative Net Present Value (NPV) of R1.086 million, a Benefit Cost Ratio (BCR) of 0,77 and an Internal Rate of Return (IRR) of 3.0%. Phase 1A is therefore not economically efficient when only the direct transport benefits are taken into account. This is evidenced by the negative NPV and a BCR, at 0.77%, which is less than one. This means that for every R1 that was/is spent on Phase 1A the societal transport benefits are 77 cents.

Phase 1B has a positive NPV of R18 million, a BCR of 1,01 and an IRR of 8.1%. Phase 1B is therefore at breakeven when only the direct transport benefits are taken into account. This is evidenced by the marginally positive NPV and a BCR of 1.01%. This means that for every R1 that was/is spent on Phase 1A the societal transport benefits are R1.01.

In aggregate the two phases have a negative NPV of R1.068 million, a BCR of 0.86% and an IRR of 5.5%. The conclusion that is drawn is that in aggregate the two phases are not economically efficient when only the direct transport benefits are considered.

The second set of results included both transport and wider social benefits, and it was concluded that both Phases 1A and 1B are economically efficient when aggregated and broader societal benefits are included.

Gibb sub contracted the same service providers who did a similar analysis and study in respect of the different options of Phase 1C. Their conclusion was that the do nothing scenario offered the best cost benefit analysis (CBA) mostly because traditional cost benefit analyses score business travel higher than travel by workers. And yes private car users were going to lose out to public transport users if a dedicated public transport lane is built in the middle of roads traditionally giving priority to private car users.

After serious consideration, the CBA was not included in the final sustainability report due to the methodological limitations of the analysis. Subsequently the authors have come across transport economists internationally who have more sophisticated approaches.

### **Result of the sustainability study**

Arising out of the qualitative work to develop an understanding of the study area, it was quickly established that a Phase 1C alignment which only went to Alexandra and did not consider demand on Louis Botha from Ivory Park, Tembisa and Midrand would be a non-starter. This was because as much as 60% during am peak of the public transport vehicles on the Louis Botha section of the corridor did not come from Alexandra but from further afield. The same situation existed for Katherine Drive – with many public transport vehicles continuing to Randburg but not to the same extent.

For this reason a new mode, called “BRT extended” was developed which included feeders to Ivory Park and Tembisa.

The earlier mentioned modal choices where then evaluated according to the criteria and the results are set out in Table 3.

| Kind of sustainability | Bus as usual | BRT       | BRT Ext    | Curb side | LRT       |
|------------------------|--------------|-----------|------------|-----------|-----------|
| Financial              | 9            | 7         | 4          | 8         | 2         |
| Economic and social    | 11           | 22        | 31         | 27        | 26        |
| Public Transport       | 7            | 20        | 35         | 26        | 27        |
| Land use               | 4            | 12        | 20         | 12        | 16        |
| Environmental          | 5            | 7         | 10         | 8         | 7         |
| <b>TOTAL</b>           | <b>36</b>    | <b>68</b> | <b>100</b> | <b>81</b> | <b>78</b> |

The issues which shaped the scores above and the key conclusions that can be derived from the scores were as follows:

- The business as usual or status quo scenario was not further considered due to the fact that it would not meet the public transport, land use and transformational objectives of the City and would lead to increased congestion in the medium term;
- Light rail would be substantially more expensive without providing a dividend in respect of an increase in speed or a reduction in space required – a key consideration on the space constrained Louis Botha corridor and Sandton CBD. In addition, land for a depot would need to be found on the route – and no land at a reasonable price was identified and the service would require more transfers for passengers from feeder buses and other modes. The rigidity required by a linear route would also require significant relocations of homes in Alexandra.
- The curb side service scored well financially because of reduced infrastructure costs and with the introduction of new vehicles could score equally well on transformation considerations. However the problem with the curb side service was that it would not meet the BRT promise of speed or reliability and this would become increasingly the case as public transport demand increased in later years.
- The BRT as initially envisaged between the CBD, Alex and Sandton had serious problems with capacity due to the reasons set out above. Because the route was shorter, there were also fewer benefits.

Thus the “extended BRT” option scored the best on all aspects of sustainability but was poor financially for the City. After this the focus of the study shifted to considering measures that could improve the financial performance of the BRT and ensure that even if the City had to invest more financially, that it would better return on its investment.

Impetus to looking at the broader impact of the BRT was also provided when on 9<sup>th</sup> May 2013, the Executive Mayor of the City of Joburg, Parks Tau announced that the City would restructure itself along key corridors of freedom with Rea Vaya as a backbone and that one such corridor would be the Louis Botha corridor extending also to Ivory Park.



## Features of an improved BRT

What then were the features proposed for an improved BRT? The guiding principle was more integration with other public transport modes and land use. Furthermore integration between infrastructure and operations and more alignment with local conditions. The assumption was that this should lead to increased sustainability.

Table 4 below sets out the proposed key changes and how they were envisaged to enable sustainability

**Table 4: Improved BRT features and impact on sustainability**

| Feature   | Impact on sustainability  |
|---|---|
| Infrastructure features   |   |
| High floor median key stations on trunk routes with integration with other modes (mini bus taxis, bikes, park and ride) | Key or limited stations would reduce the operational costs of having many stations. All proposed stations would require no land take which meant that they could be built affordably and in time for a 2016 proposed start. Integration with other modes would increase patronage especially at the stations which were serving relatively low dense areas along the Louis Botha corridor. The key stations provide the impetus for TOD and mixed use development around these hubs. And on the other hand, no heritage would be impacted upon due to the need for only a limited number of stations. |
| Multi modal public transport interchanges in Alexandra, Sandton and inner city (Westgate)                               | Increasing integration with other modes, would increase the public transport network and thus increase patronage.   |
| Complementary bus services with some public transport priority  | Some public transport priority would improve reliability and speed and thus more likely to encourage especially car users to switch to public transport   |
| Extensive NMT network especially in Alexandra and between Alexandra, Wynberg, Marlboro and the Sandton CBD              | Majority of Alexandra residents are unemployed or very low wage workers. At present they work and many distances are workable but not safe to do so. Improving walkability and introducing cyclability can improve the quality of life and sustainability of livelihoods of the poorest of the City's residents. NMT also provides significant job creation and skills development opportunities in the construction phase.   |
| Park and Rides  | Providing park and rides will create an enabling environment for private car users to switch to public transport thus reducing congestion especially in the Sandton area. This can lead to reduced congestion and also improve the attractiveness of Sandton as a growing CBD.  |
| Day and night time holding  | Creating such facilities can reduce significant dead kms thus improving operational sustainability.   |

| Operational features   |   |
|--|---|
| Extension to Ivory Park, Midrand, Sunninghill and possibly Randburg  | The travel demand patterns in this area indicate that there is high demand in both directions in the peak. This is very different from the Soweto scenario. Increased patronage leads to greater financial sustainability   |
| Operational plan to maximise on the network effect.  | The operational plan can lead<br>In the event that the system remains a high floor legacy system, there can be sharing of up to 14 buses between Phase 1A, 1B and 1C. This can lead to operational efficiencies.  |
| Distribution network of mini bus taxis and Avanzas – last mile service in narrow roads of Alexandra and feeding into public transport interchange at Alexandra (Watt Street) | Operational integration with the mini bus taxi industry can lead to more demand responsive services especially in Alexandra and Ivory Park and thus create operational efficiencies for the City and the BOC and enhanced mobility for residents.<br>This proposal can also lead to: <ul style="list-style-type: none"> <li>• Job creation in taxi industry value chain (drivers, vehicle maintenance, etc.)</li> <li>• Increased profitability for taxi industry</li> <li>• Opportunities to refleet with alternative green fuel sources</li> <li>• Reduce the potential for conflict between BRT “insiders” and “outsiders”.</li> </ul> |

However the proof will be in the eating and not the baking of the pudding. We are planning to operationalise Phase 1C in 2016, ten years after BRT was approved by the Mayoral Committee. Hopefully the passenger numbers, changing land use and bank accounts and increasing asset base of the mini bus taxi operators will tell the tale.

## **Other sustainability considerations**

The paper has focused on propositions from our experience of Phase 1A and Phase 1B on what to CHANGE in the design of Phase 1C to achieve sustainability. However the ongoing implementation of Phase 1A and 1B has also raised two further issues which impact on the sustainability of Rea Vaya which are briefly discussed below.

At the time of writing this paper, passenger numbers were at an all-time low. 19 000 passenger trips were recorded in November 2013. This is not primarily due to the fact that Phase 1A and 1B were built as 2010 legacy systems and to kick start public transport transformation but more due to lack of operational sustainability due to the fact that the introduction of the smart card system has led to a lack of accessibility of the Rea Vaya system and has also impacted on the affordability. Accessibility is reduced due to the fact that people have to have a loaded ticket to access the Rea Vaya and affordability has been reduced due to the fact that passengers are paying a distance based fee as well as a loading fee.

Our internal conclusion is that in a phase of wanting to increase public transport patronage and shift people to a new mode of public transport, accessibility has to be key. Further, in apartheid cities, the distance based fee prejudices generally the poorest people who live on the outskirts. Our message to other cities is to really focus on ensuring that your fare structure, fares and fare collection methods must be aligned to your public transport promise and strategy and not try follow international best practice or fancy systems.

Secondly, the twelve year Bus Operating Contract model we have adopted has drawn very strict lines between the responsibilities of the City and the operator. However for a system that is innovative and developmental there have been risks and unintended consequences. For example we signed off on a penalty schedule which was impractical. Circumstances may also change over a 12 year period and going forward consideration should be given to creating mechanisms for opening up the BOC contract so that there can be continuous improvements.

Thus in conclusion, sustainability is something that BRT systems need to constantly strive for and will always remain slightly illusive and changing. Nevertheless the lesson of our focus on sustainability for Phase 1C has made us much more cognisant of this consideration and much more focused on outcomes and constantly checking if the outputs steps and strategies achieve a sustainable outcome.

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