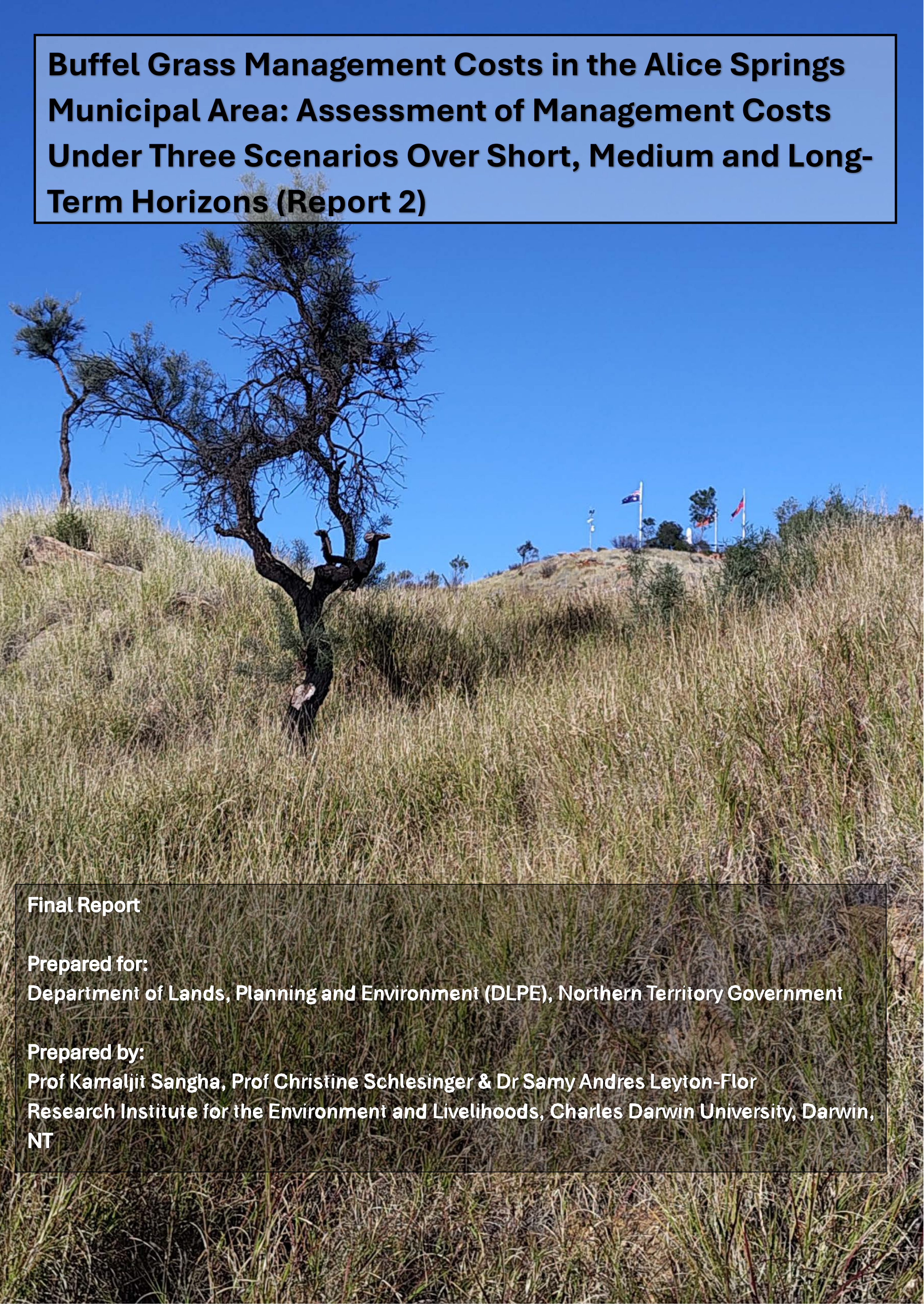
Buffel Grass Management Costs in the Alice Springs Municipal Area: Assessment of Management Costs Under Three Scenarios Over Short, Medium and Long-Term Horizons (Report 2)



Final Report

Prepared for:
Department of Lands, Planning and Environment (DLPE), Northern Territory Government

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ASTC – Alice Springs Town Council
ATV – All-Terrain Vehicle
BCR – Benefit–Cost Ratio
CBA – Cost–Benefit Analysis
C&D – Chemical and Disposal (when used in cost tables)
CWR – Crown Land <10 ha (Crown small-parcel category used in modelling)
DEPWS / DPEWS – Department of Parks, Environment and Water Security (NT)
DLPE – Department of Lands, Planning and Environment (NT)
EIA – Economic Impact Assessment
GIS – Geographic Information System
IPA – Indigenous Protected Area
KM – Kilometre
LGA – Local Government Area
LMMS – Lhere Mparntwe Management Strategy 2019
NT – Northern Territory
NTG – Northern Territory Government
NPV – Net Present Value
O&M – Operating and Maintenance Costs
PV – Present Value
WAC – Weed Advisory Committee (Buffel Grass WAC 2024)
WONS – Weed of National Significance
WMB – Weed Management Branch (NT Government)

1 Executive summary

Buffel grass (*Cenchrus ciliaris* and *C. pennisetiformis*) was declared a weed under the Northern Territory *Weeds Management Act 2001* in July 2024. This report assesses the financial cost of managing buffel grass within the Alice Springs municipal area under three management scenarios, across short (1–5 years), medium (6–20 years) and long-term (20+ years) time horizons. Each scenario is evaluated in terms of direct annual expenditure and its benefit–cost ratio (BCR), drawing on evidence demonstrating the strong links between buffel grass invasion, more frequent fires, and long-term ecological decline. The analysis is designed to inform operational and policy decision-making by comparing alternative management pathways, rather than predicting precise annual expenditure.

The three scenarios reflect structurally different management approaches, as specified in the DLPE Scope of Requirements. Scenario 1 represents a largely reactive model focused on fuel reduction, amenity, and complaint-driven control. Scenario 2 involves coordinated, active management across priority public land and a proportion of private land. Scenario 3 represents a comprehensive, proactive approach targeting high-value ecological and cultural assets and a higher level of private-land participation. These scenarios are intentionally directional as Scenario 1 carries escalating long-term social and environmental costs associated with continued buffel grass spread, while Scenarios 2 and 3 front-load investment to reduce future treatment intensity and external costs. The resulting cost trajectories reflect programme logic rather than assumptions of smooth or guaranteed outcomes.

Cost estimates draw on empirical data from the Lower Todd and Charles River chemical control program, published weed-management benchmarks, and the valuation framework established in Report 1. The Lower Todd dataset is used strictly as a local cost anchor, not as evidence of large-scale effectiveness, and scaling to the municipal level is applied conservatively. All estimates are expressed as ranges and subject to acknowledged uncertainty, including ±30 per cent uncertainty in treated area and effort due to limited current-state mapping.

Scenario 1, the current reactive approach, has the lowest direct annual cost in the short term (approximately $297,500–$535,000/yr). However, this scenario relies heavily on mowing, slashing, and ad-hoc herbicide application, practices that do not suppress buffel grass seedbanks and can contribute to further spread. When assessed using updated per-hectare benefit estimates, Scenario 1 yields a very low benefit–cost ratio (BCR). For the municipal-only variant (erosion control benefits only), the BCR is approximately 0.005, while inclusion of limited general benefits raises the BCR marginally to approximately 0.008. In all cases, benefits are an order of magnitude smaller than the external costs associated with increased fire severity, biodiversity decline, cultural site degradation, and scenic amenity loss, indicating that the reactive approach is economically inefficient and exposes government and communities to escalating long-term liabilities.

Scenario 2 introduces coordinated, active buffel grass management across river corridors, road verges, all ASTC-managed and small Crown land blocks, and an estimated 25–50% of private land. This scenario represents the minimum strategic transition required to materially reduce long-term risk, recognising that private-land uptake may be constrained by practical factors such as landholder capacity, organic-certification restrictions, and varying herbicide-use feasibility. These constraints are reflected through partial-coverage assumptions rather than increased unit costs. Direct annual costs increase substantially to approximately ~$1.5–$3.2 million in the short term, but decline over time as infestation density and seedbanks are reduced. Economic performance under Scenario 2 is reported using a coverage-adjusted benefit–cost ratio, reflecting the fact that avoided costs accrue only over the proportion of the municipal area effectively treated. Based on an effective area coverage scalar of 0.24, Scenario 2 achieves a coverage-adjusted BCR of approximately 5.3 over a 50-year horizon and 4.9 over a 20-year horizon, indicating a strong economic case once avoided fire, biodiversity, cultural, and scenic costs are accounted for. Scenario 2 represents the minimum level of investment required to materially reduce future risk and meet post-declaration management obligations.

Scenario 3 represents a comprehensive, proactive management strategy that combines integrated weed–fire management with intensive treatment of high-value ranges and nature parks, and the engagement of 50–75% of private land. Short-term costs are highest under this scenario, at approximately ~$5.0–$8.1 million per year, reflecting the scale and difficulty of operations in difficult topography. However, Scenario 3 delivers the greatest absolute avoided costs over time. Using an effective area coverage scalar of 0.48, Scenario 3 produces a coverage-adjusted BCR of approximately 3.7 over a 50-year horizon and 3.4 over a 20-year horizon. Although this ratio is lower than that of Scenario 2 due to the larger program scale, Scenario 3 generates the highest net present value overall and provides the strongest long-term protection of biodiversity, cultural sites, infrastructure, and tourism assets by breaking the buffel grass–fire feedback loop.

The results should be interpreted as comparative evidence on the relative costs, risks, and trade-offs of alternative management pathways under uncertainty, rather than as precise budget forecasts. The analysis demonstrates that Scenario 3 is the suggested strategic investment for the Northern Territory. Although the most expensive in the short term, it delivers the greatest long-term savings, ensures maximum protection of ecological and cultural assets, and reduces fire risk most effectively while reducing fire management costs. Scenario 2 is a workable compromise when budgets are constrained, but Scenario 1 exposes government and communities to accelerating, ultimately unsustainable, long-term costs.

2 Introduction

2.1 Background

Buffel grass (*Cenchrus ciliaris* and *C. pennisetiformis*) has long been recognised as one of the most impactful invasive grasses in arid and semi-arid Australia (Friedel et al., 2006; Marshall et al., 2012), and in July 2024, it was formally declared a weed under the Northern Territory *Weeds Management Act (2001)*. This declaration requires land managers to take reasonable measures to prevent the spread of buffel grass, comply with relevant management plans, and avoid propagating or transporting the species without a permit (DLPE, 2026). Although buffel grass was originally introduced for pasture production and soil stabilisation, the declaration reflects mounting evidence of its ecological, cultural, and economic harm across central Australia (NTG, 2022).

Buffel grass is now recognised nationally as a transformer species capable of altering fundamental ecosystem processes, particularly by reducing native plant richness (Abella et al., 2012; Ryan-Colton et al., 2024; Wright et al., 2021), displacing culturally and ecologically significant species (Caron et al., 2021; Read et al., 2020), and altering soil moisture and nutrient dynamics (Bonney et al., 2017; Edwards et al., 2019). It significantly increases fine-fuel continuity and biomass, resulting in hotter and more frequent fires that amplify suppression costs and threaten both biodiversity and infrastructure (Grice et al., 2013). These hotter fires also exacerbate ecological decline by further promoting buffel grass dominance, driving a grass–fire feedback loop across landscapes (Schlesinger & Westerhuis, 2021). Beyond ecological impacts, buffel grass affects cultural values by obscuring access routes, displacing cultural plant species, and threatening sacred sites. Traditional Owners have consistently reported diminished access to Country, reduced availability of bush foods, and increased fire-related risks, with some families ceasing to visit culturally significant areas due to buffel proliferation (Caron et al., 2021; DLPE, 2025a). Tourism and recreation are also negatively affected, as buffel grass degrades scenic values and increases fire risks to key visitor destinations surrounding Alice Springs (DLPE, 2025a; Friedel et al., 2006). Furthermore, infrastructure, including roads, utilities, and airport assets, is becoming increasingly vulnerable to damage from buffel grass-fuelled fires, as well as from the species' ability to colonise and spread along transport corridors (Biosecurity SA, 2019; Weed Management Branch, 2022).

The Alice Springs municipal area comprises a mosaic of land tenures, including Town Council–managed land, Northern Territory Crown and conservation land, private residential and commercial allotments, road verges, and peri-urban areas bordering conservation estates such as the West MacDonnell Ranges. Each land type exhibits distinct patterns of buffel grass establishment and for its management, complicating coordinated control. Buffel grass is widespread across municipal open spaces, drainage lines, roadside corridors, and undeveloped blocks, while also encroaching on nearby high-value cultural and biodiversity assets such as Ilparpa Swamp and Simpsons Gap (Buffel Grass Weed Advisory Committee, 2024). Effective management, therefore, requires cross-tenure strategies that consider the interconnected movement of seed, fire, and human activity across municipal boundaries.

This report builds on the findings of the preceding Economic Impact Assessment of buffel grass spread in the NT (referred to as Report 1 here onwards [Sangha et al. 2026][1]), which identified that the total annual economic costs of buffel grass, including biodiversity loss, cultural site degradation, increased fire-management costs, and scenic amenity decline, substantially exceed its pastoral and infrastructure-stabilisation benefits. By linking the ecological and socio-economic impacts documented in Report 1 with the localised management obligations within the municipal area, this report assesses the financial implications of three management scenarios. These scenarios range from maintaining the current, largely reactive approach focused on fuel loads and aesthetics to implementing intensive, integrated weed and fire management across high-value municipal and peri-urban landscapes. The management scenarios are designed to assist policy makers in identifying the most cost-effective and socially beneficial pathway for effective long-term buffel grass management in Alice Springs.

2.2 Objectives

- Assess the cost of buffel grass management under three scenarios: current management approach (Scenario 1), increased active buffel grass management (Scenario 2) and good buffel grass management (Scenario 3).
- Estimate short- (1–5 years), medium- (6–20 years), and long-term (20+ years) costs for each scenario.
- Provide comparative economic analysis to support policy and operational decision-making by the Department of Lands, Planning and Environment (DLPE) and the Minister for Lands, Planning and Environment.

2.3 Scope and assumptions

The assessment covers all land types within the Alice Springs municipal boundary, as per the DLPE mandate, including:

- Alice Springs Town Council (ASTC) managed land: parks, recreational areas, road reserves, stormwater drains and public open spaces.
- Northern Territory Crown land managed by DLPE: unallocated parcels, transport and utility corridors and drainage systems.
- Private land: residential allotments, commercial precincts and peri-urban properties.
- Road verges and transport corridors: major pathways for buffel grass spread.
- Ranges, nature parks and high-value conservation assets: Todd and Charles River corridors, Heavitree Gap, lower slopes of the MacDonnell Ranges, Alice Springs Telegraph Station Historical Reserve, Simpsons Gap (Tjoritja/West MacDonnell National Park), Ilparpa Swamp, and Yeperenye/Emily and Jesse Gap Nature Park.
- Landcare sites: community-led restoration sites, particularly along the Todd River

Key modelling assumptions include:

- All values in constant 2025 Australian dollars.
- Labour rates based on NT Government T3 classification rates: $119.65/hr (pre-August 2024) and $122.20/hr (post-August 2024).

[1] Sangha, K. K., Schlesinger, C., and Leyton-Flor, S. A. (2026). Economic Impact Assessment of Buffel Grass in the Northern Territory. A report commissioned by the Department of Lands, Planning and Environment (DLPE), Northern Territory Government.

- ATV hire estimated at $20.60/day/unit (2025 rates).
- Herbicide unit costs: Glyphosate 450 at $15.50/L; Glyphosate 360 at $18.03/L; LI700 adjuvant at $9.17/L; Flupropanate at $26.52/L.
- Control cycles guided by buffel grass biology, seed-bank persistence and rainfall-driven growth rather than fixed calendar schedules: annual treatment for high-density areas; biennial/triennial for moderate densities; opportunistic for low-density/containment zones.
- Cost benchmarks draw on empirical Lower Todd and Charles River chemical control records (2018–2025, total project costs ~$43,706) and published NT and SA weed management literature.
- Per-hectare values for fire, biodiversity, cultural and scenic costs are external costs drawn from Report 1, not re-estimated locally.

The selection of ranges and nature parks included in Scenario 3, specifically the areas surrounding Simpsons Gap, Ilparpa Swamp, and Yeperenye/Emily and Jesse Gap Nature Parks, follows the sites explicitly prescribed in the DLPE Scope of Requirements (DLPE, 2025b). Several hills and ranges within or immediately adjacent to the Alice Springs town boundary, including Heavitree Gap, Mount Gillen, the ranges behind the Desert Park, Alice Springs Telegraph Station Historic Reserve, Olive Pink Botanical Gardens, Anzac Hill, and Billygoat Hill, are not addressed in this assessment as they fall outside the specified scope. These areas may nonetheless represent significant management priorities given their proximity to urban infrastructure, high visitor use, and documented buffel grass presence. Their inclusion in cost projections and management planning would warrant consideration in any future revision of the scope or a subsequent assessment.

3 Methods

3.1 Data sources

This report draws on five primary data sources:

- Lower Todd and Charles River Chemical Control records (2018–2025): detailed operational data including staff hours, chemical volumes, ATV costs and total treatment costs across the lower Todd and Charles River corridors, compiled by the Weed Management Branch, DEPWS. Total cumulative project costs from 2018 to May 2025 amount to AU$43,706 (Weed Management Branch, 2025).
- Report 1 (Economic Impact Assessment): standardised per-hectare annual cost and benefit flows including management costs ($932/ha/yr), fire regime costs ($793/ha/yr), biodiversity loss ($2,550/ha/yr), cultural degradation ($2,260/ha/yr) and scenic amenity loss ($93/ha/yr).
- *Lhere Mparntwe Management Strategy 2019* (NTG, 2019): identifies priority actions along the Todd and Charles Rivers, including buffel grass and couchgrass suppression, fuel load management, and community engagement.
- *Buffel Grass Management Strategy: Central Australia 2024–2030* (Buffel Grass Weed Advisory Committee, 2024) identifies several priority areas for buffel grass management relevant to the Alice Springs municipal context, including: the Todd and Charles River corridors and associated riparian reserves; the lower slopes and approaches of the MacDonnell Ranges; Simpsons Gap Nature Park and its approaches; Ilparpa Swamp; Yeperenye/Emily and Jesse Gap Nature Parks; road verges and transport corridors as primary seed-dispersal pathways; and ASTC-managed public land and DLPE Crown land parcels within the municipal boundary.
- South Australian and NT published cost benchmarks (Biosecurity SA, 2019; Ferdinands et al., 2010; Friedel et al., 2009; Read et al., 2020; Schlesinger et al., 2020): restoration costs, labour and herbicide benchmarks for arid landscape management.

3.2 Land area estimates for the Alice Springs municipal area

While comprehensive GIS-derived land-use mapping for the full municipal area was not available at the time of this analysis, estimates of land categories are drawn from the *Buffel Grass Management Strategy: Central Australia 2024–2030* (Buffel Grass Weed Advisory Committee, 2024), the *Lhere Mparntwe Management Strategy 2019* (NTG, 2019), the Scope of Requirements (DLPE, 2025b), and stakeholder roles identified in the Alice Springs Regional Weeds Strategy (NTG, 2021). The Northern Territory Government's NR Maps platform was reviewed as a supplementary reference for land tenure and administrative boundaries; however, it did not provide consistent municipal-scale information on buffel grass distribution, infestation density, or management responsibility suitable for direct cost scaling. Accordingly, NR Maps was not used as the primary basis for area estimation in this assessment. Indicative area estimates used for scaling costs are presented in Table 1 (refer to Appendix A to see the full procedure):

Table 1. Estimated land category area

Land Category	Estimated Area (ha)	Description
ASTC-managed public land (parks, reserves, riverbanks)	~1,200	Includes Todd/Charles River corridors, parks and reserves

DLPE Crown land blocks <10 ha	~800	Unallocated and small parcels within the municipal boundary
Road verges and transport corridors	~300	Based on ~200 km total road network at 10 m average verge width
Private land (residential, commercial, peri-urban)	~3,500	Includes residential allotments and peri-urban blocks
Ranges, nature parks, conservation areas (within/adjacent to municipal boundary)	~8,000	Includes lower ranges, Simpsons Gap approaches and nature park buffer zones
Landcare sites (active)	~150	Active Landcare-managed areas along the Todd River
TOTAL	**~14,000**	Approximate total area subject to management consideration

Note: Area estimates carry significant uncertainty and should be refined through systematic mapping as recommended in the Buffel Grass Weed Advisory Committee (2024) strategy. Not all land within each category is covered with buffel grass, and management effort will be targeted on infested areas.

3.3 Cost modelling approach

The cost modelling framework for each scenario comprises four cost elements:

- Direct treatment costs: a combination of herbicide, manual removal, slashing and mechanical treatment. These costs are estimated separately for each scenario using a bottom-up activity-based approach. For each land-tenure category and management activity, costs are calculated from treatment areas, unit costs, and treatment frequency and phase (initial intensive treatment, maintenance, or monitoring). Where work is delivered by NT Government staff, costs are disaggregated into labour (staff wages at NT Government T3 classification rates), equipment hire (e.g., ATV hire), and chemical inputs. Where work is delivered by contractors, costs are treated as all-inclusive rates that bundle labour, equipment, and materials within the contracted fee, avoiding double-counting of these components.
- Programme coordination and monitoring: mapping, compliance, reporting and stakeholder engagement.
- Avoided costs, such as reductions in fire-management expenditure, biodiversity restoration costs, cultural site degradation, and scenic amenity loss, are derived from the valuation framework in Report 1 from parameter-driven per-hectare annual cost flows. Avoided costs are determined by three explicit scaling parameters:
    - Area (hectares): Represents the total municipal area under consideration for valuation. This provides the base spatial unit for scaling per-hectare annual cost and benefit flows.
    - Effective area coverage scalar: Recognises that avoided costs increase only over the proportion of land effectively treated under each scenario. Coverage scalars reflect the combined extent of managed public land and the assumed uptake on private land: Scenario 2: coverage scalar = 0.24 and Scenario 3: coverage scalar = 0.48.

In arid central Australia, the costs and opportunities associated with buffel grass management are inherently variable and cannot be predicted with precision from year to year (Friedel et al., 2009). The critical distinction for cost planning is that different management activities have fundamentally different relationships with rainfall. Mowing and slashing can be undertaken at any time and are particularly valuable during dry periods and early winter when buffel grass is dry or cured, serving primarily to reduce fuel loads; these mechanical treatments do not require rainfall and can proceed regardless of seasonal conditions (Biosecurity SA, 2019; Buffel Grass Weed Advisory Committee, 2024; Weed Management Branch, 2021).

However, the primary trigger for effective herbicide application is active growth, the presence of new green leaf matter, rather than rainfall or germination per se (Farrell & Gornish, 2019; NTG, 2022). Active growth occurs only after sufficient rainfall stimulates buffel grass growth, and herbicide treatment is most effective during the initial growth period following a rainfall event, typically within a few weeks, with the window varying considerably depending on the amount and continuity of rainfall (Biosecurity SA, 2019). A single small event may yield only a brief and unreliable treatment window, whereas sustained or repeated rainfall can significantly extend management opportunities (Biosecurity SA, 2019). Unmown or unburnt buffel grass is generally less responsive to herbicide following smaller events, as new growth can remain obscured within dry or cured standing material, reducing chemical contact and uptake (Biosecurity SA, 2019; Schlesinger et al., 2020). Mowing prior to a rainfall event improves herbicide efficacy because mown buffel grass responds more vigorously to subsequent rain, producing more accessible new growth; this mow-then-spray sequence is therefore a recommended approach where follow-up capacity exists (Biosecurity SA, 2019; Farrell & Gornish, 2019).

Rainfall in cooler winter months may not produce the same level of active growth and may therefore not trigger the same treatment needs (Biosecurity SA, 2019; Panetta, 2025). These dynamics mean that annual management costs within the ranges presented in this report will fluctuate materially from year to year. The costs across all three scenarios implicitly absorb some of this variability, but they cannot predict the specific timing or scale of investment required in any given year, nor the risk that treatment opportunities may be missed if funding and workforce are not available at short notice.

Fire is not recommended as a primary management tool given its role in amplifying the buffel grass–fire feedback cycle, in which increased fine-fuel loads lead to more frequent and severe fires that further promote buffel grass expansion (Miller et al., 2010; Ryan-Colton et al., 2024; Schlesinger et al., 2013); however, where burns occur accidentally or are used for necessary fuel reduction, post-fire areas can be managed in the same manner as mown areas, with herbicide applied during the first active growth period following rain, provided that follow-up capacity is available and planned in advance (Buffel Grass Weed Advisory Committee, 2024; Schlesinger & Westerhuis, 2021). The deliberate use of fire as a buffel grass management tool should be considered only where herbicide follow-up is certain. The critical investment periods, when the greatest management gains can be achieved, and rapid deployment of resources is required, are warm-season rainfall events that occur roughly between September and March, which stimulate rapid active growth and open the most effective treatment windows (Biosecurity SA, 2019; Panetta, 2025). These events are inherently unpredictable in terms of timing and intensity, meaning the scale of investment required in any given year cannot be determined in advance (NTG, 2022). Rain combined with hot temperatures represents prime conditions for buffel grass growth and therefore the greatest management opportunity (Friedel et al., 2014; Panetta, 2025).

Costs are presented as annual averages within each time horizon, with ranges reflecting uncertainty in treatment area, treatment frequency and chemical costs. A 7% discount rate is applied for present value comparisons, consistent with Report 1 (Appendix B to see the full procedure).

Benefit–cost ratios (BCRs) and net present values (NPVs) are reported as coverage-adjusted metrics for Scenarios 2 and 3. This reflects the fact that avoided external costs are realised only on the portion of the municipal area where sustained management occurs. Scenario 1 does not apply a coverage scalar, as it does not achieve systematic suppression of buffel grass and therefore does not materially reduce landscape-scale external costs.

Cost estimates and economic indicators reported in this assessment are derived from a modular valuation framework implemented in Report 1, which standardises all costs and benefits on a per-hectare, annual basis in 2025 Australian dollars. This approach allows direct comparability across land tenures, management scenarios and time horizons, and provides a transparent bridge between the municipal-scale management costs reported in this study and the broader economic impact assessment presented in Report 1.

The valuation framework separates impacts into distinct benefits and losses, reflecting different economic mechanisms (Figure 1). Market benefits were estimated for direct production and erosion control, while non-market benefits/costs were estimated for biodiversity restoration, cultural sites, fire management and loss of scenic beauty. Specifically, forage benefits are estimated using a discounted cash-flow (DCF) enterprise model based on livestock production, erosion control benefits are estimated as avoided infrastructure and maintenance costs, and changes in the fire regime are represented as incremental fire-management and asset-protection costs attributable to buffel grass invasion. Non-market impacts, including biodiversity loss, cultural site degradation and scenic amenity decline, were monetised separately and treated as external costs.

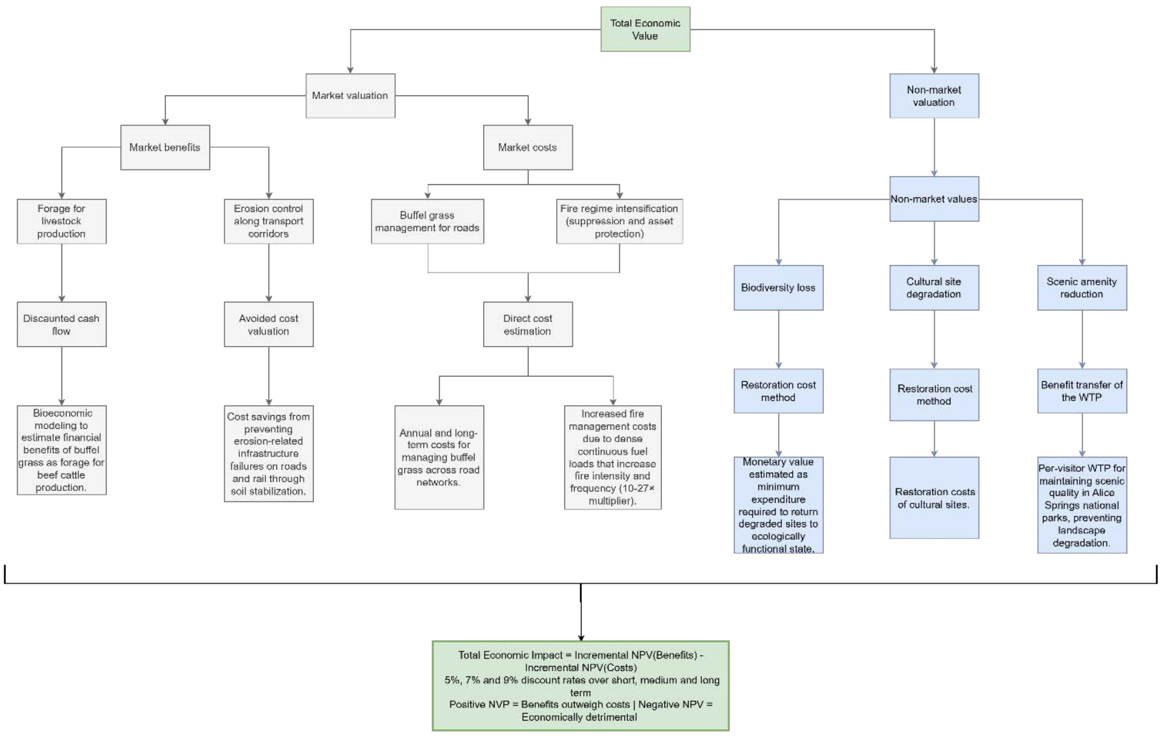

Figure 1. Valuation methods to estimate the economic impact of buffel grass

All per-hectare annual values applied in the scenario analysis are taken directly from Report 1 and are applied consistently across the three buffel grass management scenarios. These values include a standardised buffel grass management cost of $932 per hectare per year, an incremental fire regime intensification cost of $793.38 per hectare per year, biodiversity restoration costs of $2,550 per hectare per year, cultural site degradation costs of $2,260 per hectare per year, and scenic amenity losses of $93 per hectare per year. These values are aggregated and discounted using a 7% real discount rate and standard annuity factors to produce net present value (NPV) and benefit–cost ratio (BCR) estimates for short (1-5 years), medium (6-20 years), and long-term (+20 years) horizons.

Restoration cost and benefit-transfer methods were used for non-market impacts because biodiversity, cultural and scenic values do not have observable market prices, yet impose real and persistent economic costs when degraded. Restoration cost methods provide a conservative and policy-relevant proxy for these losses by estimating the minimum expenditure required to prevent, repair, or offset damage to ecological and cultural assets. This approach is consistent with established ecological economic practice and avoids the ethical and methodological challenges associated with assigning intrinsic values to irreplaceable assets such as sacred sites or native ecosystems (Costanza et al., 2014).

These methods are particularly appropriate for municipal-level decision-making, where the policy question is not what ecosystems or cultural values are “worth” in an abstract sense, but whether proactive management is less costly than allowing degradation to occur and attempting restoration later. By framing non-market impacts in terms of avoided future expenditure and long-term liabilities, the cost modelling approach used in Report 2 aligns closely with public-sector budgeting, risk management, and statutory obligations under the *Weeds Management Act 2001*, and supports defensible comparisons between alternative management strategies.

Declining average costs in Scenarios 2 and 3 are not based on an assumption of uniform or automatic treatment success, but on the structural distinction between initial intensive control phases and subsequent maintenance phases once seedbanks and standing biomass are reduced. This distinction underpins the treatment-cycle assumptions described in Appendix A, where indicative land areas are scaled into treatment and maintenance phases rather than assumed to be uniformly treated over time (Appendix A.4). Importantly, projected cost trajectories therefore represent expected programme states under continuous management, not optimistic best-case outcomes. To accommodate uncertainty in treatment effectiveness, all scenario costs are presented as ranges and are subject to an acknowledged ±30 per cent uncertainty on area and effort (Appendix A; Appendix C.5). Rather than embedding unobservable success probabilities directly into the cost model, uncertainty is handled transparently through sensitivity testing and bounded estimates, consistent with the Scope of Requirements’ emphasis on broad modelling rather than predictive operational forecasting (DLPE, 2025b).

4 Scenario 1: Current management approach (reactive)

4.1 Description

Despite buffel grass's formal listing under the *Weeds Management Act 2001* in July 2024, management within the Alice Springs municipal area has not yet transitioned to systematic weed-focused control. Existing municipal management plans predate the declaration and were designed around fuel reduction, public amenity and access rather than targeted weed suppression. As a result, the obligations imposed by the declaration, requiring land managers to take reasonable measures to prevent the spread and comply with relevant management plans, have not yet been translated into updated operational frameworks for the municipal area. Instead, management efforts are largely reactive and centred on fuel-load reduction, public safety, visual amenity, and maintaining public access, rather than on targeted, strategic weed suppression (DLPE, 2025b). This approach reflects historical patterns of management across the Todd and Charles River corridors, where control actions have primarily responded to immediate fire risks or aesthetic concerns rather than to long-term ecological or cultural outcomes.

Key characteristics of the current approach include annual or seasonal mowing and slashing along riverbanks and high-use areas; reactive herbicide application (primarily glyphosate) in response to visible overgrowth or fire risk; and community Landcare contributions along targeted sections of the Todd River. Crucially, slashing and mowing do not reduce seedbanks and can spread seed onto bare substrates, potentially accelerating buffel grass reinvasion. The Lhere Mparntwe Strategy 2019 recognises that poorly timed mechanical disturbance can increase long-term fuel loads and ecological impacts (NTG, 2019).

4.2 Empirical baseline: Lower Todd and Charles River chemical control program

The most detailed publicly available operational cost data for buffel grass control in the Alice Springs municipal area comes from the Weed Management Branch chemical control records of the Lower Todd and Charles River (2018–2025) (Weed Management Branch, 2025). This program provides an empirical baseline for the current management approach over one key riverine corridor, as shown in Table 2:

Table 2. Weed Management Branch chemical control records of the Lower Todd and Charles River (2018–2025)

Period	**Total staff hours**	**Total mix of chemicals (litres)[1]**	**Total cost of the programme, including chemicals, staff and ATV (AU$)[2]**	**Description of costs**
2018–2019	38	2,210	~$383	Chemical+ staff (estimated)
2020	85	7,130	~$1,204	Chemical costs; staff $12,300 separately
2021	68	6,230	$8,554	Chemical + ATV + staff; full costing
2022	32	3,040	$4,054	Chemical + ATV + staff
2023 (to Dec)	73.5	7,200	~$8,290	Jan–May + Dec; full costing from Dec 2023
2024	47	4,280	$6,503	Chemical + ATV + staff (P3+T3)

2025 (to May)	13.5	1,000	$807	Partial year; Charles Creek only
TOTAL (2018–May 2025)	**357**	**31,090**	**~$43,707**	**Cumulative project cost to May 2025**

Note: [1]The total mix (litres) represents the total volume of prepared herbicide solution applied per treatment event, not the volume of chemical concentrate. The mix comprised primarily Glyphosate 360 (at 1 L/100 L water) or Glyphosate 450 (at 800 mL/100 L water), combined with LI700 adjuvant (at 300 mL/100 L water), and in some years, Flupropanate (at 300 mL/100 L water) at monitoring sites. [2]The total cost (AU$) reflects the full programme cost for each period, comprising chemical costs (glyphosate and adjuvant at purchase prices), ATV hire (at AU$20.60/day/unit, equivalent to AU$618/month), and staff wages at NT Government T3 classification rates; where total costs are marked as partial or estimated (2018–2020), chemical and staff costs were recorded separately and combined retrospectively. It should be noted that the 2018–2020 period lacks fully integrated cost records, and the figures reported for those years represent conservative estimates based on chemical volumes and partial staff records, which reduces their comparability with the fully costed years from 2021 onwards.
Source: Weed Management Branch: Chemical Control of Lower Todd & Charles River (internal records, April 2025).

These records cover approximately 10–12 km of the lower Todd River and Charles Creek, a small fraction of the total municipal area. The cumulative programme cost from 2018 to May 2025 totals AU$43,707 across approximately 7 years, yielding a simple average of AU$6,244 per year (Weed Management Branch, 2025). However, this average masks substantial year-to-year variability driven by rainfall, seasonal treatment windows, and staff and equipment availability. Annual costs can only be meaningfully compared across years with complete cost records comprising chemical inputs, ATV hire, and staff wages, which are available for 2021 through 2024; the 2018–2020 period recorded chemical costs separately from a pooled staff cost block, and 2025 represents a partial year (Weed Management Branch, 2025). Across those four fully costed years, the annual programme cost ranged from approximately AU$4,054 (2022, a low-rainfall, reduced-intensity year) to AU$9,516 (2023, a high-rainfall year requiring two treatment rounds), with a four-year average of approximately AU$7,157 (Weed Management Branch, 2025). This range, rather than the cumulative average, is the appropriate empirical basis for scaling cost estimates to the municipal area under current management conditions. This level of effort is insufficient to prevent reinvasion and does not address buffel grass's expanding footprint across other land types.

The Lower Todd and Charles River program was used as an empirical cost anchor rather than as evidence of large-scale effectiveness. This program represents the only publicly available, internally costed buffel grass chemical control dataset specific to the Alice Springs municipal area and is therefore a necessary reference point for estimating unit costs of labour, chemical use, and equipment under local conditions. The analysis does not generalise the observed outcomes of the Lower Todd program to the broader municipal area, nor does it interpret the program as demonstrating successful suppression at scale. Instead, costs were scaled using conservative assumptions, adjusted upward to account for access constraints, coordination overheads, and variability across land tenures.

4.3 Scaled cost estimates for the municipal area (including Lower Todd and Charles Rivers)

Scaling from the Lower Todd baseline to the full municipal area requires consideration of all land types (Table 3). Under the current reactive approach, management effort is concentrated in:

- Riverine corridors and high-visibility public areas: approximately 15 km of Todd and Charles Rivers actively treated in any given year, at an average cost of ~$500–

1,000/km/yr, based on empirical Lower Todd records conservatively scaled to reflect municipal-level variability and overheads[2]. Across the four years with complete cost accounting spanning chemical inputs, ATV hire, and staff wages at NT Government classification rates (2021–2024), total annual programme costs ranged from AU$4,054 to AU$9,516 across a treated corridor of approximately 10–12 km, yielding an observed per-kilometre range of AU$338–$952/km/yr and a four-year average of AU$596–$716/km/yr (Weed Management Branch, 2025). The upper bound of AU$500–$1,000/km/yr applied in Table 3 is consistent with this empirical range and incorporates a modest upward adjustment to reflect the greater heterogeneity and coordination demands of a 15 km municipal corridor relative to the core Lower Todd reach (Weed Management Branch, 2025).

- ASTC parks and reserves: mowing/slashing of approximately 1,000 ha, estimated at $150–250/ha/yr for mechanical operations, reflects NT and South Australian operational benchmarks for reactive fuel-load management on public land (Biosecurity SA, 2019; Friedel et al., 2009; Read et al., 2020).
- Road verge slashing: approximately 200 km of verges slashed annually, at ~$200–400/km/yr, draws on NT regional weed strategy operational estimates for slashing-only maintenance without herbicide follow-up (Buffel Grass Weed Advisory Committee, 2024).
- Landcare volunteer effort: approximately 150 ha, valued at ~$30,000–50,000/yr, reflects current programme coordination and materials costs for approximately 150 ha of active community-managed sites, consistent with Alice Springs Landcare's reported operational expenditure (Alice Springs Landcare, 2025; DLPE, 2025a).
- Limited reactive herbicide on DLPE Crown land: estimated at $50,000–100,000/yr carries the highest uncertainty of any line item, as it is based on expert judgment rather than operational records, reflecting the ad hoc and uncoordinated nature of current Crown land management in the absence of a systematic treatment program.

Table 3. Scaled cost estimates for the Alice Springs municipal area under current (reactive) management

Management Activity	Scale	Unit Cost	Annual Cost (Low bound)	Annual Cost (High bound)	References
Riverine corridor reactive herbicide (~15 km)	15 km	~$500–1,000 /km/yr	$7,500	$15,000	Weed Management Branch (2025) empirical records; Lower Todd/Charles River average (~$4,000–$8,500/yr for 10–12 km)

[2] The corridor length and unit cost range are derived directly from the Lower Todd River and Charles Creek chemical control program records (2018–2025). Across the four years with complete cost accounting (2021–2024), total annual programme costs ranged from AU$4,054 (2022) to AU$9,516 (2023), applied to a treated corridor of approximately 10–12 km. This yields an observed per-kilometre cost range of AU$338–$952/km/yr, with a four-year average of approximately AU$596–$716/km/yr depending on the corridor length assumption used. For municipal-scale estimation under Scenario 1, the treated length is rounded to approximately 15 km to reflect variable inclusion of high-visibility and complaint-driven reaches beyond the core Lower Todd corridor, and the unit cost range is expressed as AU$500–$1,000/km/yr, which is consistent with the empirical mid-to-upper range of observed per-kilometre costs and accounts for the additional coordination and access overheads associated with managing a longer and more heterogeneous corridor (Weed Management Branch, 2025).

ASTC parks/reserves mowing and slashing (~1,000 ha)	1,000 ha	~$150–250/ha	$150,000	$250,000	Biosecurity SA (2019); Friedel et al. (2009); Read et al. (2020); Schlesinger et al. (2020)
Road verge slashing (~200 km)	200 km	~$200–400/km	$40,000	$80,000	NT Weed Management Strategy 2024–2030; operational estimate
Landcare volunteer effort and coordination	~150 ha	~$200–$333/ha/yr	$30,000	$50,000	Based on Alice Springs Landcare (2025); DLPE (2025a)
Reactive herbicide on DLPE Crown land	Ad hoc	Varies	$50,000	$100,000	WMB operational estimate; expert judgment
Programme admin and coordination	—	—	$20,000	$40,000	Standard programme overhead assumption
TOTAL ANNUAL DIRECT COST			**~$297,500**	**~$535,000**	

Note: The treatment areas and scales in this table reflect only those land categories where the Alice Springs municipality currently directs active management effort under the reactive approach. They do not represent the full extent of buffel grass infestation across the municipal area (~14,000 ha total; see Table 1), but rather the subset of locations where management is currently concentrated. Unit costs are provided for each activity to enable transparent scaling as mapped treatment areas are refined through future GIS survey work. The estimate for reactive herbicide on DLPE Crown land ($50,000–$100,000/yr) carries the highest uncertainty of any line item, as it is based on expert judgment rather than empirical treatment records, reflecting the ad hoc and uncoordinated nature of current Crown land management. Report 1 estimated that annual external costs per hectare total $5,396/ha/yr under a no-active-management scenario, representing the accumulating cost of inaction.

4.4 Cost projections by time horizon

Table 4 describes cost projections under Scenario 1, the reactive or current management approach, across three time horizons. The following analysis draws on the figures in Table 3 and the broader economic framework established in Report 1.

Table 4. Annual management cost for Scenario 1: Current management approach (reactive) by time horizon (1-5 yrs, 6-20 yrs, and 20+ years)

Time Horizon	Annual Direct Management Cost	Estimated Indirect Costs (Fire, Biodiversity, Cultural, Scenic)	Assumptions
Short-term (1–5 yrs)	$297.5K–$535K/yr	Rising; $500K–$1M/yr	Buffel expansion continues; fire costs begin to escalate
Medium-term (6–20 yrs)	$400K–$700K/yr	$1M–$2M/yr	Fire-suppression costs compound; cultural and biodiversity losses accelerate
Long-term (20+ yrs)	$500K–$1M/yr	$2M–$4M+/yr	Landscape-scale transformation; irreversible biodiversity and cultural loss; very high fire and infrastructure costs

Note: Direct management costs are scaled from the empirical Lower Todd and Charles River chemical control records (2018–2025; Weed Management Branch, 2025) and published NT and SA weed management cost benchmarks (Friedel et al., 2009; Read et al., 2020; Schlesinger et al., 2020), as detailed in Table 3 and Appendix B.1. Medium- and long-term direct cost increases reflect projected expansion of buffel grass across untreated land categories and the higher per-unit retreatment costs associated with episodic rather than sustained management. Indirect costs (fire, biodiversity, and cultural degradation) are derived from the per-hectare annual external cost flows established in Report 1: fire regime intensification $793/ha/yr; biodiversity loss $2,550/ha/yr; cultural site degradation $2,260/ha/yr; and scenic amenity loss $93/ha/yr. (total $5,396/ha/yr).

These rates are applied to an estimated expanding area of high-value land experiencing active cost accumulation within and adjacent to the municipal boundary, approximately 100–200 ha in the short term, growing to 400–750 ha over the long term as buffel spreads across untreated public and private land. The implied ramp is consistent with the order-of-magnitude indirect cost ranges shown. All values are in constant 2025 Australian dollars. Indirect cost ranges are highly uncertain and intended as order-of-magnitude estimates; comprehensive GIS mapping would substantially improve precision.

Table 4 reveals a structurally deteriorating cost position under continued reactive management. Two distinct but interrelated cost streams are presented: direct management expenditure, which increases only modestly over time, and estimated indirect costs attributable to fire, biodiversity loss and cultural degradation, which escalate sharply and come to dominate the total cost burden by the long-term horizon.

In the short term, direct management costs of $297,500–$535,000/yr reflect existing expenditures on mowing, slashing, reactive herbicide treatments and Landcare coordination, activities that address symptoms rather than the underlying weed problem. Indirect costs are already rising, estimated at $500,000–$1 million per year, driven by the early stages of fire-regime intensification as buffel grass fuel loads build across the landscape. Even at this early stage, indirect costs are comparable in magnitude to direct costs, indicating that the true economic burden of inaction significantly exceeds what appears in operational budgets.

In the medium term, the cost structure shifts decisively. Indirect costs reach $1–2 million per year, as fire-suppression expenditure compounds, consistent with Report 1's modelling, which documents that buffel grass-driven fires can cost ~13 times more per event than native-grass fires, reflecting modelled post-invasion conditions based on the current distribution and fuel load characteristics of buffel grass in the Alice Springs region, not a future projection. Biodiversity restoration costs, estimated at $2,550/ha/yr and cultural site degradation costs ($2,260/ha/yr) begin to accumulate across an increasingly large affected area, reflecting the documented lag between buffel grass establishment and measurable ecological change.

The long-term trajectory is the most significant. Direct management costs, while growing to $500,000–$1 million per year, remain bounded, yet indirect costs reach $2–4 million per year or more, representing a ratio of indirect to direct costs of between 2:1 and 8:1. This ratio reflects the fundamental dynamic of reactive management: because buffel grass is not being suppressed, the landscape continues to transform, generating accelerating externalities that no level of reactive expenditure can address. The notes to the table flag the risk of irreversible biodiversity and cultural loss at this stage, a threshold effect supported by the broader literature on grass–fire feedback loops in which buffel grass establishment and repeat burning progressively eliminate native species capable of recovery (Ryan-Colton et al., 2024; Schlesinger et al., 2013).

Table 4 makes a clear economic case against continued reactive management. The long-term total cost, combining direct and indirect streams, of $2.5–5 million per year under Scenario 1 substantially exceeds the annual cost of Scenario 2 in the medium and long term, and approaches the medium-term cost of Scenario 3, without delivering any of the biodiversity, cultural or fire-regime benefits those scenarios achieve. The apparent short-term savings of reactive management are therefore illusory; each year of inaction increases both the treatment area required for future control and the magnitude of largely irreversible external costs that accumulate in the interim.

4.5 Risks and limitations

The reactive approach carries significant and escalating risks:

- Buffel grass continues to expand, increasing treatment area and future control costs.
- Mowing and slashing without herbicide does not suppress seed banks and may spread seed.
- Escalating fire suppression costs: Report 1 documented that buffel grass produces 2–3 times as much combustible material as native grasses (Biosecurity SA, 2019), driving an increase in post-invasion wildfire frequency from one to five significant events per year in the Alice Springs municipal area; this combination of higher fuel loads and increased fire frequency produces an estimated annual incremental fire cost of AU$793,380 under base conditions, with standby costs (AU$480,000 per year) and asset repair costs (AU$300,000 per year) constituting the dominant expenditure components[3].
- Progressive biodiversity and cultural site degradation that will become increasingly difficult to reverse over 10–20 year timeframes. While many ecological changes could be reversed if buffel grass were removed and fire regimes restored, some losses are already irreversible, including the ongoing death of centuries-old culturally significant trees from buffel grass-fuelled fires. Even where ecological recovery is theoretically possible, restoration of vegetation structure to pre-invasion condition may require timeframes of 100 years or more, and only where fire patterns are successfully returned to pre-buffel levels (Ryan-Colton et al., 2024; Schlesinger & Westerhuis, 2021)."
- Increasing private land liability and compliance complexity as buffel grass spreads to new allotments.
- Potential public and government health costs related to allergies and buffel grass-fuelled fires.

[3] Note: these figures are drawn directly from Report 1 (Table 7 and Table 8) and should be updated in this report if the corresponding values in Report 1 are revised prior to finalisation. All fire cost figures in Report 2 are linked to Report 1 and must be checked for consistency at each review stage.

5 Scenario 2: Increased active buffel grass management (strategic transition)

5.1 Description

Scenario 2 represents a strategic transition to proactive, weed-focused management across the municipal area. It encompasses five key action areas:

- Implementing all buffel grass management actions in the Lhere Mparntwe Management Strategy 2019.
- Active buffel grass management of all ASTC and DLPE Crown land blocks of <10 ha.
- Active buffel grass management of road verges (herbicide-based, not just slashing).
- Active management of buffel grass on 25–50% of private land (through compliance, incentive and support programs).
- Maintaining current Landcare efforts.

5.2 Lhere Mparntwe Management Strategy 2019 actions

The Lhere Mparntwe Management Strategy 2019 identifies the Todd and Charles Rivers as the primary management corridors within the municipal area. Key buffel grass-relevant actions include: prioritising buffel grass and couch grass suppression as part of fuel management along 25+ km of river corridor; coordinating treatment across multiple tenures (ASTC, DLPE, NLC, private landowners); seasonal herbicide programs in combination with fire management; monitoring and mapping; and ranger and community training (NTG, 2019).

Full implementation of all LMM Strategy actions is estimated to require a step-change in investment relative to current levels. Drawing on the empirical Todd/Charles River data (an average of ~$6,000–7,000/yr for ~10–12 km over recent years, representing a 1-person part-time effort over few weeks) and scaling to the full river corridor and all Strategy actions, a conservative estimate for full Lhere Mparntwe plan implementation is:

- River corridor treatment (25 km at $1,200–1,800/km/yr for herbicide + labour): $30,000–45,000/yr.
- Cross-tenure coordination, mapping and monitoring: $50,000–80,000/yr.
- Ranger and community training: $20,000–30,000/yr.
- Fire management integration (firebreaks, seasonal coordination): $40,000–60,000/yr.
- Contingency and administration: $15,000–25,000/yr.
- Lhere Mparntwe subtotal: $155,000–240,000/yr

5.3 Active management of ASTC and DLPE Crown land blocks <10 ha

Transitioning from slashing-only to active herbicide-based management of all ASTC parks, reserves and DLPE Crown land blocks under 10 ha represents a major scaling-up of effort. The estimated aggregate area comprises: ~1,200 ha (ASTC) + ~800 ha (DLPE <10 ha blocks) = ~2,000 ha.

Cost basis: initial treatment year at $500–1,000/ha, followed by annual maintenance at $200–400/ha for moderate-density areas. Using a treatment cycle approach (initial year + 2 follow-ups at reduced intensity over 3 years):

- Year 1 intensive treatment (~2,000 ha at $600/ha average): $1,200,000.
- Years 2–5 maintenance (~2,000 ha at $300/ha average): $600,000/yr.
- ASTC/Crown blocks subtotal: $600K–$1.2M/yr (average over 5 years)

5.4 Active management of road verges

Road verge management transitions from slashing-only to integrated slashing plus targeted herbicide treatment. Based on an estimated 200 km of priority road verges at a treatment cost of $1,200–1,500/km/yr:

- Road verge subtotal: $240,000–$300,000/yr

5.5 Active management of 25-50% of private land

Private land management requires a combination of compliance enforcement, education, support grants and contractor assistance. For a 25–50% target across ~3,500 ha of private land (875–1,750 ha actively managed):

- Contractor herbicide treatment for willing landholders (875–1,750 ha at $400–600/ha/yr): $350,000–1,050,000/yr.
- Education, compliance and support program: $60,000–100,000/yr.
- Incentive grants and subsidy program: $50,000–150,000/yr.
- Private land subtotal (summation of above costs): $460,000–$1,300,000/yr

Within the Alice Springs municipal area, a subset of residential and peri-urban properties operate under organic or low-chemical management regimes, which can restrict or preclude the application of certain herbicides and impose buffer requirements near neighbouring properties (DEPWS, 2023). Such constraints influence the feasibility, timing, and method of buffel grass control on individual parcels but vary substantially according to certification status, landholder preferences, property configuration, and the availability of alternative control methods (Biosecurity SA, 2019; Buffel Grass Weed Advisory Committee, 2024).

Given the absence of a mapped inventory of organically managed land within the municipal boundary, and the scope of this assessment, the analysis does not attempt to isolate organic-land constraints as a discrete modelling parameter. Instead, these limitations are implicitly incorporated through conservative assumptions regarding private-land uptake (25–50% under Scenario 2 and 50–75% under Scenario 3), partial-coverage scalars, and wide cost ranges. Where herbicide use is constrained, management effort may shift toward mechanical control, staged treatment, negotiated buffers, or exclusion from active management in the short term, all of which are consistent with the coverage-based approach applied in this report. The impact of such constraints is therefore reflected in reduced effective coverage rather than increased unit costs, ensuring that economic estimates are not biased toward optimistic assumptions about universal herbicide access.

The implications of partial private-land participation, including organic-management constraints, are reflected in the coverage scalars and sensitivity analysis applied across Scenarios 2 and 3 (see Sections 7.3 and Appendix C.5).

5.6 Maintaining current landcare efforts

Maintaining the current Landcare effort (valued at $30,000–50,000/yr, including coordination and materials) as a baseline community contribution:

- Landcare subtotal: $30,000–$50,000/yr

5.7 Cost summary and projections

Avoided fire, biodiversity, cultural, and scenic costs applied to Scenario 2 are drawn directly from Report 1. These per-hectare values are scaled using an effective area coverage scalar of 0.24, derived by dividing the total area effectively treated under Scenario 2 (~3,325 ha, comprising ~2,000 ha of ASTC and Crown land, ~300 ha of road verges, ~875 ha of private land at the lower-bound 25% uptake rate, and ~150 ha of active Landcare sites) by the total municipal area of ~14,000 ha (3,325 ÷ 14,000 = 0.237, rounded to 0.24). This scalar reflects the proportion of the municipal area over which sustained management is assumed to occur, and avoided external costs are therefore realised.

Table 5 presents estimated annual costs for Scenario 2, increased active buffel grass management, across six activity components, with a total programme cost ranging from approximately $1.5 million to $3.2 million per year, averaging around $2.5 million.

Table 5. Cost summary for Scenario 2: Increased active buffel grass management (strategic transition)

Activity Component	Annual Low (AU$)	Annual High (AU$)	Assumptions	References
Lhere Mparntwe Strategy implementation	$155,000	$240,000	Full river corridor + coordination	NTG (2019); Weed Management Branch (2025) Lower Todd empirical records
ASTC and DLPE Crown land blocks <10 ha	$600,000	$1,200,000	~2,000 ha; year 1 intensive	Biosecurity SA (2019); Friedel et al. (2009); Read et al. (2020); Schlesinger et al. (2020); Buffel Grass Weed Advisory Committee (2024)
Road verge herbicide management	$240,000	$300,000	200 km at $1,200–1,500/km	NT Draft Buffel Grass Weed Management Plan 2026–2036 (NTG, 2025); Report 1 benchmark ($1,200/km/yr)
Private land (25–50% of ~3,500 ha)	$460,000	$1,300,000	Contractor + compliance + grants	Friedel et al. (2009); Read et al. (2020); NTG (2025); Weeds Management Act 2001 obligations
Maintain current Landcare	$30,000	$50,000	Coordination + materials	Based on Alice Springs Landcare (2025); Clarke and Morgan (2025)
Programme administration and hygiene	$50,000	$80,000	Incl. washdown facilities	Ferdinands et al. (2010); Friedel et al. (2009); standard programme overhead assumption
TOTAL ANNUAL (SCENARIO 2)	**~$1,535,000**	**~$3,170,000**	**Average ~$2.5M/yr**	

Note: Cost estimates are based on published NT and SA weed management benchmarks and operational records, scaled to the treatment areas defined in Appendix A. All values are in constant 2025 Australian dollars. Ranges reflect uncertainty in treatment intensity, seasonal conditions, and private land uptake rates. The largest and most variable cost component is active management of ASTC and DLPE Crown land blocks smaller than 10 ha, estimated at $600,000–$1,200,000 per year across approximately 2,000 ha. The wide range reflects the intensity of first-year treatment, which typically involves the highest herbicide, labour and equipment inputs before a maintenance regime can be established. Avoided costs are not embedded in Table 5; instead, they are accounted for in economic comparison using Report 1 parameters. The applied coverage scalar is 0.24.

The second largest component is private land management, costing $460,000–$1,300,000 per year, reflecting the challenge of engaging 25–50% of the approximately 3,500 ha of private land in the municipal area. This component necessarily includes contractor delivery, technical advice and extension support, compliance support, and grant incentives, recognising that under the *Weeds Management Act 2001*, landholders are required to take reasonable measures to prevent spread, but may require financial assistance to do so effectively (NTG, 2025).

Road verge herbicide management is estimated at $240,000–$300,000 per year, based on treatment of 200 km of road corridor at $1,200–$1,500/km. The lower bound of this unit cost aligns directly with the $1,200/km/yr benchmark for roadside buffel grass control identified in Report 1. Transport corridors are designated as a priority management area under the Buffel Grass Weed Management Plan 2026–2036 (DLPE, 2026), reflecting their role as key pathways for seed dispersal and landscape-scale spread.

Full implementation of the *Lhere Mparntwe Management Strategy 2019* is estimated at $155,000–$240,000 per year, covering the full Todd and Charles River corridor and inter-agency coordination. The strategy identifies buffel grass control as a central action for protecting the ecological health and cultural values of the river system, with ASTC, DLPE and traditional owners sharing lead responsibilities across the management zones (NTG, 2019).

The two smallest components, maintaining current Landcare effort ($30,000–$50,000/yr) and programme administration and hygiene ($50,000–$80,000/yr), covering vehicle and equipment washdown facilities and protocols to prevent seed transfer between treatment sites, are modest in cost but operationally significant. Landcare activities represent some of the longest-standing and most successful site-level buffel control work in the Alice Springs municipal area (DLPE, 2025a). Hygiene and washdown costs, while small relative to control expenditure, are recognised as among the most cost-effective prevention measures available, reducing propagule pressure and limiting reinfestation across all treatment areas (Ferdinands et al., 2010; Friedel et al., 2009).

The cost structure of Scenario 2 reflects the multi-tenure, multi-agency nature of buffel grass management in the Alice Springs municipal area. The strong year-1 weighting in Crown land costs and the wide range on private land engagement indicate that total programme expenditure will vary materially depending on uptake rates, seasonal conditions, and the sequencing of intensive versus maintenance-phase operations across the land categories.

Table 6 projects annual management costs for Scenario 2 across three time horizons and illustrates a cost trajectory that is the inverse of the reactive management approach under Scenario 1: expenditure is highest in the short term and declines progressively as active management takes effect.

Table 6. Annual management costs for Scenario 2: Increased active buffel grass management (strategic transition) by time horizon (1-5 yrs, 6-20 yrs, and 20+ years)

Scenario 2 encompasses the full implementation of the Lhere Mparntwe Management Strategy 2019 buffel actions; active herbicide-based management of all ASTC and DLPE Crown land blocks <10 ha (~2,000 ha); integrated herbicide treatment of road verges (200 km); active management of 25–50% of private land through contractor delivery, compliance and incentive programs; and maintenance of current Landcare efforts.

Time Horizon	Annual Cost (Low)	Annual Cost (High)	Key cost drivers

Short-term (1–5 yrs)	~$1.5M/yr	~$3.2M/yr	High initial treatment costs; infrastructure establishment; compliance setup
Medium-term (6–20 yrs)	~$1.5M/yr	~$2.6M/yr	Maintenance cycles; declining retreatment needs as seedbanks depleted; continued private land engagement
Long-term (20+ yrs)	~$0.9M/yr	~$2.0M/yr	Lower treatment intensity, periodic monitoring and maintenance significantly reduced fire and biodiversity costs

In the short term, annual costs of ~$1.5–$3.2 million reflect the front-loading inherent in any programme of active weed management. Initial treatment of approximately 2,000 ha of ASTC and Crown land, establishment of compliance infrastructure for private landholders, and the capital costs of hygiene and washdown facilities all concentrate expenditure in the first one to five years. This pattern is consistent with documented cost structures for intensive buffel grass control, where first-year treatment costs of $5,000–$10,000/ha give way to substantially lower maintenance rates in subsequent seasons as infestation density declines (Friedel et al., 2009; Read et al., 2020).

In the medium term, annual costs reduce to ~$1.5–$2.6 million as treatment programmes transition from initial control to maintenance cycles. The key mechanism driving this reduction is progressive buffel grass seedbank depletion: sustained herbicide application and mechanical treatment across successive growing seasons reduce viable seed density, lowering retreatment requirements over time (Farrell & Gornish, 2019). A 10-year control cycle has been identified as consistent with NT management planning horizons and the persistence of buffel grass seedbanks, which require long-term monitoring and periodic re-treatment to maintain low-density conditions (Panetta, 2025), a principle that holds more broadly across invasive grass systems (Rossiter-Rachor et al., 2023). Private land engagement costs remain present in this phase but are expected to moderate as landholder capacity and compliance systems mature under the obligations established by the *Weeds Management Act 2001* and the Buffel Grass Weed Management Plan.

In the long term, annual costs fall further to ~$0.9–$2.0 million, with treatment intensity reduced to periodic monitoring and targeted follow-up in areas of reinfestation risk. Critically, this reduction in direct management expenditure is accompanied by significantly lower fire, biodiversity, and cultural costs, benefits absent in Scenario 1 at the equivalent time horizon. The long-term cost profile of Scenario 2 is therefore not merely lower in absolute terms than its short-term costs, but substantially lower in total cost, direct plus indirect, than the long-term trajectory of reactive management under Scenario 1.

5.8 Benefits and co-benefits

Avoided fire, biodiversity, cultural, and scenic costs applied to Scenario 2 are sourced from Report 1 and scaled by the Scenario 2 effective coverage of 0.24. Scenario 2 is expected to generate high avoided costs and co-benefits compared to Scenario 1:

- Reduced fire suppression costs: prevention of buffel grass-fuelled wildfires avoids significant annual fire suppression expenditure, estimated at AU$793,380/yr under base conditions and rising to AU$927,180/yr at higher fire frequencies, constituting the dominant expenditure components that active management under Scenario 2 seeks to avoid.

- Biodiversity protection: active management of river corridors and public land reduces the rate of native species displacement and long-term restoration costs (valued at $2,550/ha/yr in Report 1).
- Cultural site protection: implementation of the Lhere Mparntwe Strategy's cultural site actions reduces ongoing degradation costs (valued at $2,260/ha/yr in Report 1).
- Infrastructure protection: reduced fire damage to fencing, utilities and roads along managed corridors.
- Improved scenic amenity: reduced buffel grass dominance along tourism-facing corridors and riverbanks.
- When assessed using the cost–benefit framework applied in this report, Scenario 2 demonstrates strong economic performance once external costs are accounted for. The reported benefit–cost ratios of approximately 5.3 over a 50-year horizon and 4.9 over a 20-year horizon are coverage-adjusted BCRs, calculated by applying the Scenario 2 effective area coverage scalar of 0.24, which reflects the proportion of the municipal area over which sustained management is assumed to occur, and benefits are therefore realised.

6 Scenario 3: Good buffel grass management (proactive asset protection)

6.1 Description

Scenario 3 represents the most comprehensive management approach, designed to protect high-value biodiversity and cultural assets, minimise long-term fire risk, and achieve landscape-scale suppression of buffel grass across the municipal area. It comprises four key action areas:

- Employing integrated weed and fire management practices across the municipal area.
- Active management of buffel grass on the ranges surrounding Simpsons Gap, Ilparpa and Yeperenye/Emily and Jesse Gap Nature Parks, and at Ilparpa Swamp.
- Active management of buffel grass on 50–75% of private land.
- Extending current Landcare efforts by 50%.

6.2 Integrated weed and fire management

Integrated weed and fire management involves coordinating herbicide programs with strategic prescribed burning, firebreak construction, and cross-agency planning. Evidence from comparable arid and semi-arid programs, such as the *South Australia Buffel Grass Strategic Plan 2019-2024* (Biosecurity SA, 2019) demonstrates that integration of weed control with fire management is more cost-effective than treating each separately. Costs for this element include[4]:

- Integrated planning and coordination ($80,000–120,000/yr) is estimated as a lump-sum programme overhead based on comparable cross-agency weed and fire coordination programs in the NT, consistent with coordination cost assumptions in Drucker and Setterfield (2008) and Beaumont et al. (2018).
- Strategic prescribed burning program ($120,000–200,000/yr) draws on NT fire management operational benchmarks for preparation, execution and post-burn monitoring in arid landscapes, informed by the South Australia Buffel Grass Strategic Plan 2019–2024 (Biosecurity SA, 2019).
- Firebreak construction and annual maintenance ($100,000–180,000/yr) reflects standard NT operational estimates for mechanical firebreak preparation and annual maintenance across the priority management zones identified in the Alice Springs Regional Weeds Strategy 2021–2026 (NTG, 2021).
- Emergency response capacity and post-fire buffel grass treatment ($80,000–150,000/yr) is a contingency allowance based on the documented pattern of post-fire buffel grass reinvasion requiring immediate herbicide intervention (Schlesinger et al., 2013; Schlesinger & Westerhuis, 2021).
- Integrated weed/fire subtotal ($380,000–$650,000/yr) represents the direct arithmetic sum of the four components above and does not incorporate discounting or probability weighting across components.

6.3 Active management of ranges and nature parks

Active management of buffel grass on the ranges surrounding Simpsons Gap, Ilparpa, Yeperenye/Emily and Jesse Gap Nature Parks and Ilparpa Swamp targets the highest-value

[4] All components carry significant uncertainty given the absence of systematic operational cost records for integrated weed-fire programs in the Alice Springs municipal area; these estimates should be refined as program delivery data become available.

biodiversity and cultural assets within and adjacent to the municipal boundary. These areas are characterised by rugged terrain, limited vehicle access, and dense buffel grass infestations.

Estimated area for priority ranges management: approximately 2,000–3,000 ha of targeted high-value zones (not the entire park area). Using a staged approach:

- Year 1–3: intensive initial treatment (~2,500 ha at $3,000–5,000/ha initial treatment + helicopter/foot access costs): $7,500,000–$12,500,000 total over 3 years; ~$2,500,000–$4,200,000/yr[5].
- Years 4–10: maintenance treatment (~2,500 ha at $800–1,500/ha/yr): $2,000,000–$3,750,000/yr.
- Years 10+: monitoring and targeted spot treatment: $500,000–$1,200,000/yr.
- Ranges/nature parks subtotal: $2,500,000–$4,200,000/yr (short-term); $2,000,000–$3,750,000/yr (medium-term); $500,000–$1,200,000/yr (long-term).

6.4 Active management of 50-75% of private land

Scaling private land management to 50–75% coverage (~1,925–2,625 ha actively managed from the ~3,500 ha total of the Alice Springs municipality):

- Contractor herbicide treatment (1,925–2,625 ha at $400–600/ha/yr): $770,000–$1,575,000/yr.
- Enhanced compliance and education program: $100,000–150,000/yr.
- Incentive grants and support: $100,000–200,000/yr.
- Private land subtotal: $970,000–$1,925,000/yr

6.5 Extension of landcare efforts by 50%

A 50% extension of current Landcare efforts would increase the active Landcare area from ~150 ha to ~225 ha and proportionally increase coordination and materials costs:

- Extended Landcare subtotal: $45,000–$75,000/yr

6.6 Carry-over of scenario 2 elements

Scenario 3 also maintains all Scenario 2 activities (Lhere Mparntwe actions, ASTC/Crown land blocks, road verges, administration):

- Carry-over Scenario 2 elements: ~$1,100,000–$1,900,000/yr

6.7 Cost summary and projections

Avoided fire, biodiversity, cultural, and scenic costs applied to Scenario 3 are sourced from Report 1 and scaled using an effective area coverage scalar of 0.48, derived by dividing the total area effectively treated under Scenario 3 (~6,775 ha, comprising ~2,000 ha of ASTC and Crown land, ~300 ha of road verges, ~1,750 ha of private land at approximately 50% uptake, ~225 ha of extended Landcare sites, and ~2,500 ha of priority ranges and nature park zones) by the total municipal area of ~14,000 ha (6,775 ÷ 14,000 = 0.484, rounded to 0.48). This scalar reflects the substantially greater proportion of the municipal area over which sustained management is assumed to occur under Scenario 3 relative to Scenario 2 (0.24), and therefore a larger share of avoided external costs realised.

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[5] Note: Helicopter and off-road ATV access for rugged terrain adds 30–50% to standard herbicide costs.

Table 7 presents the annual cost components of Scenario 3, which extends the activities of Scenario 2 to include the ranges, nature parks and a higher proportion of private land, reflecting the full scope of landscape-scale management specified in the project scope (DLPE, 2025b).

Table 7. Cost summary for Scenario 3: Good buffel grass management (proactive asset protection)

Activity Component	Annual Low (AU$)	Annual High (AU$)	Time Horizon	Assumptions	References
Integrated weed/fire management	$380,000	$650,000	All years	Cross-agency coordination + fire	Biosecurity SA (2019); Drucker and Setterfield (2008); Beaumont et al. (2018); NTG (2021)
Ranges and nature parks: initial treatment	$2,500,000	$4,200,000	Short (1–3 yrs)	Intensive; helicopter/ATV access	Biosecurity SA (2019); Buffel Grass Weed Advisory Committee (2024); Friedel et al. (2009); operational estimate for helicopter/ATV-assisted access (+30–50% terrain premium)
Ranges and nature parks: maintenance	$2,000,000	$3,750,000	Medium (4–20 yrs)	Biennial/triennial retreatment	Friedel et al. (2009); Read et al. (2020); Rossiter-Rachor et al. (2023)
Ranges and nature parks: monitoring only	$500,000	$1,200,000	Long (20+ yrs)	Spot treatment + mapping	Read et al. (2020); Panetta (2025); standard monitoring programme assumption
Private land (50–75% of ~3,500 ha)	$970,000	$1,925,000	All years	Contractor + compliance + grants	Friedel et al. (2009); Read et al. (2020); NTG (2025); Weeds Management Act 2001 obligations
Extended Landcare (+50%)	$45,000	$75,000	All years	~225 ha	Based on Alice Springs Landcare (2025); Clarke and Morgan (2025)
Carry-over Scenario 2 elements	$1,100,000	$1,900,000	All years	River corridors, roads, ASTC/Crown	As per Table 5 sources, Appendix B.2

Notes: Cost estimates are based on published NT and SA weed management benchmarks, operational records, and programme overhead assumptions, scaled to the treatment areas defined in Appendix A. Ranges and nature parks initial treatment costs include a terrain access premium of 30–50% above standard herbicide and labour rates, reflecting helicopter and ATV-assisted operations in rugged terrain (Biosecurity SA, 2019; Buffel Grass Weed Advisory Committee, 2024). Carry-over Scenario 2 elements are costed at maintenance-year rates consistent with Table 5 and Appendix B.2. All values are in constant 2025 Australian dollars. Cost ranges carry significant uncertainty (±30%) due to the absence of comprehensive GIS mapping across the municipal area; estimates should be refined as systematic treatment and monitoring records become available.

The most distinctive and cost-intensive feature of Scenario 3 is the addition of active management across the ranges and nature parks surrounding Alice Springs, including Simpsons Gap, Ilparpa and Yeperenye/Emily and Jesse Gap Nature Park, areas of high biodiversity and cultural significance that are specifically identified as priority management targets under the project scope and the Alice Springs Regional Weeds Strategy 2021–2026 (NTG, 2021). Rugged terrain in these areas necessitates helicopter and ATV-assisted access, driving initial treatment costs to $2.5–$4.2 million per year in the first one to three years, the dominant cost across the entire scenario.

The medium-term ranges and parks cost of \$2.0–\$3.75 million per year reflects a transition to biennial or triennial retreatment cycles as initial infestation density declines. In the long term, the costs of ranges and parks fall substantially to \$500,000–\$1.2 million per year, reflecting periodic spot treatment and distributional mapping rather than broad-scale control, an outcome contingent on maintaining the management effort established in earlier phases.

Integrated weed and fire management, costing at \$380,000–\$650,000 per year across all time horizons, reflects the cross-agency coordination required to align herbicide programs with prescribed burning regimes. This integration is central to Scenario 3's rationale: buffel grass drives a self-reinforcing grass–fire feedback cycle in which increased fuel loads lead to more frequent and severe fires, which in turn promote further buffel grass expansion (Schlesinger et al., 2013; Schlesinger & Westerhuis, 2021). Coordinating weed control with fire management is therefore not merely operationally convenient but ecologically essential to breaking this cycle.

Private land management costs of \$970,000–\$1.925 million per year are higher than in Scenario 2, reflecting the increased target of 50–75% of approximately 3,500 ha of private land, a coverage level that requires more intensive contractor engagement, compliance support and grant incentives.

The extended Landcare component (\$45,000–\$75,000/yr across ~225 ha) and the carry-over of Scenario 2 elements (\$1.1–\$1.9 million/yr covering river corridors, road verges and ASTC/Crown land) provide programme continuity, ensuring that gains achieved under Scenario 2 activities are not lost as resources shift toward the ranges. The carry-over element recognises that Alice Springs Landcare has demonstrated some of the most sustained and ecologically successful buffel grass control in the municipal area, with long-term sites showing native plant recovery following persistent management effort (Clarke & Morgan, 2025).

The cost structure of Scenario 3 reflects the scale of ambition required for good buffel grass management at the landscape level. Total annual costs are highest in the short term due to the intensive treatment demands of the ranges and parks, but the programme's long-term cost profile, and its potential to substantially reduce fire suppression, biodiversity restoration and cultural remediation costs, positions it as the scenario with the greatest capacity to generate net economic and ecological returns over time.

Table 8 projects annual management costs for Scenario 3 across three time horizons and reveals a cost trajectory that is the most front-loaded of the three scenarios but converges, in the long term, with the lowest total cost position of any management approach considered.

Table 8. Annual management for Scenario 3: Good buffel grass management (proactive asset protection) by time horizon (1-5 yrs, 6-20 yrs, and 20+ years)

Scenario 3 (Good Buffel Grass Management: Proactive Asset Protection) encompasses: integrated weed and fire management across the municipal area, including cross-agency coordination, strategic prescribed burning, firebreak construction and emergency response capacity; intensive active management of buffel grass across the ranges and nature parks surrounding Alice Springs, including Simpsons Gap, Ilparpa Swamp, and Yeperenye/Emily and Jesse Gap Nature Parks (~2,500 ha of priority zones); active management of 50–75% of private land (~1,925–2,625 ha) through contractor delivery, enhanced compliance and incentive programs; extension of current Landcare efforts by 50% (~225 ha); and carry-over of all Scenario 2 elements covering river corridors, road verges and ASTC/Crown land blocks. Scenario 3 is the most comprehensive management approach, designed to break the buffel grass–fire feedback loop, protect irreplaceable biodiversity and cultural assets, and achieve landscape-scale suppression across the full municipal area.

Time Horizon	Annual Cost (Low)	Annual Cost (High)	Key cost drivers
Short-term (1–5 yrs)	~$5.0M/yr	~$8.1M/yr	High initial treatment; ranges access; fire management setup; private land mobilisation
Medium-term (6–20 yrs)	~$4.5M/yr	~$7.7M/yr	Maintenance cycles; declining retreatment density; private land compliance ongoing
Long-term (20+ yrs)	~$3.0M/yr	~$5.1M/yr	Lowest cost scenario in the long run; monitoring + spot treatment; very low fire and biodiversity costs

Note: Annual cost ranges are derived from the component costs detailed in Table 7 and Appendix B.3, aggregated across time horizons. Short-term costs are dominated by intensive initial treatment of ranges and nature parks, including helicopter and ATV-assisted access (terrain premium of 30–50% above standard rates). Medium-term cost reductions reflect the transition from intensive initial treatment to biennial or triennial maintenance cycles as infestation density declines. Long-term costs represent periodic monitoring and targeted spot treatment, contingent on maintaining the management effort established in earlier phases. All values are in constant 2025 Australian dollars.

Short-term costs of ~$5.0–$8.1 million per year are driven primarily by the intensive initial treatment required across the ranges and nature parks surrounding Alice Springs, combined with the mobilisation costs of fire management setup and private land engagement at scale. The upper bound of ~$8.1 million per year reflects a realistic worst-case scenario in which all major treatment areas require simultaneous intensive intervention, including helicopter- and ATV-assisted access in rugged terrain, in the same season. This front-loading is a well-established characteristic of proactive weed management investment: research on analogous invasive grass programmes in the NT demonstrates that delay makes eradication progressively less achievable and more expensive, and that early intervention consistently provides the clearest return on investment (Drucker & Setterfield, 2008). The same dynamic applies to buffel grass, where the window for cost-effective landscape-scale control narrows with each year of inaction as infestation density and spatial extent increase (Friedel et al., 2009; Ryan-Colton et al., 2024).

In the medium term, annual costs moderate to ~$4.5–$7.7 million as the ranges and parks transition from intensive initial treatment to biennial or triennial maintenance cycles, and private land engagement moves from mobilisation to routine compliance and follow-up. This phase closely mirrors the medium-term cost profile of Scenario 2, underscoring that the additional expenditure of Scenario 3 is concentrated in the short term and is not a permanently elevated cost commitment.

The long-term cost range of approximately $3.0–$5.1 million per year, as shown in Table 9, is not the lowest direct management cost among the scenarios, but it represents the lowest long-term whole-of-system cost once external costs are accounted for. This result reflects the fundamental economics of invasive species management: by suppressing buffel grass across the municipality's highest-value ecological and cultural landscapes, Scenario 3 achieves the largest reductions in fire-regime intensification, biodiversity restoration requirements, and cultural site remediation, cost categories that increasingly dominate total impacts under Scenarios 1 and 2 over time. As a result, the comparatively moderate and stable costs of long-term monitoring and targeted spot treatment under Scenario 3 replace what would otherwise be a persistent multi-million-dollar burden of unmanaged fire, ecological degradation, and cultural loss. This dynamic provides the strongest economic justification for the higher short-term investment required under Scenario 3.

6.8 Long-term benefits

Avoided fire, biodiversity, cultural, and scenic costs applied to Scenario 3 are sourced from Report 1 and scaled by the Scenario 3 effective coverage of 0.48. It is expected that Scenario 3 delivers the following long-term benefits:

- Maximum biodiversity protection: long-term saving of restoration costs across high-value areas.
- Largest reduction in fire suppression costs: integrated weed/fire management prevents landscape-scale fire events.
- Strongest protection of cultural assets: active management at sacred sites, waterholes and songline corridors.
- Enhanced tourism outcomes: improved scenic amenity along visitor-facing corridors and into adjacent national parks.
- Greatest avoided infrastructure damage: reduction in fire-related damage to fencing, utilities, roads and park assets.
- Scenario 3 has a lower BCR than Scenario 2 because costs are greater than benefits, but produces the highest absolute net present value and strongest risk reduction.

7 Cross-scenario economic comparison

7.1 Summary of costs by time horizon

A comparison of annual management costs across the three scenarios highlights a clear trade-off between short-term expenditure and long-term ecological and cultural risk (Table 9). Scenario 1 (Reactive) appears least expensive in the short term (~$297.5K–$535K/yr), but this approach relies on mowing, slashing, and ad-hoc herbicide, actions shown to fail to suppress buffel grass seedbanks, which may facilitate further spread (Friedel et al., 2006; Puckey & Albrecht, 2004). Because buffel grass dramatically increases fuel continuity and fire intensity, landscapes under reactive management experience more frequent and severe fires, escalating long-term costs associated with biodiversity decline, cultural-site degradation, and fire suppression (Fusco et al., 2019; Schlesinger et al., 2013). These externalities consistently outweigh the modest operational savings of Scenario 1, making it the most economically inefficient pathway over medium- and long-term horizons (refer to Appendix C).

Table 9. Cross-scenario comparison of annual management costs by time horizon

Scenario	Short-term (1-5yrs) annual cost (Low–High)	Medium-term (6-20yrs) annual cost (Low–High)	Long-term (20+ yrs) annual cost (Low–High)	Key trade-off	Key areas covered/managed
Scenario 1: Reactive Management	~$297.5K–$535K	~$400K–$700K	~$500K–$1M	Low upfront; very high long-term fire, biodiversity and cultural costs	Todd and Charles River corridors (~15 km, reactive herbicide); ASTC parks and reserves (~1,000 ha, mowing/slashing only); road verges (~200 km, slashing only); Landcare sites (~150 ha); ad hoc DLPE Crown land
Scenario 2: Increased Active Management	~$1.5M–$3.2M	~$1.5M–$2.6M	~$0.9M–$2.0M	Moderate upfront; substantially reduced long-term costs	Todd and Charles River corridors (25 km, herbicide); ASTC and DLPE Crown land blocks <10 ha (~2,000 ha); road verges (200 km, herbicide); 25–50% of private land (~875–1,750 ha); Landcare sites (~150 ha)
Scenario 3: Good/Proactive Management	~$5.0M–$8.1M	~$4.5M–$7.6M	~$3.0M–$5.1M	Highest upfront and long-term direct management cost; maximum savings of external costs over time; maximum asset protection	All Scenario 2 areas plus ranges and nature parks (~2,500 ha priority zones: Simpsons Gap, Ilparpa Swamp, Yeperenye/Emily and Jesse Gap Nature Parks); 50–75% of private land (~1,925–2,625 ha); extended Landcare (~225 ha); integrated fire management across all areas

Scenario 2 (Increased Active Management) involves investment of ~$1.5–$3.2M/yr in the short term, while targeting corridors, road verges, and 25–50% of private land. This aligns with

documented best-practice approaches showing that early and sustained active management reduces reinvasion pressure and lowers fire risk, particularly where cross-tenure coordination is applied (NTG, 2022; Read et al., 2020). By reducing buffel grass biomass and seedbank persistence, Scenario 2 transitions to a lower, stable long-term cost (~$0.9–$2.0M/yr) while avoiding a substantial proportion of the ecological and cultural losses typical of Scenario 1. These avoided losses are significant, given that buffel grass invasions are associated with rapid shifts in vegetation structure, declines in native species richness, and reduced habitat quality (Bonney et al., 2017; Marshall et al., 2012).

Scenario 3 (Good Management) involves the highest short-term costs (~$5.0–$8.1M/yr), primarily due to intensive treatment of rugged ranges and high-value cultural and biodiversity areas. However, scientific evidence consistently shows that high-value arid landscapes are the most vulnerable to irreversible transformation under buffel grass invasion, making early intervention essential (Clarke et al., 2005; Ryan-Colton et al., 2024). Integrated weed–fire strategies, such as those included in Scenario 3, are widely recognised as the most effective means of breaking the buffel grass–fire feedback loop (Schlesinger & Westerhuis, 2021). Although long-term direct management costs under Scenario 3 remain higher than those of Scenario 2, declining to approximately $3.0–$5.1 million per year, Scenario 3 delivers the greatest long-term risk reduction and asset protection of all options. This outcome reflects the comprehensive suppression of buffel grass across the municipality's highest-value ecological, cultural, and tourism landscapes, including the ranges and nature parks that are most vulnerable to irreversible transformation. By breaking the grass–fire feedback loop in these priority areas, Scenario 3 achieves substantially larger reductions in fire-regime intensification, biodiversity loss, and cultural site degradation, impact categories that dominate total long-term costs under both Scenarios 1 and 2. When avoided costs are taken into account, the higher ongoing management costs are more than offset by the reduction in persistent, multi-million-dollar external cost burdens, resulting in the highest absolute net present value and the strongest long-term economic case.

The additional cost of Scenario 3 relative to Scenario 2 is strongly front-loaded and time-limited. In the short term (1–5 years), the upper-bound annual cost difference is approximately $4.9 million (about $8.1 million under Scenario 3 compared with $3.2 million under Scenario 2), reflecting intensive initial treatment of rugged ranges and nature parks, and expanded private-land participation. This differential remains substantial in the medium term (6–20 years), at approximately $3.9–$5.0 million per year (around $4.5–$7.7 million versus $1.5–$2.6 million), before stabilising in the long term as both scenarios transition to lower-intensity maintenance and monitoring. This cost structure reinforces the strategic rationale for Scenario 3: the higher expenditures are concentrated in the early years and finance the decisive, landscape-scale interventions required to protect the biodiversity values of Simpsons Gap, Yeperenye, and Ilparpa nature parks, preserve the integrity of culturally significant sites, and suppress the grass–fire dynamics that drive escalating long-term damage. Consistent with the broader invasive-species literature, the analysis indicates that delaying such intervention progressively narrows the window for cost-effective control and increases the risk of irreversible ecological and cultural loss (Argyll Consulting, 2017; Beaumont et al., 2018; Drucker & Setterfield, 2008; Rossiter-Rachor et al., 2023).

The directional differences in cost trajectories across scenarios reflect intentional structural contrasts rather than assumptions of smooth or guaranteed performance. Scenario 1 represents a reactive approach in which treatment effort responds to symptoms rather than suppressing buffel grass at the landscape level; as infestation extent and fire risk increase, both direct and indirect costs are expected to trend upward over time. By contrast, Scenarios 2 and 3 are designed as proactive programmes in which higher early investment is explicitly intended to reduce future treatment intensity and external costs. The resulting declining average cost profiles represent a planning logic for sustained management programmes rather than a prediction of monotonic year-on-year cost reductions. Inter-annual variability remains likely under all scenarios due to rainfall, access, and operational constraints, and is reflected in the use of cost ranges rather than single-point estimates.

7.2 Cost-benefit analysis

Applying the per-hectare benefit-cost flows established in Report 1, the three management scenarios show markedly different economic performance when assessed using benefit–cost ratios (BCRs). A 7% real discount rate was applied consistently across scenarios. Results are reported using coverage-adjusted BCRs for Scenarios 2 and 3, reflecting the proportion of the municipal area over which sustained management is assumed to occur.

Table 10. Summary of cost–benefit analysis per scenario

Scenario	Management approach	Benefit–cost ratio (BCR)	Interpretation
Scenario 1: Reactive management	Current approach (mowing, slashing, ad-hoc herbicide)	≈ 0.005 (20-years)–0.01 (50-years)	Benefits are negligible relative to costs
Scenario 2: Increased active management	Coordinated control on public land, road verges, and 25–50% of private land	≈ 4.9 (20-years) ≈ 5.3 (50-years)	Strong economic return; benefits outweigh costs by ~5:1
Scenario 3: Good buffel grass management	Proactive, integrated weed–fire management, including ranges and 50–75% of private land	≈ 3.4 (20-years) ≈ 3.7 (50-years)	High absolute benefits despite higher program costs

Note: BCRs for Scenarios 2 and 3 are coverage-adjusted (Scenario 2 ≈ 24%; Scenario 3 ≈ 48%).

Scenario 1 (Reactive Management) exhibits a very low BCR, confirming that continued reactive management generates negligible economic value relative to the scale of accumulating external costs. Using the municipal-only benefit variant (erosion control valued at AU$32/ha/yr), the BCR is approximately 0.005, rising marginally to around 0.01 if limited general benefits are included. By contrast, annual external costs associated with unmanaged buffel grass, comprising fire-regime intensification, biodiversity loss, cultural site degradation and scenic amenity loss, sum to approximately AU$5,396/ha/yr. Over a 20-year horizon and a modelled 1,500 ha of high-value land, the economic burden of Scenario 1 substantially exceeds that of either active management scenario once indirect and avoided costs are considered, illustrating the severe long-term penalty of inaction.

Scenario 2 (Increased Active Management) involves higher direct management expenditure but achieves substantial economic gains through avoided external costs. Benefits include reductions in fire management costs, biodiversity restoration liabilities, cultural site degradation, and scenic amenity loss, drawn directly from Report 1 and scaled by the Scenario 2 effective coverage factor of 0.24. Under this framework, Scenario 2 achieves a coverage-adjusted BCR of approximately 4.9 over a 20-year horizon (and around 5.3 over 50 years), demonstrating a strongly positive economic return. These results indicate that even partial but coordinated active management across public land, road verges, and 25–50% of private land delivers benefits that substantially outweigh costs over policy-relevant timeframes.

Scenario 3 (Good Buffel Grass Management) requires the highest upfront investment but produces the highest absolute avoided external costs over the medium and long term. Using the Scenario 3 effective coverage factor of 0.48, the coverage-adjusted BCR is approximately 3.4 over 20 years (and about 3.7 over 50 years). Although this ratio is lower than Scenario 2 on a pure efficiency basis, reflecting the program's larger scale and complexity, Scenario 3 delivers the strongest reduction in systemic risk. By intensively managing high-value ranges, nature parks and a majority of private land, it achieves the greatest reductions in fire-regime intensification, long-term biodiversity loss and cultural site degradation. Overall, the analysis shows that early, comprehensive intervention produces the most durable economic and ecological outcomes once avoided costs and the risks of irreversible damage are fully accounted for.

7.3 Sensitivity analysis and key concerns

Key sensitivity considerations:

- Discount rate: A uniform discount rate is applied across all cost and benefit categories, biodiversity, cultural site degradation, fire suppression and scenic amenity reduction, consistent with the standard Cost-Benefit Analysis method. However, the choice of discount rate has a disproportionate effect on biodiversity values compared with other categories, because biodiversity losses are long-term and irreversible. Unlike fire suppression costs, which materialise within annual or decadal timeframes, biodiversity restoration costs of $2,550/ha/yr accumulate progressively and, once ecosystem thresholds are crossed, cannot be reversed within any practical planning horizon. At a lower discount rate (3%), future losses are discounted less heavily, meaning the full weight of long-term biodiversity degradation is more fully captured in present value terms, substantially increasing the avoided-cost advantage of Scenarios 2 and 3 relative to the base case 7% rate for consistency with Report 1 and standard NT government practice, a uniform 7% rate is retained as the base case.
- Rainfall variability and management timing: Annual direct management costs across all three scenarios are sensitive to the timing, amount, and continuity of rainfall events, which determine when active buffel grass growth, the trigger for effective herbicide application, occurs (Farrell & Gornish, 2019). Mowing and slashing can proceed regardless of conditions and carry relatively predictable costs (Biosecurity SA, 2019; Weed Management Branch, 2021); however, the herbicide component of all three scenarios, which accounts for the majority of treatment expenditure, is contingent on active growth periods that are inherently unpredictable. Hence, rainfall is a key determining factor, requiring constant updates to buffel grass management plans and actions.
- Treatment effectiveness: If herbicide efficacy is reduced by 20% (e.g. due to timing issues or repeat germination), short-term costs increase by ~20% and additional retreatment cycles are needed.
- Fire frequency scalation: Report 1's sensitivity analysis varied post-invasion wildfire frequency rather than applying a suppression cost multiplier; as fire frequency

increases from the base assumption of five events per year up to eleven events per year (+150%), the estimated annual incremental fire cost rises from AU$793,380 to AU$927,180, representing an approximately 17% increase above the base case rather than a doubling, with standby costs (AU$480,000/year) and asset repair (AU$300,000/year) remaining the dominant fixed components throughout all scenarios.

- Private land uptake: If private land uptake falls below 25% in Scenario 2 or 50% in Scenario 3, reinvasion from untreated blocks can negate treatment gains in adjacent public areas, materially increasing ongoing control costs.
- Area uncertainty: Estimates carry ±30% uncertainty due to limited current-state mapping. Comprehensive mapping (recommended in Strategy 2024–2030) is the highest-priority data gap.
- Reinvasion rates and treatment windows: In arid central Australian systems, reinvasion dynamics, treatment timing constraints, and rainfall variability are tightly coupled and cannot be meaningfully parameterised without fine-scale spatial and temporal data on seedbank persistence, rainfall sequencing, workforce availability, and treatment response. Rather than introducing speculative reinvasion functions, this assessment incorporates these risks through conservative area estimates, wide cost ranges, and coverage scalars that limit the proportion of avoided costs assumed under each scenario. The analysis, therefore, does not assume complete or permanent suppression, but instead reflects the economic consequences of sustained management under heterogeneous conditions. Explicit modelling of reinvasion rates or missed treatment windows would require long-term experimental datasets or municipal-scale GIS and monitoring systems that do not currently exist; their absence is treated as an acknowledged evidence gap rather than a model omission.

7.4 Distributional effects across stakeholder groups

Costs and benefits are not distributed equally across stakeholder groups:

- NT Government (DLPE, Parks): bears the largest share of direct management costs for Crown land, ranges and programme coordination.
- Alice Springs Town Council: high costs for ASTC land under Scenarios 2 and 3; benefits from reduced fire risk and amenity improvement.
- Private landowners: compliance obligations and cost-sharing requirements under Scenarios 2 and 3; benefit from reduced fire risk and property protection, but also incur indirect costs to health and well-being under all scenarios, including exposure to smoke and particulates from buffel grass-fuelled fires, increased allergenic load from buffel grass pollen, and the psychological burden of managing weed obligations on private land with limited resourcing.
- Traditional Owners and Arrernte people: benefit most from cultural site protection and reduced access barriers; incur the highest indirect costs of any stakeholder group from cultural site degradation, loss of access to Country, displacement of culturally significant plant and animal species, and compromised intergenerational transmission of cultural knowledge, costs that are most severe under Scenario 1 but persist to varying degrees across all scenarios
- Landcare and community groups: benefit from increased resourcing and coordination under Scenarios 2 and 3.
- Tourism industry: benefits from improved scenic amenity and reduced fire-related park closures under Scenarios 2 and 3; however, it incurs both direct and indirect costs

across all scenarios. Direct costs include increased operational expenses from buffel grass-fuelled fire events, such as tour cancellations, rescheduling, and infrastructure damage at visitor sites. Indirect costs include reputational damage from degraded scenic amenity, reduced visitor satisfaction and return rates, loss of wildlife viewing opportunities, compromised access to culturally significant landscapes that underpin nature-based and cultural tourism products, and the long-term erosion of the NT's tourism brand as buffel grass continues to homogenise and transform iconic arid landscapes. These costs are most severe under Scenario 1, where unmanaged buffel grass expansion progressively degrades the natural and cultural assets on which the Alice Springs tourism economy depends.

8 Synthesis and strategic recommendations

8.1 Cost-effectiveness of early intervention

The economic analysis demonstrates a clear cost-efficiency argument for early, proactive investment in Scenario 2 or Scenario 3 management. The compounding nature of buffel grass expansion means that each year of delay under Scenario 1 increases the future cost of achieving equivalent management outcomes.

The Lower Todd and Charles River program demonstrates that sustained river corridor management is feasible at a cost of $4,000–$8,500/yr for a 10–12 km corridor, but only when treatment is responsive to seasonal conditions. Rainfall is a critical determinant of both treatment timing and frequency. In high-rainfall years, multiple treatment rounds may be required to address successive germination events, while in dry years, herbicide application may not be possible or cost-effective due to insufficient buffel grass growth. Effective management, therefore, requires the capacity to respond rapidly to rainfall events rather than following a fixed annual schedule. Gaps in treatment responsiveness, as observed between 2018 and 2020, allow rapid reinvasion following rainfall, requiring higher-intensity retreatment and significantly increasing cumulative program costs (Weed Management Branch, 2025).

Published evidence from gamba grass management in the NT shows that the cost of controlling established infestations is 3–5× higher than for managing early-stage invasions (Beaumont et al., 2018). The same principle applies to buffel grass, where seedbank persistence can extend the effective management horizon by 5–10 years if initial treatment is missed.

Scenario 3 achieves the lowest long-term cost trajectory despite the highest short-term investment, consistent with the "invest now to save later" principle demonstrated in Australian invasive species literature (Read et al., 2020; Sinden et al., 2005; Weed Management Branch, 2021).

To date, no municipality-scale or landscape-scale suppression programs comparable to Scenarios 2 or 3 have been implemented and evaluated across central Australia. As a result, the analysis necessarily relies on partial operational records, smaller-scale restoration studies, and general principles from invasive grass economics and fire ecology. This report does not assume that large-scale suppression will succeed; rather, it evaluates the relative costs and risks of alternative management pathways under conditions of uncertainty. The comparison between scenarios is robust to uncertainty in expected ecological outcomes, because all scenarios are assessed using the same valuation framework and conservative assumptions (Appendix C.5).

8.2 Priority actions for resource allocation

Given resource constraints, the following prioritisation of management actions is recommended:

- Immediate priority (Year 1–2): Full implementation of the Lhere Mparntwe Management Strategy 2019 buffel grass actions. This is the highest-leverage investment, targeting the primary ecological and cultural corridors within the municipal area at relatively low cost (~$155K–$240K/yr). It is important to note that the existing Lower Todd and Charles River program has operated only at a reactive level, characterised by ad hoc herbicide application, limited resourcing, and no systematic rainfall-responsive scheduling, and does not represent full Strategy implementation. Full implementation would require a substantial upscaling of effort to best-practice weed management, including systematic rainfall-responsive treatment, cross-tenure coordination, dedicated ranger capacity, and integration with fire management. The empirical data from the Lower Todd program nonetheless demonstrate the logistical feasibility of river corridor herbicide treatment, and provide a useful cost anchor, but the transition to full Strategy implementation represents a significant step-change in both investment and operational capacity.
- Short-term priority (Year 1–5): Active management of all ASTC and DLPE Crown land blocks under 10 ha, and transition of road verge management to integrated herbicide treatment. Together, these protect the most publicly visible and accessible municipal land at a manageable scale.
- Short-to-medium term priority (Year 2–5): Establish the private land engagement, compliance and an appropriate incentive program encouraging land managers/owners to manage buffel grass spread. Even modest uptake (25–30% of private land) materially reduces reinvasion pressure on adjacent public lands.
- Medium-term priority (Year 3–10): Scale up to Scenario 3 range and nature park management as programme capacity and mapping data improve. The initial treatment investment for the ranges is high but essential to protecting irreplaceable biodiversity and cultural assets.
- Ongoing: Maintain and grow the Landcare workforce, which offers a huge service to the community, and dedicate efforts to volunteer engagement (or even covering basic living costs for workdays for youth/adults) as a cost-effective complement to government-funded programs.
- Alternative management approaches: Herbicide application, mechanical treatment, fire management, monitoring, and coordination were prioritised because they form the core of existing NT and arid-zone buffel grass management frameworks and are the actions most consistently documented in operational cost records. Other approaches, such as grazing-based suppression, altered land-use practices, or novel biological controls, may play a role in specific contexts, but were not included as standalone scenario elements because they are not specified in the commissioned management scenarios and lack sufficiently robust, localised cost data for municipal-scale modelling.

8.3 Data and monitoring recommendations

The most significant limitation of this assessment is the lack of comprehensive current-state mapping of buffel grass distribution in the Alice Springs municipal area. The following actions would substantially improve future cost modelling:

- Commission systematic GIS mapping of buffel grass distribution and density across all land types within the municipal boundary, as recommended by the *Buffel Grass Management Strategy 2024–2030*. Recent advances in high-resolution predictive mapping using time-series Sentinel-2 satellite imagery, including work by Box et al. (2026), demonstrate that municipal-scale buffel grass distribution can be mapped with high accuracy and represent a significant opportunity to refine treatment area estimates and prioritisation in future assessments. Integrating such predictive products into operational planning frameworks and validating them against management records would substantially reduce uncertainty in subsequent cost modelling exercises.
- Establish annual reporting of treatment areas, staff hours and chemical volumes across all management agencies (ASTC, DLPE, Parks) and associated costs (if possible) to plan for coordination and effective management of buffel grass at the municipality scale.
- Develop a municipal-scale buffel grass monitoring framework/online tool (such as an app) with annual photo-monitoring plots at representative sites across all land types.
- Track private land uptake and compliance rates annually to refine cost projections for Scenarios 2 and 3.
- Raise community awareness and conduct special campaigns to involve the community in managing buffel grass around residential and public areas.
- Update and/or design policies and programs to manage and control buffel grass in the area.

8.4 Adaptive funding and workforce planning

Effective buffel grass management in the Alice Springs municipal area cannot be delivered solely through fixed annual budgets. As described in Section 3.3, different management activities have fundamentally different relationships with rainfall. Mowing and slashing for fuel reduction can proceed at any time and are most valuable during dry periods and early winter, when fuel loads are highest, and conditions are safest for operations (Biosecurity SA, 2019; Buffel Grass Weed Advisory Committee, 2024). These activities can be planned and budgeted with reasonable predictability. Herbicide treatment, however, which constitutes the largest component of active management expenditure under Scenarios 2 and 3, is contingent on active buffel grass growth in response to rainfall, and rainfall events that cannot be scheduled in advance (Farrell & Gornish, 2019).

The critical investment periods are warm-season rainfall events between approximately September and March, which stimulate rapid active growth and open the treatment windows during which the herbicide is most effective (Biosecurity SA, 2019; Panetta, 2025). These windows may last only a few weeks following a single rainfall event (Panetta, 2025), or much longer during sustained or repeated rain, and they require rapid mobilisation of staff, contractors, equipment, and chemical supplies (Friedel et al., 2009) that standard procurement and annual budget-release processes may not support (Clarke & Morgan, 2025; Panetta, 2025). Importantly, continuing to mow large areas without the capacity to follow up with herbicide when rain arrives risks stimulating more vigorous buffel grass regrowth, potentially increasing future management costs rather than reducing them (Buffel Grass Weed Advisory Committee, 2024; Clarke & Morgan, 2025; Desert Support Services, 2018). Workforce and contractor planning must therefore be capable of scaling up rapidly during high-rainfall periods and scaling back during extended dry periods, with unspent funds carried over rather than forfeited at year's end (Panetta, 2025).

This challenge was explicitly identified by the Buffel Grass Technical Working Group, which recommended that: "The management of buffel grass is an evolving process that requires adaptive management strategies. Continuity of funding allows for flexibility and adaptability in responding to seasonal variability of growth and spread, new challenges, emerging research findings, and the development of innovative solutions. It enables adjusting management approaches based on the effectiveness of previous efforts, changing needs driven by weather variations, and the dynamics of buffel grass infestations. Establishing a trust fund would provide proactive or 'just-in-time' funding for buffel grass management, ensuring resources are available to address the variable nature of its growth and spread" (DEPWS, 2023, p. 1).

This assessment endorses the above, Buffel Grass Technical Working Group's recommendation. In practical terms, funding arrangements for buffel grass management in Alice Springs should provide for: carry-over of unspent funds between financial years during extended dry periods; rapid-deployment mechanisms to scale up operations during warm-season rainfall events; and workforce and contractor planning that anticipates surges in treatment demand without requiring lengthy procurement processes. Without these mechanisms, even well-resourced programs under Scenarios 2 or 3 may be unable to act at the moments when intervention would be most effective and cost-efficient, undermining the economic case for proactive investment established in this report.

9 Conclusion

The economic comparisons presented in this report rely on the valuation framework established in Report 1. Conclusions regarding the relative magnitude of management costs and avoided economic losses are contingent on the scope, valuation choices, and counterfactuals documented in Report 1, particularly with respect to pastoral and erosion control benefits. This report does not re-estimate or extend those values, but instead applies them consistently to test the cost-effectiveness of alternative municipal-scale management pathways. Readers are therefore encouraged to interpret the results as a comparison of management strategies under a defined valuation approach, rather than as a definitive statement on the total value of buffel grass in all contexts.

This assessment provides the first fully updated and empirically grounded comparison of buffel grass management costs for the Alice Springs municipal area. Across all three scenarios, the analysis demonstrates that the key determinant of long-term economic, ecological and cultural outcomes is not the annual cost of weed control itself, but rather the extent to which each strategy reduces the well-documented and escalating external costs generated by unmanaged buffel grass.

The analysis explicitly recognises that buffel grass management in arid systems is rainfall-responsive rather than calendar-driven. Treatment windows depend on periods of active growth following rainfall, and infection density varies across land types. Control cycles described as annual, biennial or opportunistic should therefore be interpreted as expected average effort over time, contingent on seasonal conditions, access constraints, and follow-up capacity. Reinvasion risk, missed treatment windows, variable treatment success, and climatic variability are treated as inherent uncertainties rather than modelled as precise parameters. Their economic implications are incorporated through conservative coverage assumptions, cost ranges, and sensitivity analysis.

Reactive management, although superficially inexpensive, allows buffel grass to continue expanding through urban, peri-urban and range environments where its impacts compound over time. As numerous studies have shown, buffel grass increases fuel continuity, elevates fire frequency and severity, and drives rapid, costly, and often irreversible ecosystem transitions. These consequences, rather than annual operational expenditures, ultimately shape the NT government's true cost trajectory.

Reactive management is not sustainable; the costs of inaction grow each year. Scenario 2 is a viable middle path that delivers substantial risk reduction. But Scenario 3 (Good Buffel Grass Management) offers the most effective and sound strategy, ensuring that the Alice Springs municipal area avoids the escalating ecological, cultural and financial consequences of unchecked buffel grass invasion.

The report recognises that buffel grass can contribute to ground cover and erosion control in disturbed or already-degraded environments such as road verges and drainage corridors, and these functions are incorporated into the economic framework via the erosion-control benefit of AU$32/ha/yr drawn from Report 1, applied consistently across all three scenarios. Short-term forage availability, while a documented benefit of buffel grass in pastoral contexts elsewhere in central Australia, is not a relevant benefit within the Alice Springs municipal area, which contains no pastoral enterprises operating under grazing leases. The management scenarios assessed here, therefore, do not incorporate forage benefits but do not assume blanket removal of buffel grass; rather, they target suppression in areas where long-term ecological, cultural, and fire-related costs demonstrably outweigh the limited stabilisation benefits applicable in the municipal context.

This assessment does not attempt to model all possible management tools; the three scenarios are structured around the activities specified in the DLPE Scope of Requirements, which reflect the management approaches considered appropriate and feasible within the Alice Springs municipal boundary. Alternative or emerging management approaches, including biological control options that may warrant future evaluation, are not included as distinct scenarios due to scope limitations and the absence of sufficient localised cost and efficacy data.

Finally, the report acknowledges recent advances in high-resolution predictive mapping of buffel grass distribution in the Alice Springs region, including work using satellite time-series analysis. While such products were not directly incorporated into cost scaling during this assessment, they represent a significant opportunity to refine treatment-area estimates, prioritisation, and future cost modelling. Involving local community members and integrating their knowledge, along with systematic GIS-based buffel grass mapping, to identify priority areas and implement targeted actions to manage them will improve the precision and targeting of municipal-scale management efforts.

10 References

Abella, S. R., Chiquoine, L. P., & Backer, D. (2012). Ecological characteristics of sites invaded by buffelgrass (Pennisetum ciliare). *Invasive Plant Science and Management*, *5*(4), 443–453. https://doi.org/10.1614/IPSM-D-12-00012.1

Alice Springs Landcare. (2025). *2025 Financial Report*. https://alicespringslandcare.com/alice-springs-landcare-agm/

Argyll Consulting. (2017). *Prickly Acacia in the Northern Territory: Costs and Benefits of Erradication*. Argyll Consulting.

Beaumont, T., Keily, T., & Kennedy, S. (2018). *Counting the cost. Economic impacts of gamba grass in the Northern Territory*. The Pew Charitable Trusts and Environment Centre Northern Territory.

Biosecurity SA. (2019). *South Australia Buffel Grass Strategic Plan 2019–2024: A plan to reduce the weed threat of buffel grass in South Australia*. Government of South Australia.

Bonney, S., Andersen, A., & Schlesinger, C. A. (2017). Biodiversity impacts of an invasive grass: ant community responses to Cenchrus ciliaris in arid Australia. *Biological Invasions*, *19*(1), 57–72. https://doi.org/10.1007/s10530-016-1263-6

Box, P., Leiper, I., Nano, C., Young, L., Caron, V., Gibson, S., Guest, T., Cobban, D., Treilibs, C., & Brim Box, J. (2026). High-resolution mapping of introduced buffel grass (Cenchrus ciliaris) in central Australia. *Environ Monit Assess*, *198*(4). https://doi.org/10.1007/s10661-026-15183-7

Buffel Grass Weed Advisory Committee. (2024). *Buffel Grass Management Strategy: Central Australia 2024 – 2030*. Department of Environment Parks and Water Security.

Caron, V., Brim-Box, J., Dobson, V. P., Dobson, V., Richmond, L., Thompson, R. M., & Dyer, F. (2021). Restoring cultural plant communities at sacred water sites. *Australian Journal of Water Resources*, *25*(1), 70–79. https://doi.org/10.1080/13241583.2021.1888854

Clarke, A., & Morgan, T. (2025). *Buffel Grass Have Your Say Survey. Summary of Responses*. Department of Lands Planning and Environment.

Clarke, P. J., Latz, P. K., & Albrecht, D. E. (2005). Long-term changes in semi-arid vegetation: Invasion of an exotic perennial grass has larger effects than rainfall variability. *Journal of Vegetation Science*, *16*(2), 237–248. https://doi.org/10.1111/j.1654-1103.2005.tb02361.x

Costanza, R., de Groot, R., Sutton, P., van der Ploeg, S., Anderson, S. J., Kubiszewski, I., Farber, S., & Turner, R. K. (2014). Changes in the global value of ecosystem services. *Global Environmental Change*, *26*, 152–158. https://doi.org/10.1016/j.gloenvcha.2014.04.002

Department of Environment Parks and Water Security (DEPWS). (2023). *Buffel Grass Technical Working Group: Report and Recommendations – November 2023*. https://nt.gov.au/_media/docs/environment/weeds/buffel-grass/buffel-grass-technical-working-group-report-and-recommendations-november-2023.pdf

Department of Lands Planning and Environment (DLPE). (2025a). *Buffel Grass Have Your Say Survey. Summary of Responses*. Northern Territory Government (NTG).

Department of Lands Planning and Environment (DLPE). (2025b). *Scope of Requirements: Buffel Grass Economic Impact Assessment*. NTG.

Department of Lands Planning and Environment (DLPE). (2026). *Buffel Grass Weed Management Plan 2026–2036*. Northern Territory Government (NTG). https://nt.gov.au/__data/assets/pdf_file/0020/1600841/buffel-grass-weed-management-plan-2026-2036-attachment-c.pdf

Desert Support Services. (2018). *Integrated buffel grass management plan for the Great Victoria Desert*. Rural Solutions SA.

Drucker, A., & Setterfield, S. A. (2008). *Gamba Grass Benefit Cost Analysis*.

Edwards, K. M., Schlesinger, C. A., Ooi, M. K. J., French, K., & Gooden, B. (2019). Invasive grass affects seed viability of native perennial shrubs in arid woodlands. *Biological Invasions*, *21*(5), 1763–1774. https://doi.org/10.1007/s10530-019-01933-x

Farrell, H. L., & Gornish, E. S. (2019). Pennisetum ciliare: A review of treatment efficacy, competitive traits, and restoration opportunities. *Invasive Plant Science and Management*, *12*(4), 203–213. https://doi.org/10.1017/inp.2019.28

Ferdinands, K. B., Setterfield, S. A., Clarkson, J. R., Grice, A. C., & Friedel, M. (2010). *Embedding economics in weed risk management to assess contentious plants* Seventeenth Australasian Weeds Conference, New Zealand.

Friedel, M., Marshall, N. A., Rieks, D., van Klinken, R. D., & Grice, T. (2009). *Quantifying costs and benefits of buffel grass*. Land & Water Australia.

Friedel, M., Puckey, H., O'Malley, C., Waycott, M., Smyth, A., & Miller, G. (2006). *Buffel grass: both friend and foe*. Desert Knowledge Cooperative Research Centre.

Friedel, M. H., Allan, G. E., & Duguid, A. (2014). Do we know enough about vegetation dynamics to manage fire regimes in central Australia? *Ecological Management and Restoration*, *15*(2), 128–132. https://doi.org/10.1111/emr.12104

Fusco, E. J., Finn, J. T., Balch, J. K., Nagy, R. C., & Bradley, B. A. (2019). Invasive grasses increase fire occurrence and frequency across US ecoregions. *Proc Natl Acad Sci U S A*, *116*(47), 23594–23599. https://doi.org/10.1073/pnas.1908253116

Grice, A. C., Vanderduys, E. P., Perry, J. J., & Cook, G. D. (2013). Patterns and processes of invasive grass impacts on wildlife in Australia. *Wildlife Society Bulletin*, *37*(3), 478–485. https://doi.org/10.1002/wsb.314

Marshall, V. M., Lewis, M. M., & Ostendorf, B. (2012). Buffel grass (Cenchrus ciliaris) as an invader and threat to biodiversity in arid environments: A review. *JOURNAL OF ARID ENVIRONMENTS*, *78*, 1–12. https://doi.org/10.1016/j.jaridenv.2011.11.005

Miller, G., Friedel, M., Adam, P., & Chewings, V. (2010). Ecological impacts of buffel grass (Cenchrus ciliaris L.) invasion in central Australia - does field evidence support a fire-invasion feedback? *The Rangeland Journal*, *32*, 353–365. https://doi.org/10.1071/RJ09076

Northern Territory Government (NTG). (2019). *Lhere Mparntwe Management Strategy 2019*. NTG. https://environment.nt.gov.au/media/docs/strategy/lhere-mparntwe-management-strategy/lhere-mparntwe-management-strategy.pdf

Northern Territory Government (NTG). (2021). *Alice Springs Regional Weeds Strategy 2021-2026*. Department of Environment Parks and Water Security.

Northern Territory Government (NTG). (2022). *Cenchrus ciliaris: NT Weed Risk Assessment Technical Report*. Northern Territory Government.

Northern Territory Government (NTG). (2025). *Draft Buffel Grass Weed Management Plan 2026-2036*. Department of Lands Planning and Environment (DLPE).

Panetta, F. D. (2025). *A plan for reducing buffel grass impacts on priority species in the MacDonnell Ranges*. Department of Lands Planning and Environment.

Puckey, H., & Albrecht, D. E. (2004). Buffel grass (Cenchrus ciliaris): presenting the arid NT experience to our South Australian neighbours. *Plant Protection Quarterly*, *19*, 69–72.

Read, J. L., Firn, J., Grice, A. C., Murphy, R., Ryan-Colton, E., & Schlesinger, C. A. (2020). Ranking buffel: Comparative risk and mitigation costs of key environmental and socio-cultural threats in central Australia. *Ecology and Evolution*, *10*(23), 12745–12763. https://doi.org/10.1002/ece3.6724

Rossiter-Rachor, N. A., Adams, V. M., Canham, C. A., Dixon, D. J., Cameron, T. N., & Setterfield, S. A. (2023). The cost of not acting: Delaying invasive grass management increases costs and threatens assets in a national park, northern Australia. *Journal of Environmental Management*, *333*, Article 116785. https://doi.org/10.1016/j.jenvman.2022.116785

Ryan-Colton, E., French, K., Wardle, G. M., Read, J. L., Canty, P. D., Lang, P. J., Bickerton, D. C., & Schlesinger, C. A. (2024). Long-term and landscape impacts of buffel grass on arid plant communities: Ecosystem shifts and acceleration by fire. *Ecosphere*, *15*(10), Article e70033. https://doi.org/10.1002/ecs2.70033

Sangha, K. K., Schlesinger, C., and Leyton-Flor, S. A. (2026). Economic Impact Assessment of Buffel Grass in the Northern Territory. A report commissioned by the Department of Lands, Planning and Environment (DLPE), Northern Territory Government.

Schlesinger, C., White, S., & Muldoon, S. (2013). Spatial pattern and severity of fire in areas with and without buffel grass (Cenchrus ciliaris) and effects on native vegetation in central Australia. *Austral Ecology*, *38*(7), 831–840. https://doi.org/10.1111/aec.12039

Schlesinger, C. A., Kaestli, M., Christian, K. A., & Muldoon, S. (2020). Response of reptiles to weed-control and native plant restoration in an arid, grass-invaded landscape. *Global Ecology and Conservation*, *24*. https://doi.org/10.1016/j.gecco.2020.e01325

Schlesinger, C. A., & Westerhuis, E. L. (2021). Impacts of a single fire event on large, old trees in a grass-invaded arid river system. *Fire Ecology*, *17*(1), Article 34. https://doi.org/10.1186/s42408-021-00121-4

Sinden, J., Jones, R., Hester, S., Odom, D., Kalish, C., James, R., Cacho, O., & Griffith, G. (2005). The economic impact of weeds in Australia. *Plant Protection Quarterly*, *20*(1), 25–32.

Weed Management Branch. (2021). *NT Weed Management Handbook*. Northern Territory Government.

Weed Management Branch. (2022). *Buffel Grass (Cenchrus ciliaris): NT Weed Risk Assessment Summary Review*. Department of Environment Parks and Water Security.

Weed Management Branch. (2025). *Lower Todd and Charles River chemical control program: Operational records April 2025 [Internal dataset]* (

Wright, B. R., Latz, P. K., Albrecht, D. E., & Fensham, R. J. (2021). Buffel grass (Cenchrus ciliaris) eradication in arid central Australia enhances native plant diversity and increases seed resources for granivores. *Applied Vegetation Science*, *24*(1), Article e12533. https://doi.org/10.1111/avsc.12533

Appendix A: Land area estimation procedure for the Alice Springs municipal area

This appendix documents the methodology and data sources used to derive the indicative land area estimates for each tenure category within the Alice Springs municipal boundary. These estimates underpin the cost scaling in all three management scenarios. Because comprehensive GIS-based buffel grass mapping for the full municipal area was not available at the time of this assessment, estimates were assembled from sources and carry an acknowledged uncertainty of ±30%.

A.1. Approach and data sources

Estimates were derived using a five-step procedure:

- Step 1. Define the municipal boundary: The Alice Springs municipal boundary was used as the spatial extent for the assessment, encompassing the Alice Springs Town Council (ASTC) local government area and adjacent peri-urban land managed under NT Crown land and nature park arrangements.
- Step 2. Identify land tenure categories: Six primary categories were identified based on management responsibility: (i) ASTC-managed public land; (ii) DLPE Crown land blocks <10 ha; (iii) road verges and transport corridors; (iv) private residential and peri-urban land; (v) ranges and nature park buffer zones adjacent to the municipal boundary; and (vi) active Landcare sites.
- Step 3. Source category-specific estimates: Area estimates for each category were drawn from available published buffel grass management strategies, such as Buffel Grass Management Strategy: Central Australia 2024–2030, Alice Springs Regional Weeds Strategy 2021–2026 and the Lhere Mparntwe Management Strategy 2019 (detailed in Section A.2 below).
- Step 4. Apply conservative rounding: All estimates were rounded to the nearest 50 ha (or 10 km for linear features) to avoid false precision.
- Step 5. Aggregate and sense-check: The sum of the category estimates (~14,000 ha) was cross-checked against available reporting on the Alice Springs municipality's footprint. The total is consistent with the broader Alice Springs gazetted area, accounting for the exclusion of large pastoral and remote Crown parcels outside the urban boundary.

A.2. Category-by-category estimation

A.2.1. ASTC-managed public land (~1,200 ha)

The ASTC manages parks, recreation areas, reserves, the Todd and Charles River corridors, stormwater drainage reserves and road medians within the town boundary. The estimate of 1,200 ha draws on:

- The Lhere Mparntwe Management Strategy 2019, which identifies the Todd and Charles River management corridors and associated riparian reserves as the primary management focus area for NTG and ASTC.
- The approximately 900–1,200 ha of managed open space and river corridor within the municipal boundary was inferred from the management zones described in the Lhere Mparntwe Management Strategy 2019.
- The Buffel Grass Weed Advisory Committee (2024) management strategy, which references the riverine and park systems of Alice Springs as priority management areas.
- Buffel grass coverage within ASTC land is estimated at 60–80% of the total managed area, based on field observations reported in the Lhere Mparntwe Strategy 2019 (NTG, 2019) and Buffel Grass Have Your Say Survey responses (Clarke & Morgan, 2025).

A.2.2. DLPE Crown land blocks <10 ha (~800 ha)

DLPE manages unallocated Crown land parcels within the municipal boundary, including small utility reserves, road corridors, drainage easements and undeveloped allotments. The estimate of 800 ha is based on:

- The Scope of Requirements (DLPE, 2025) specification states that management of ASTC and DLPE Crown land blocks <10 ha is a key action under Scenario 2, implying a defined and enumerable set of parcels.
- Conservative assumption that parcels >10 ha (larger Crown reserves and nature parks) are counted separately under the ranges/nature park category.
- Buffel grass coverage on DLPE Crown land varies widely, from near-complete coverage on disturbed urban-fringe parcels to patchy incursions on less-disturbed parcels. An average coverage of 50–70% is assumed.

A.2.3. Road verges and transport corridors (~300 ha / 200 km)

Road verges are expressed as both linear (km) and area (ha) estimates. The linear estimate of 200 km covers:

- Major sealed arterial roads within and radiating from Alice Springs (Stuart Highway, Ross Highway, Larapinta Drive, Schwarz Crescent and connecting roads): estimated ~80 km.
- Secondary sealed roads and key unsealed access corridors within the urban fringe: estimated ~120 km.
- An average verge width of 10 m on each side (20 m total) was applied, consistent with the Buffel Grass Management Strategy (2024–2030) benchmark for road buffer management.
- 200 km × 20 m average verge width = 400 ha of verge area; reduced to ~300 ha to account for intersections, sealed shoulders and verges already included under ASTC or Crown land categories.
- Road verge buffel grass coverage is typically very high (70–100%) due to vehicle-mediated seed dispersal and disturbed substrate conditions (Buffel Grass Weed Advisory Committee, 2024).

A.2.4. Private land: Residential, commercial and peri-urban (~3,500 ha)

Private land within the municipal boundary includes residential allotments in established suburbs, commercial and industrial precincts, and larger peri-urban rural lifestyle blocks on the town fringe. The estimate of 3,500 ha is derived from:

- Alice Springs Town Council's suburb boundary estimates, covering approximately 3,000–4,000 ha of private residential and commercial land within the gazetted town area.
- Exclusion of very small inner-city allotments where buffel grass coverage is negligible due to regular maintenance.
- Inclusion of peri-urban rural blocks (1–50 ha) on the town fringe (e.g. along Ross Highway and South Stuart Highway corridors), which represent a significant proportion of private land by area.
- Buffel grass coverage on private land varies substantially: inner residential blocks may have 10–30% coverage, while outer peri-urban blocks may have 50–90% coverage. An average of 40–60% is assumed across the category.

A.2.5. Ranges and national parks: Priority management zones (~2,500 ha, from ~8,000 ha total adjacent area)

The ranges and nature parks category[6] covers areas within or immediately adjacent to the municipal boundary that contain high-value biodiversity and cultural assets, including:

- The lower ranges of the MacDonnell Ranges adjacent to Alice Springs (Heavitree Gap area, south-facing slopes).
- The approaches to Simpsons Gap Nature Park and the eastern end of the West MacDonnell Ranges.
- Ilparpa Swamp and surrounding habitat.
- The approaches to Yeperenye/Emily and Jesse Gap Nature Parks.
- The total area of these conservation areas within or adjacent to the municipal boundary is estimated at approximately 8,000 ha. However, for costing purposes under Scenario 3, only the ~2,500 ha of highest-priority buffel-infested zones (based on field assessments referenced in the Buffel Grass Weed Advisory Committee, 2024 strategy and the Lhere Mparntwe Strategy, 2019) are included in the treatment cost calculations. The balance of the area is assumed to be managed under separate Parks and Wildlife Service programs outside the municipal management scope.

A.2.6. Active landcare sites (~150 ha)

The active Landcare site estimate of 150 ha reflects currently managed areas under community-led buffel grass suppression programs, primarily along the Todd River. This figure is drawn from:

- The Lhere Mparntwe Management Strategy 2019 identifies ongoing Landcare efforts along targeted sections of the Todd River.
- Alice Springs Landcare Committee operational records indicating active management of river sections and adjacent reserves (Alice Springs Landcare, 2025).
- The Buffel Grass Have Your Say Survey responses (Clarke & Morgan, 2025) describing Landcare group activities and the Todd River Landcare program's geographic scope.

A.3. Summary of area estimates

Land Tenure Category	Area Estimate	Unit	Est. Buffel Coverage	Primary Data Sources
ASTC-managed public land	~1,200	ha	60–80%	ASTC records; Lhere Mparntwe Strategy 2019; Buffel WAC 2024
DLPE Crown land blocks <10 ha	~800	ha	50–70%	DLPE Crown land register; DLPE Scope of Requirements 2025
Road verges and transport corridors	~300 / ~200	ha / km	70–100%	Road network estimate; NT WM Strategy benchmark (20 m verge)
Private land (residential/peri-urban)	~3,500	ha	40–60%	ASTC suburb boundaries; ABS urban extent data
Ranges and nature parks (priority zones)	~2,500 (of ~8,000)	ha	50–80%	Buffel WAC 2024 strategy; Lhere Mparntwe Strategy 2019
Active Landcare sites	~150	ha	Variable	Alice Springs Landcare Committee; Lhere Mparntwe Strategy 2019
TOTAL (approximate)	**~14,000**	ha	—	Aggregate; ±30% uncertainty

[6] Note: The ranges and nature parks included here reflect the sites specified in the DLPE Scope of Requirements. For discussion of town-adjacent ranges not included in this assessment, see Section 2.3.

Note: These estimates carry significant uncertainty (±30%) due to the absence of comprehensive current-state GIS mapping for the full municipal area.

A.4. Scaling to treatment areas

Not all land within each category will carry buffel grass at a density requiring active management. For cost modelling, treatment areas were scaled by applying the mid-point buffel grass coverage estimate to the total category area, and then applying a 'management proportion' factor reflecting the management intensity under each scenario. The resulting effective treatment areas used in cost calculations are summarised below.

Land Category	Total Area (ha)	Est. Infested (ha)	Sc. 1 Treatment (ha/yr)	Sc. 2 Treatment (ha/yr)	Sc. 3 Treatment (ha/yr)
ASTC public land	1,200	840	~400 (slashing)	~2,000*	~2,000*
DLPE Crown land <10 ha	800	560	Ad hoc	~2,000*	~2,000*
Road verges	300 ha/200 km	250 ha	Slashing only	200 km (herbicide)	200 km (herbicide)
Private land	3,500	1,750	Nil (owner-managed)	875–1,750	1,925–2,625
Ranges/nature parks	8,000 total; 2,500 priority	~2,000	Nil	Nil	~2,500 (intensive)
Landcare sites	150	100	~150 (current)	~150 (current)	~225 (+50%)

* ASTC and DLPE Crown land blocks <10 ha are combined for management costing purposes under Scenarios 2 and 3, with a total treatment area of approximately 2,000 ha.

Appendix B: Detailed cost estimates by scenario

This appendix presents the full itemised cost estimates for each management scenario, including unit cost assumptions, treatment-area basis, annual cost calculations, and time-horizon projections. All values are in constant 2025 Australian dollars. Blue shading indicates cells derived from the Lower Todd empirical data.

B.1. Scenario 1: Reactive / Current management approach

B.1.1. Empirical basis: Lower Todd and Charles River program

The most directly observable cost data for current management in the Alice Springs municipal area comes from the Weed Management Branch chemical control records (2018–2025). This program covers approximately 10–12 km of the lower Todd River and Charles Creek and provides the empirical anchor for Scenario 1 cost estimates.

Year	Staff Hours	Mix Volume (L)	Chemical Cost (AU$)	Total Cost Incl. Staff & ATV (AU$)	Effective Cost/km/yr
2018–2019	38	2,210	~$383	Partial: staff in 2018–2020 block	~$35/km (chem only)
2020	85	7,130	~$1,204	Partial: staff in 2018–2020 block	~$110/km (chem only)
2021	68	6,230	$971	$9,516	~$778/km
2022	32	3,040	$486	$4,054	~$369/km
2023 (Jan–May)	60	6,150	$932	Partial: Dec full costing	~$85/km (chem only)
2023 (Dec)	13.5	1,050	$218	$1,893	~$172/km
2024	47	4,280	$671	$6,503	~$591/km
2025 (to May)	13.5	1,000	$152	$807	Partial year
Average (2021–2025 full-cost years)	**44.6 hrs/yr**	**~4,360 L/yr**	—	**~$5,190/yr**	**~$473/km/yr**
Cumulative Total (2018–May 2025)	**357 hrs**	**31,090 L**	—	**~$43,707**	—

B.1.2. Scaled annual cost estimates: Full municipal area

Activity Component	Basis / Scale	Unit Cost (Low)	Unit Cost (High)	Annual Cost Low	Annual Cost High
Riverine corridor reactive herbicide	15 km treated/yr	$500/km	$1,000/km	$7,500	$15,000
ASTC parks/reserves mowing & slashing	1,000 ha/yr	$150/ha	$250/ha	$150,000	$250,000
Road verge slashing (no herbicide)	200 km/yr	$200/km	$400/km	$40,000	$80,000
Landcare coordination & materials	~150 ha	Incl.	Incl.	$30,000	$50,000
Reactive herbicide: DLPE Crown land	Ad hoc	—	—	$50,000	$100,000
Programme administration	—	—	—	$20,000	$40,000
TOTAL ANNUAL: SCENARIO 1	—	—	—	**$297,500**	**$535,000**

B.1.3. Time-horizon projections: Scenario 1

Time Horizon	Direct Management Cost (AU$/yr)	Est. Indirect Costs (Fire, Biodiversity, Cultural) (AU$/yr)	Total Estimated Annual Cost (AU$/yr)	Key Driver
Short-term (1–5 yrs)	$300K–$535K	$500K–$1.0M	$800K–$1.5M	Buffel expansion continues; fire risk rising
Medium-term (6–20 yrs)	$400K–$700K	$1.0M–$2.0M	$1.4M–$2.7M	Fire suppression costs compound; biodiversity losses accelerate
Long-term (20+ yrs)	$500K–$1.0M	$2.0M–$4.0M+	$2.5M–$5.0M+	Landscape transformation: potential irreversible loss

Note: Indirect costs (fire regime, biodiversity loss, cultural degradation, scenic amenity) are derived from the per-hectare annual cost flows in Report 1: fire $793/ha/yr; biodiversity $2,550/ha/yr; cultural degradation $2,260/ha/yr; scenic amenity $241/ha/yr. Applied to a modelled 1,500 ha treatment-area proxy consistent with Report 1 methodology.

B.2. Scenario 2: Increased active buffel grass management

B.2.1. Component costs

Activity Component	Treatment Scale	Unit Cost Basis	Annual Cost Low	Annual Cost High	Source
River corridor treatment (25 km)	25 km/yr	$1,200–1,800/km/yr	$30,000	$45,000	NT WM Strategy; Lower Todd records
Cross-tenure coordination & mapping	Program	Lump sum	$50,000	$80,000	Lhere Mparntwe Strategy 2019
Ranger & community training	Program	Lump sum	$20,000	$30,000	WMB operational estimate
Fire management integration	Program	Lump sum	$40,000	$60,000	Seasonal firebreak maintenance
Admin & contingency	Program	Lump sum	$15,000	$25,000	Programme overhead
ASTC/Crown land <10 ha; initial (Yr 1)	~2,000 ha	$600/ha	$1,200,000	$1,200,000	Biosecurity SA 2019; Buffel WAC 2024
ASTC/Crown land <10 ha; maintenance (Yr 2–5)	~2,000 ha	$300/ha/yr	$600,000	$600,000	Literature benchmark
Road verge integrated herbicide	200 km/yr	$1,200–1,500/km	$240,000	$300,000	NT WM Strategy 2024–2030
Private land contractor treatment (25–50%)	875–1,750 ha	$400–600/ha	$350,000	$1,050,000	Literature benchmark
Private land education & compliance	Program	Lump sum	$60,000	$100,000	WMB estimate
Private land incentive grants	Program	Lump sum	$50,000	$150,000	Policy design assumption
Maintain current Landcare	~150 ha	Incl. coordination	$30,000	$50,000	Current program
Programme admin & hygiene (washdown)	Program	Incl. washdown	$50,000	$80,000	NT WM Strategy
TOTAL ANNUAL: SCENARIO 2 (Year 1)	—	—	**$2,735,000**	**$3,770,000**	—
TOTAL ANNUAL: SCENARIO 2 (Years 2–5 avg)	—	—	**$1,535,000**	**$2,570,000**	—

B.2.2. Time-horizon projections: Scenario 2

Time Horizon	Annual Cost Low	Annual Cost High	Mid-point Estimate	Key Cost Driver
Short-term (1–5 yrs)	$1,535,000	$3,170,000	~$2,352,500	Year 1 intensive ASTC/Crown treatment; road verge ramp-up; private land mobilisation
Medium-term (6–20 yrs)	$1,535,000	$2,570,000	~$2,052,500	Maintenance cycles; seedbank depletion; private land engagement ongoing
Long-term (20+ yrs)	$935,000	$1,970,000	~$1,452,500	Lower retreatment intensity, monitoring, significantly reduced fire and biodiversity costs

B.3. Scenario 3: Good buffel grass management

B.3.1. Component costs

Activity Component	Treatment Scale	Unit Cost Basis	Annual Cost Low	Annual Cost High	Source
Cross-agency planning & coordination	Program	Lump sum	$80,000	$120,000	Integrated planning estimate
Strategic prescribed burning	Program	Lump sum	$120,000	$200,000	NT fire management benchmark
Firebreak construction & maintenance	Program	Lump sum	$100,000	$180,000	Operational estimate
Emergency response & post-fire treatment	Contingency	Lump sum	$80,000	$150,000	Contingency allowance
Ranges/nature parks; initial (Yrs 1–3)	~2,500 ha	$1,000–1,700/ha/yr	$2,500,000	$4,200,000	Rugged terrain; Biosecurity SA 2019; Buffel WAC 2024
Ranges/nature parks; maintenance (Yrs 4–20)	~2,500 ha	$800–1,500/ha/yr	$2,000,000	$3,750,000	Biennial/triennial retreatment
Ranges/nature parks; monitoring (Yr 20+)	~2,500 ha	$200–480/ha/yr	$500,000	$1,200,000	Spot treatment + mapping
Private land contractor treatment (50–75%)	1,925–2,625 ha	$400–600/ha	$770,000	$1,575,000	Literature benchmark
Private land compliance & education	Program	Lump sum	$100,000	$150,000	Enhanced WMB program
Private land incentive grants	Program	Lump sum	$100,000	$200,000	Policy design assumption
Extended Landcare (+50%)	~225 ha	$300–333/ha/yr	$45,000	$75,000	Scale-up of current program
Carry-over: Lhere Mparntwe Strategy	Program	As Sc. 2	$155,000	$240,000	Sc. 2 river corridor rate
Carry-over: ASTC/Crown maintenance	~2,000 ha	$300/ha/yr	$600,000	$600,000	Maintenance year rate
Carry-over: road verge herbicide	200 km/yr	$1,200–1,500/km	$240,000	$300,000	NT WM Strategy
Programme admin, mapping & hygiene	Program	Lump sum	$80,000	$120,000	Full monitoring framework

TOTAL (Scenario 3, Years 1–3 / short-term)	—	—	**$4,970,000**	**$7,910,000**	Incl. intensive range treatment
TOTAL (Scenario 3, Years 4–20 / medium-term)	—	—	**$4,470,000**	**$7,460,000**	Maintenance range rate
TOTAL (Scenario 3, Year 20+ / long-term)	—	—	**$2,970,000**	**$4,960,000**	Monitoring + spot treatment

B.3.2. Time-horizon projections: Scenario 3

Time Horizon	Annual Cost Low	Annual Cost High	Mid-point Estimate	Key Cost Driver
Short-term (1–5 yrs)	$4,970,000	$8,110,000	~$6,540,000	Initial intensive range treatment; fire management setup; private land mobilisation
Medium-term (6–20 yrs)	$4,470,000	$7,660,000	~$6,065,000	Ranges maintenance cycles, declining retreatment density, and private land compliance
Long-term (20+ yrs)	$2,970,000	$5,110,000	~$4,040,000	Lowest long-term cost; monitoring + spot treatment; very low fire and biodiversity costs

Appendix C: Cross-scenario economic comparison

This appendix presents the full cross-scenario comparison, including direct management cost trajectories, avoided cost analysis, benefit-cost ratios and sensitivity testing. All figures are in constant 2025 Australian dollars at a 7% base discount rate unless otherwise stated.

C.1. Annual direct management cost comparison

Scenario	Short-term (1–5 yrs) Low	Short-term (1–5 yrs) High	Medium-term (6–20 yrs) Low	Medium-term (6–20 yrs) High	Long-term (20+ yrs) Low	Long-term (20+ yrs) High
Scenario 1: Reactive	$297,500	$535,000	$400,000	$700,000	$500,000	$1,000,000
Scenario 2: Increased Active	$1,535,000	$3,170,000	$1,535,000	$2,570,000	$935,000	$1,970,000
Scenario 3: Good Management	$4,970,000	$8,110,000	$4,470,000	$7,660,000	$2,970,000	$5,110,000
Sc. 2 vs Sc. 1: additional annual cost	$1,237,500	$2,635,000	$1,135,000	$1,870,000	$435,000	$970,000
Sc. 3 vs Sc. 1: additional annual cost	$4,672,500	$7,575,000	$4,070,000	$1,870,000	$2,470,000	$4,110,000

C.2. Avoided cost analysis

The key economic case for Scenarios 2 and 3 rests on avoided external costs relative to continuing Scenario 1. Report 1 established per-hectare annual external cost flows that accumulate under inaction. The table below applies these flows to the modelled management areas, illustrating the scale of avoided costs under each scenario.

External Cost Category	Per-Hectare Annual Cost (AU$/ha/yr)	Modelled Area (ha)	Annual External Cost Under Sc. 1 (AU$/yr)	Reduction Under Sc. 2 (%)	Reduction Under Sc. 3 (%)
Biodiversity loss	$2,550	1,500 (proxy area)	$3,375,000	~40–60%	~60–80%
Cultural site degradation	$2,260	1,500 (proxy area)	$3,3390,000	~30–50%	~50–70%
Fire regime intensification	$793,38	1,500 (proxy area)	$1,190,070	~30–50%	~60–80%
Scenic amenity loss	$93.09	1,500 (proxy area)	$139,635	~20–30%	~40–60%
Total annual external cost (Sc. 1 proxy)	**~$5,396/ha/yr**	**1,500 ha**	**~$8.09M/yr**	—	—

Note: The 1,500 ha modelled proxy area is drawn from Report 1's buffel grass management cost analysis and represents a conservative lower-bound for the area of high-value land experiencing active external cost accumulation within and adjacent to the Alice Springs municipal area. The actual affected area is likely significantly larger.

C.3. Net Present Value and benefit-cost ratio summary

The table below summarises NPV and BCR results across all three scenarios and three discount rates, drawing on the per-hectare PV analysis from Report 1 and the scenario cost estimates from this report. Results are expressed per hectare of modelled area and for the 50-year horizon.

Scenario	Discount Rate	PV Benefits (AU$/ha, 50yr)	PV Costs (AU$/ha, 50yr)	NPV (AU$/ha, 50yr)	BCR (50yr)	BCR (20yr horizon)
Scenario 1 (General)	3%	$1,941	$270,477	−$268,536	0.007	0.007
Scenario 1 (General)	7%	$1,546	$146,622	−$145,076	0.011	0.011
Scenario 1 (General)	10%	$1,303	$104,227	−$102,924	0.013	0.013
Scenario 1 (Municipal only)	7%	$442	$146,622	−$146,180	0.005	0.005
Scenario 2 (Increased Active)	3%	Incl. avoided costs	Higher PV	Improving	~6.0-6.5	~5.0-5.5
Scenario 2 (Increased Active)	7%	$10,463	$1,974	$8,489	5.3	4.9
Scenario 3 (Good Management)	3%	Incl. avoided costs	Higher PV	Positive (long-term)	~4.5–5.5	~4.0–5.0
Scenario 3 (Good Management)	7%	$20,927	$5,654	$15,273	3.7	3.4
Scenario 3 (Good Management)	10%	Incl. avoided costs	Lower PV	Near break-even	~2.5–3.0	~2.3–2.8

Note: BCR ranges for Scenarios 2 and 3 reflect uncertainty in: (i) the proportion of external costs avoided under each scenario (30–80% depending on uptake and treatment effectiveness); (ii) private land management uptake rates; and (iii) the discount rate applied to long-term biodiversity and cultural values. Scenarios 2 and 3 BCRs are estimated using avoided cost flows from Report 1 as benefits, offset against the incremental direct management costs above Scenario 1.

C.4. Cumulative cost comparison over 20-year horizon

The table below presents illustrative cumulative direct management costs over a 20-year modelling horizon, using mid-point annual cost estimates for each scenario and time block. These figures do not include discounting and are intended as a quick reference for total expenditure.

Cost Period	Scenario 1 (Mid-point)	Scenario 2 (Mid-point)	Scenario 3 (Mid-point)	Sc. 2 vs Sc. 1 (additional)	Sc. 3 vs Sc. 1 (additional)
Years 1–5 (annual avg)	$416,000	$2,352,500	$6,540,000	+$1,936,500/yr	+$6,124,000/yr
5-year total	$2,080,000	$11,762,500	$32,700,000	+$9,682,500	+$30,620,000
Years 6–20 (annual avg)	$550,000	$2,052,500	$6,065,000	+$1,502,500/yr	+$5,515,000/yr
15-year total	$8,250,000	$30,787,500	$90,975,000	+$22,537,500	+$82,725,000
20-year cumulative total	**$10,330,000**	**$42,550,000**	**$123,675,000**	**+$32,220,000**	**+$113,345,000**

Note: These figures represent cumulative direct management expenditure only and do not include avoided external costs. When the avoided fire, biodiversity, cultural, and scenic costs are incorporated through the valuation framework, Scenario 3, despite higher cumulative expenditure, produces the highest net present value and the greatest long-term risk reduction.

The additional 20-year direct management cost of Scenario 2 relative to Scenario 1 is approximately $32 million, based on the updated cumulative expenditure estimates. This incremental cost must be weighed against avoided external costs associated with reduced fire-regime intensification, biodiversity loss, cultural site degradation, and scenic amenity impacts. Applying the Report 1 valuation framework to a 1,500 ha proxy area at a 7% discount rate, and assuming a 40–60% reduction in external costs, Scenario 2 yields an estimated $35–50 million in avoided net present cost over 20 years. These avoided losses are broadly comparable to, and in the mid-range exceed, the additional direct management expenditure, supporting a coverage-adjusted benefit–cost ratio near or above 1.0 over policy-relevant timeframes.

For Scenario 3, the cumulative cost comparison indicates an additional 20-year direct management cost of approximately $113 million relative to Scenario 1, reflecting the scale and intensity of intervention required across high-value ranges, nature parks, and a larger proportion of private land. While this incremental cost is substantially higher than for Scenario 2, it is offset by larger avoided external cost flows, reflecting a 60–80% reduction in long-term fire, biodiversity, cultural, and scenic impacts. Applying the same valuation framework, Scenario 3 generates markedly higher avoided losses than Scenario 2 and delivers the largest absolute reduction in long-term risk and damage, consistent with its higher net present value despite a lower efficiency ratio. This pattern reflects the central trade-off identified in the analysis: Scenario 3 requires greater cumulative investment, but it also achieves the most comprehensive suppression of the grass–fire feedback and the strongest protection of ecological and cultural assets over the long term.

C.5. Sensitivity analysis

Variable Tested	Base Case	Low Case	High Case	Effect on Sc. 1 NPV	Effect on Sc. 2 BCR	Effect on Sc. 3 BCR
Discount rate	7%	3%	10%	NPV becomes more negative	BCR increases at	Same directional

				at lower discount rates; the magnitude of losses increases	lower discount rates; decreases at higher rates	effect; stronger sensitivity due to longer benefit stream
Treatment effectiveness	100%	−20%	+20%	Minimal effect (reactive management does not suppress impacts)	BCR changes by approximately ±0.2	BCR changes by approximately ±0.3
Post-invasion fire frequency	5 events/yr (AU$793,380/yr	5 events/yr (base; no downward scenario modelled)	11 events/yr +150% (AU$927,180/yr)	Annual incremental fire cost increases by approximately 17% at maximum frequency; standby (AU$480,000/yr) and asset repair (AU$300,000/yr) remain the dominant fixed components across all frequency scenarios	Avoided fire-related costs increase modestly (≈+17% on the fire component only) as active management suppresses frequency escalation risk	Greater avoided-cost benefit than Sc. 2 due to more intensive management reducing the likelihood of reaching higher frequency scenarios
Private land uptake: Sc. 2	37.5% (coverage scalar = 0.24)	<25%	50%	N/A	BCR falls markedly if uptake <25%; reinvasion risk increases	N/A
Private land uptake: Sc. 3	65% (coverage scalar = 0.48)	<50%	75%	N/A	N/A	BCR falls if <50%
Area uncertainty	±30% on total	−30%	+30%	Low sensitivity overall	Total costs and benefits scale approximately ±30%	Total costs and benefits scale approximately ±30%
Biodiversity restoration cost	$2,550/ha/yr	−25% ($1,688)	+25% ($2,813)	±25% external costs	Avoided benefits vary by ≈ ±15%	Avoided benefits vary by ≈ ±20%
Cultural degradation cost	$2,260/ha/yr	−30% ($1,582)	+30% ($2,938)	±5% external costs	Avoided benefits vary by ≈ ±5%	Avoided benefits vary by ≈ ±8%

Notes: Per-hectare biodiversity, cultural, fire, and scenic values are taken directly from Report 1 and applied consistently across scenarios. Scenarios 2 and 3 results are coverage-adjusted, using effective area scalars of 0.24 and 0.48, respectively. Sensitivity results are reported directionally and as bounded ranges, reflecting the fact that the calculations support robust trends rather than single-point estimates under alternative assumptions.

C.6. Distributional analysis

The costs and benefits of buffel grass management are not borne equally across stakeholder groups. The table below summarises the primary cost-bearing and benefit-receiving parties under each scenario.

Stakeholder Group	Cost Under Sc. 1	Cost Under Sc. 2	Cost Under Sc. 3	Primary Benefits
NT Government (DLPE, Parks)	Low direct cost; high indirect liability	Moderate: Crown land, coordination	High: ranges, fire, coordination	Weed compliance; park protection; reduced fire liability
Alice Springs Town Council	Mowing/slashing budget	Significant: ASTC land treatment	Significant: ASTC land + fire mgmt	Reduced fire risk; amenity; compliance
Private landowners	Owner-managed; minimal compliance	Cost-sharing + compliance	Higher cost-sharing; compliance	Reduced fire risk; property protection
Traditional Owners / Arrernte people	High indirect cost: cultural loss	Reduced cultural degradation	Greatest cultural site protection	Access to Country, sacred site protection, and bush foods
Landcare / community groups	Current effort maintained	Maintained: coordination support	+50% resourcing and coordination	Expanded program; community engagement
Tourism industry	Rising amenity loss; fire closures	Improved scenic amenity	Maximum amenity and access protection	Visitor experience, park access, and reduced fire closures
Pastoral industry	Low impact within the municipal area	Low impact within the municipal area	Low impact within the municipal area	Not the primary target in the municipal context

C.7. Key conclusions from the cross-scenario analysis

- Scenario 1 generates the lowest direct management cost in the short term (approximately $297.5K–$535K per year), but it accumulates the highest total cost over time once escalating external impacts,fire-regime intensification, biodiversity loss, cultural site degradation, and scenic amenity decline are included. The municipal-only BCR of approximately 0.005 indicates a severe economic penalty for inaction, with ongoing external costs vastly exceeding the limited benefits achieved under a reactive approach.
- Scenario 2 requires a substantial uplift in short-term direct expenditure (approximately $1.5M–$3.2M per year), but delivers a strongly positive economic return once avoided external costs are incorporated. Using coverage-adjusted valuation (effective coverage = 0.24), Scenario 2 achieves a BCR of approximately 4.9 over a 20-year horizon (and around 5.3 over 50 years). This makes Scenario 2 the most practical and economically efficient near-term option for DLPE and ASTC, consistent with existing program capacity and implementation pathways.
- Scenario 3 delivers the greatest long-term value and risk reduction, despite the highest upfront costs. At a 7% discount rate, the coverage-adjusted 20-year BCR is approximately 3.4 (rising to about 3.7 over a 50-year horizon). While less efficient than Scenario 2 on a ratio basis, Scenario 3 generates the highest absolute net present value and the strongest protection for biodiversity, cultural assets, infrastructure, and

community safety by suppressing buffel grass across high-value ranges, nature parks, and a larger proportion of private land.

- The compounding nature of buffel grass expansion means each year of delay under Scenario 1 increases the future cost of achieving equivalent management outcomes, establishing a strong economic case for early, proactive investment.
- The highest-priority action to improve cost estimate accuracy is commissioning comprehensive GIS mapping of buffel grass distribution and density across all land tenure categories within the Alice Springs municipal boundary.