






Proposing principles towards responsible waste management in South African protected areas



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This article synthesises principles towards achieving responsible waste management in South African protected areas. These principles are distilled from and based on existing legislation, guidelines and best practices applicable to environmental management, waste management and protected areas management. The principles are framed around the South African environmental management principles, and specifically contextualised for waste management in protected areas, based on legislation, guidelines and best practices from the literature. Six key principles are synthesised, which aim to achieve responsible waste management in protected areas through: (1) protection of ecosystems and biodiversity; (2) prevention and remediation of pollution; (3) implementation of the waste management hierarchy; (4) provision of effective waste services and infrastructure; (5) promotion of participation and building of partnerships; and (6) contribution to wellbeing, livelihoods and capacity. These principles provide a first step towards the development of detailed guidance on dealing with waste management in South African protected areas and may have relevance in other countries.

Conservation implications: The suggested principles for responsible waste management in protected areas aim to provide strategic direction, coordinate and standardise waste management in protected areas. The ultimate aim of the principles is to reduce the adverse impacts of waste in protected areas and to align waste management practices with South African laws and international best practice.

Keywords: principles; responsible waste management; protected areas; pollution prevention; waste management hierarchy; waste services; mitigation hierarchy; knowledge sharing; partnerships.

Introduction

Waste management as a concern to protected areas

Because of development pressures, population growth, rapid urbanisation and increased consumption habits, waste management has become a global concern (Kaza et al. 2018). In an effort to mitigate and address the adverse impacts of waste, most governments around the world have developed legislation to regulate the management of waste. While national governments are responsible for developing laws, local municipalities are typically responsible for the collection, transportation and disposal of waste, and for the development and maintenance of municipal waste management infrastructure. In developing countries, municipalities often lack the capacity, budget and skills to effectively manage waste. This leads to pressures such as weak governance and enforcement and waste service delivery backlogs, which contribute to the unlawful disposal of waste, littering and resultant pollution of the environment (DEA 2018; Kaza et al. 2018).

Waste management has been identified as one of the most significant challenges facing many protected areas around the world (Hong & Chan 2010; Rodríguez-Rodríguez 2012; Roos et al. 2022). If not managed responsibly, waste may lead to pollution, land degradation, resource depletion, loss of biodiversity, unsightliness and other negative impacts on ecotourism (Du Plessis, Van Der Merwe & Saayman 2013; Morrison-Saunders et al. 2019; Przydatek 2009; Steg & Vlek 2009). In his study, 'The relevance and resilience of protected areas in the Anthropocene', Cumming (2016) acknowledged the importance of the spatial connectivity between protected areas and their surroundings. He further recognised that protected areas are in many instances characterised by weak governance, which contributes to challenges in managing these areas. In the context of this study, it is important to highlight that responsible waste management in protected areas must encompass, not only the management practices within these areas but also those in their surroundings, given their interconnectedness. Moreover, it is essential to underscore the pivotal role that governance plays towards facilitating responsible waste management within protected areas.

Protected areas have complex governance jurisdictions, which could influence the way in which waste is managed. For instance, in South Africa, national parks and marine protected areas are generally managed by the national government (i.e. SANPARKs or Department of Forestry Fisheries and Environment), while provincial protected areas are managed by the provincial government, and private nature reserves are managed by its owners or an assigned management authority. In many cases, tourism-related activities within protected areas may involve partnerships with external entities or contractors, which could further complicate waste management roles and responsibilities. Moreover, local governments are mandated to deliver waste management services, encompassing waste collection, storage and disposal services, as specified in Schedule 5B of the South African Constitution (RSA 1996). The involvement and responsibilities of these role players in waste management may vary depending on the type and location of the protected area. This dynamic results in a multifaceted waste management landscape, where various stakeholders, each with varying capacities, budgets and management contexts, assume responsibility for different aspects of waste management within and around protected areas. Failure by any of these stakeholders to fulfil their waste management obligations can exert pressure on others to assume those responsibilities. Should such responsibilities, however, remain unaddressed, adverse consequences may ensue.

Responsible waste management in protected areas is crucial to ensure that these areas remain protected and to reduce negative impacts on the environment. Visitor experience and adjacent communities also benefit from responsible waste management. Wylie, Bhattacharjee and Ramped (2018); Sandham et al. (2020); and Claassens et al. (2022), however, showed that waste management measures are rarely integrated into environmental impact assessments (EIAs) of developments in South African protected areas. The need to develop principles, which direct responsible waste management behaviour and provide strategic direction, guidance and standardisation of waste management practices for South Africa, is highlighted by Makgae (2011). Likewise, Roos et al. (2022) and Claassens et al. (2022) advocated the development of best practice principles and guidelines for waste management in South African protected areas. To date, no such principles for waste management in protected areas have been proposed in South Africa or elsewhere in the world. To this end, it is the aim of this article to synthesise such principles that may be used to inform and guide future waste management practices in protected areas and to measure existing practices.

Objectives of protected areas

Protected areas are defined as 'Geographical spaces, recognised, dedicated and managed, through legal or other effective means, to achieve the long term conservation of nature with associated ecosystem services and cultural values' (Dudley 2008). South Africa has declared roughly 1500 protected areas, across the differing types and protection levels as afforded by the *National Environmental Management*

Protected Areas Act (57 of 2003) (NEMPAA) (Alberts, Retief, Cilliers, Roos, & Hauptfleisch 2021).

According to Section 17 of NEMPAA, protected areas have the following objectives:

- Provision for rehabilitated and restored ecosystems and recovery of endangered species;
- Provision of a sustainable supply of environmental goods and services, and sustainable use of natural and biological resources;
- Creation of nature-based tourism destinations; and
- Provision for human, social, cultural, spiritual and economic development.

Consideration of the above objectives indicates the intersectionality between what protected areas in South Africa are set to achieve responsible waste management. Pursuit of the above objectives could have as their result activities that generate waste within these areas. For instance, the creation of nature-based tourism activities may lead to the generation of waste. Likewise, activities aimed at waste reduction in these areas could also serve to achieve objectives related to economic development and restoration of ecosystems.

It is therefore important that the above objectives are considered when proposing principles for waste management in protected areas.

The need for principles for responsible waste management in protected areas

According to the *Oxford Dictionary*, the term *principle* is defined as 'a moral rule or a strong belief that influences our actions'. Principles create a moral compass that guides behaviour and should inform actions and practice by setting the standard for how an individual or group should act or behave. In the context of setting principles for waste management in protected areas, the principles should aim to guide waste management practices and related behaviour in protected areas. Such principles could typically inform the direction of waste management measures, procedures or practices, which could be incorporated into protected areas management plans. They should guide not only the management authorities in these areas with regard to implemented measures and objectives but also visitors to such areas and how they should conduct themselves.

The development of principles towards responsible waste management in protected areas is imperative and necessary, because of the unique features of these areas, which often include high biodiversity and sensitive environments (Brownlie & Treweek 2018). Furthermore, these areas are seeing a rise in popularity with ever-increasing visitor numbers and increasing developmental pressure in relation to tourist facilities (Roos et al. 2022; Sandham et al. 2020). Increasing tourism revenue and socio-economic development is a clear expectation of South Africa's protected areas specifically, with increased tourism numbers and infrastructure plausibly

leading to increased waste generation within such areas. Any adverse effects on these areas because of poor waste management can have long-term implications on the value and ecosystem functions of protected areas, as well as tourism experience and perceptions. In comparison to typical, generic waste management principles, principles for waste management in protected areas would likely focus more readily on preventing impacts to the natural environment as a preferred option and mitigating impacts (as a last resort). Emphasis would also likely be placed on preventing pollution, reducing waste that is harmful to the environment and minimising the accumulation of waste in these areas. Additionally, principles in protected areas would likely stress the importance of biodegradable and recyclable materials, as well as ensuring that any waste management activities or infrastructure is compatible with the unique characteristics and objectives of specific protected areas. Finally, responsible waste management principles would recognise that protected areas often rely on a delicate balance between nature and human intervention and that any waste created, stored, transported or disposed of should be managed in a way that respects this balance. It is also important to note that typical, generic waste management principles might not apply to protected areas because they might conflict with the conservation objectives and goals of protected area management.

We argue that principles for waste management in protected areas should at least or as a minimum:

- Provide for unique characteristics of protected areas (i.e. sensitive habitats, protection species);
- Align with protected areas objectives (as set out in Section 17 of NEMPAA);
- Provide for operational impacts of activities of protected areas (such as ecotourism activities, modifications and construction);
- Align with the objectives of the *National Environmental Management Waste Act (59 of 2008)* (NEMWA) and the National Waste Management Strategy (NWMS) (i.e. waste management hierarchy, waste services, pollution prevention) as a minimum;
- Provide for operational challenges related to waste management in protected areas (size, remoteness, access to infrastructure); and
- Provide for social and/or community benefits (such as skills transfer, capacity building and meaningful participation).

Generally, such principles also provide standards for practice, increased legitimacy for decision-making, a basis for accountability, inspiration, consistency in terminology, an appropriate scope and focus, and informed legislation and policy (Brownlie & Treweek 2018; Vanclay 2003). In keeping with the aim of this study, the following sections synthesise principles towards responsible waste management in South African protected areas. These principles are distilled from existing legislation and literature, framed around the South African environmental management principles and contextualised for waste management in protected areas based on South African legislation, as well as guidelines and best practice provided for in international literature.

Relevant principles and guidelines

The environmental management principles, set out in Section 2 of the *National Environmental Management Act (107 of 1998)* (NEMA) (RSA 1998), form the basis for the synthesised South African principles for responsible waste management in protected areas. They are further aligned with the objectives of the NEMWA (RSA 2008), the focus areas of the NWMS (DEFF 2020), as well as international peer-reviewed publications on waste management best practice. Lastly, the principles are contextualised for protected areas based on the objectives of the NEMPAA (RSA 2003), the *National Environmental Management Biodiversity Act (10 of 2004)* (NEMBA) (RSA 2004) and the National Biodiversity Strategy and Action Plan (NBSAP) (DEA 2015). Additionally, principles, guidelines and good and/or best practices proposed for the management of biodiversity, ecotourism and protected areas by the International Union for Conservation of Nature (IUCN), International Association for Impact Assessment (IAIA), United States Agency for International Development (USAID), World Bank, European Union (EU) and the United States Environmental Protection Agency (US EPA) are considered.

Environmental management principles

The environmental management principles in Section 2 of NEMA aim to guide the interpretation and implementation of the Act and other South African laws concerned with the protection or management of the environment (RSA 1998). Box 1 outlines the key environmental management principles from NEMA that were considered to be most relevant to the proposal of principles for responsible waste management in protected areas. These principles form the basis for environmental management and governance in the country and, therefore, also form the basis of the synthesised principles for responsible waste management in protected areas in South Africa.

Waste management principles and guidelines

The objectives of the NEMWA align with Section 2 of the NEMA. It provides for minimising the consumption of natural resources; avoiding and minimising the generation of waste; implementing the waste management hierarchy; preventing pollution and ecological degradation; promoting the effective delivery of waste services; and remediating contaminated land, among others (RSA 2008). The NWMS (DEFF 2020) provides strategic interventions towards achieving these objectives. The 2020 NWMS is centred around the waste management hierarchy and the circular economy and has three priority areas – referred to as ‘pillars’. Pillar 1 specifically focusses on waste minimisation, while Pillar 2 provides for effective and sustainable waste services, and Pillar 3 highlights the importance of compliance, enforcement and awareness.

Additionally, existing international waste management guidelines and best practices provide further learning towards contextualising principles for responsible waste management in South African protected areas. These include:

BOX 1: Key environmental management principles guiding the development of principles for responsible waste management in protected areas.

- Sustainable development requires the consideration of all relevant factors including:
 - that the **disturbance of ecosystems and loss of biological diversity are avoided** or, where they cannot be altogether avoided, are minimised and remedied;
 - that **pollution and degradation of the environment are avoided** or, where they cannot be altogether avoided, are minimised and remedied;
 - that the **disturbance of landscapes and sites that constitute the nation's cultural heritage** is avoided or, where it cannot be altogether avoided, is minimised and remedied;
 - that **waste is avoided or, where it cannot be altogether avoided, minimised and re-used or recycled** where possible and otherwise disposed of in a responsible manner;
 - that the **use and exploitation of non-renewable natural resources is responsible and equitable** and takes into account the consequences of the **depletion of the resource**;
 - that the development, use and exploitation of **renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity** is jeopardised;
 - that a **risk-averse and cautious approach** is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions; and
 - that **negative impacts on the environment and on people's environmental rights be anticipated** and prevented and, where they cannot be altogether prevented, are minimised and remedied.
- The **participation of all interested and affected parties** in environmental governance must be promoted, and all people must have the opportunity to develop the understanding, **skills and capacity** necessary for achieving equitable and effective participation, and participation by vulnerable and disadvantaged persons must be ensured.
- Decisions must take into account the **interests, needs and values of all interested and affected parties**, and this includes recognising all forms of knowledge, including traditional and ordinary knowledge.
- **Community wellbeing and empowerment** must be promoted through environmental education, the raising of environmental awareness, the sharing of knowledge and experience and other appropriate means.
- The **social, economic and environmental impacts of activities**, including disadvantages and benefits, must be considered, assessed and evaluated, and decisions must be appropriate in the light of such consideration and assessment.
- The **costs of remedying pollution, environmental degradation and consequent adverse health effects** and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects must be **paid for by those responsible for harming the environment**.

Source: Republic of South Africa (RSA), 1998, *National Environmental Management Act 107 of 1998*, GN 1540 in Government Gazette 19519 of 19 November 1998, Government Gazette, Cape Town

- 'Best Environmental Management Practice for the Waste Management Sector' by the EU (Dri et al. 2018),
- 'Best Practices for Solid Waste Management: A Guide for Decision-Makers in Developing Countries' by the US EPA (2020),
- 'Sector Environmental Guideline: Solid waste' and 'Environmental Guidelines for Small-Scale Activities in Africa (EGSSAA): Ecotourism' by the USAID (2009) and
- 'Bridging the Gap in Solid Waste Management: Governance Requirements for Results' by the World Bank (2021b).

Waste management principles and best practice considerations are also suggested in academic literature. Cointreau (2001) proposed 'Principles for Sustainable and Integrated Solid Waste Management' with the aim of guiding waste management practice within the municipal waste management context. She suggested 10 principles for sustainable and integrated waste management, which include: (1) the provision of good governance and service delivery, (2) establishing cost recovery mechanisms, (3) conserving natural resources, (4) embracing public participation, (5) fostering appropriate technologies and sites, (6) seeking appropriate levels of source separation, (7) providing for recycling and resource recovery,

(8) conducting strategic facility planning, (9) building institutional capacity and (10) promoting private sector involvement. These principles have been adapted by Mwangi and Thuo (2014) for municipal waste management in developing countries.

Although useful and relevant, these principles suggest generic waste management practices (aligned with these principles), which do not make explicit provision for waste management in protected areas. Protected areas present unique conservation and governance contexts, as well as valuable ecosystem services and sensitive environments. Therefore, existing biodiversity, conservation and protected areas-related legislation, guidelines and best practices ought to be taken into consideration when creating waste management principles.

Biodiversity, conservation and protected area principles and guidelines

In South Africa, the NEMBA regulates the protection and conservation of biodiversity and ecosystems, while the NBSAP provides for strategic objectives towards achieving the vision of the strategy, which is to 'Conserve, manage and sustainably use biodiversity to ensure equitable benefits to the people of South Africa, now and in the future'. The NEMPAA makes provision for the declaration and management of protected areas and stipulates the purpose of protected areas in Section 17 of the Act. The purpose of protected areas is both ecocentric and anthropocentric in their orientation. Sections 17(a) to (f) and (l) provide for the preservation of ecological integrity, the conservation of biodiversity and the protection of threatened or rare species, and vulnerable or ecologically sensitive habitats, among others, while Sections 17(f) to (k) provide for the supply of environmental goods and services, sustainable use of natural resources, nature-based tourism, and contributions of protected areas to human, social, cultural, spiritual and economic development.

The IUCN seeks to influence and encourage conservation and ensure that the use of natural resources is equitable and ecologically sustainable. They have developed a guideline series that aims to guide good practice in protected areas focussing on aspects such as sustainable tourism in protected areas (IUCN Protected Area Guideline [PAG] 008), ecological restoration for protected areas (IUCN PAG 018), and tourism and visitor management in protected areas (IUCN PAG 027). Other applicable guidelines include the IAIA *International Best Practice Principles for Biodiversity in Impact Assessment* (Brownlie & Treweek 2018), which outlines guiding and operating principles, promoting no net loss to biodiversity. The USAID provides environmental guidelines for ecotourism activities in Africa, while the World Bank has also published useful guidance on promoting sustainable tourism in protected areas and good practice options for sustainable solid waste management in mountain tourism areas. Again, no guidelines or best practice principles exist which explicitly address the management of waste in protected areas. The guidance, mentioned above, does, nonetheless, provide best practices that relate to the management of protected areas, such as pollution prevention, ecological protection,

biodiversity conservation and resource preservation, which are equally applicable to the management of waste in protected areas.

Methods

The suggested principles for responsible waste management in South African protected areas were synthesised by following four steps as set out below. The method employed is in line with and adapted from similar attempts at the development of best practice principles (Brownlie & Treweek 2018; Morrison-Saunders 2023; Vanclay 2003).

Step 1: Framing principles based on South African environmental management principles and legislation

As explained above, the environmental management principles, outlined in Section 2 of the NEMA (as summarised in Box 1), were used as an overall framing for the synthesis of principles for responsible waste management in protected areas. These principles were aligned with South African waste management and protected areas management legislation, such as the NEMWA, the NWMS, the NEMPAA, the NEMBA and the NBSAP.

Step 2: Literature review and document analysis to contextualise principles for waste management and protected areas

Step 2 involved a review of literature to identify guideline documents, best practices and academic literature applicable

to waste management and protected areas management. These documents are outlined in Table 1. Literature was critically analysed to identify examples that could provide for waste management and protected areas management contexts to the environmental management principles identified in Step 1.

Step 3: Specialist workshop to validate and refine synthesised principles for waste management in protected areas

The synthesised principles for responsible waste management in South African protected areas were reviewed and refined during a specialist workshop between five specialists. The specialists all had PhDs and are experts in conservation planning, environmental law, environmental assessment, environmental science and waste management. The outcome of the specialist workshop is presented in Table 1, which outlines synthesised principles for waste management in South African protected areas and references to justify their inclusion.

The sections following Table 1 discuss each of the suggested principles individually to illustrate the practices and considerations, which should be implemented towards achieving responsible waste management in protected areas.

Step 4: Consideration of the extent to which the synthesised principles meet the minimum requirements for responsible waste management in protected areas

The suggested principles were assessed to indicate the extent (low, medium, high) to which these principles address the

TABLE 1: Synthesised principles for responsible waste management in South African protected areas based on learning from law, policy, strategy guidelines and academic publications.

Principle	References		
	Law, policy and strategy	Guidelines	Academic publications
In protected areas, waste should be managed in order to achieve:			
1. Protection of ecosystems and biodiversity	NEMA Section 2 (4)(a)(i)&(viii); NEMWA Section 2(a)(iv); NEMWA Part 8; NEMBA Section 2(a)(i), (IA), (ii), 7, 52; NBSAP (Strategic objective 1 and 4); NEMPAA Section 17(1) (a) to (f)	IUCN PAG 003 (Kelleher 1999); IUCN PAG 018 (Keenleyside et al. 2012); Dri et al. (2018); Brownlie and Treweek (2018); USAID (2018); IUCN PAG 031 (Crofts et al. 2020); World Bank (2021c)	Roos et al. (2022)
2. Prevention and remediation of pollution	NEMA Section 2 (4)(a)(ii); NEMWA Section 2(a)(iv); 2(a)(viii), Section 21 – 27, 39; NWMS Pillar 3 (focus area: reduce littering and illegal dumping)	IUCN PAG 008 (Eagles, McCool & Haynes 2002); IUCN PAG 018 (Keenleyside et al. 2012); IUCN PAG 019 (eds. Day et al. 2012); IUCN PAG 024 (eds. Gross et al. 2016); Brownlie and Treweek (2018); USAID (2018); IUCN PAG 031 (Crofts et al. 2020); US EPA (2020); World Bank (2021c)	Rodríguez-Rodríguez (2012); Mwangi and Thuo (2014)
3. Implementation of the waste management hierarchy	NEMA Section 2 (4)(a)(iv); NEMWA Section 2(a)(ii)(iii)(iv), Section 16, 17, 26; NWMS Section 4.3 & Pillar 1 (waste minimisation, advance waste as a resource)	Cointreau (2001); IUCN PAG 008 (Eagles et al. 2002); USAID (2009); IUCN PAG 022 (Trzyzna 2014); Dudley, Ali and MacKinnon (2017); IUCN PAG 029 (Mitchell et al. 2018); USAID (2018); US EPA (2020); World Bank (2021a, 2021b, 2021c)	Mwangi and Thuo (2014); Dunjić et al. (2017); Dri et al. (2018); Strydom (2018)
4. Provision of effective waste services and infrastructure	NEMWA Section 2(a)(vii) and 2(4)(p), Section 23 and 24; NWMS Pillar 2 (effective and sustainable waste services; financially sustainable waste services)	Cointreau (2001); IUCN PAG 013 (Emerton, Bishop & Thomas 2006); IUCN PAG 027 (eds. Leung et al. 2018); USAID (2018); US EPA (2020); World Bank (2021a, 2021b, 2021c)	Mwangi and Thuo (2014); Dri et al. (2018)
5. Promotion of participation and building of partnerships	NEMA Section 2 (4)(f)(g); NWMS Pillar 1 (Focus area: Build sustainable partnerships), Pillar 3 (Focus area: Awareness and community participation)	Cointreau (2001); IUCN PAG 027 (eds. Leung et al. 2018); US EPA (2020)	Mwangi and Thuo (2014); Dunjić et al. (2017)
6. Contribution to wellbeing, livelihoods and capacity	NEMA Section 2 (4)(f)(g)(h); NWMS Pillar 1 (Focus area: Build sustainable partnerships; Increase technical capacity and innovation for beneficiation of waste), Pillar 3 (Focus area: Awareness and community participation); NEMBA Section 2(a)(iii); NBSAP (Strategic objectives 1, 2, 4, 5 and 6); NEMPAA Section 17 (g)(h)(j)(k)	Cointreau (2001); IUCN PATRS 002 (Appleton 2016); IUCN PAG 032 (Verschuuren et al. 2021); World Bank (2021a, 2021b)	Rodríguez-Rodríguez (2012); Mwangi and Thuo (2014); Dunjić et al. (2017)

NEMA, *National Environmental Management Act (107 of 1998)*; NEMWA, *National Environmental Management Waste Act (59 of 2008)*; NEMBA, *National Environmental Management Biodiversity Act (10 of 2004)*; NBSAP, *National Biodiversity Strategy and Action Plan*; NEMPAA, *National Environmental Management Protected Areas Act (57 of 2003)*; IUCN, *International Union for Conservation of Nature*; USAID, *United States Agency for International Development*; US EPA, *United States Environmental Protection Agency*; PATRS, *Protected Area Technical Report Series*.

Note: Please see the full reference list of the article, Roos, C., Alberts, R.C., Retief, F.P., Cilliers, D.P. & Bond, A.J., 2023, 'Proposing principles towards responsible waste management in South African protected areas', *Koedoe* 65(1), a1753. <https://doi.org/10.4102/koedoe.v65i1.1753>, for more information.

'minimum requirements' for responsible waste management in protected areas:

- Provide for unique characteristics of protected areas (i.e. sensitive habitats, protection species);
- Align with protected areas' objectives (as set out in Section 17 of NEMPAA);
- Provide for operational impacts of activities of protected areas (such as ecotourism activities, modifications and construction);
- Align with the objectives of the NEMWA and the NWMS (i.e. waste management hierarchy, waste services, pollution prevention);
- Provide for operational challenges related to waste management in protected areas (size, remoteness, access to infrastructure); and
- Provide for social and/or community benefits (such as skills transfer, capacity building and meaningful participation).

The assessment is summarised in Table 2.

Review findings

Principle 1. Protection of ecosystems and biodiversity

Ecosystems and biodiversity within protected areas need to be conserved to ensure that they provide services, value and benefits for current and future generations (Brownlie & Treweek 2018). Ultimately, waste management needs to be aimed at achieving *no net loss* to biodiversity. In line with the IAIA *Best Practice Principles for Biodiversity in Impact Assessment* (Brownlie & Treweek 2018), this may be achieved by managing waste in such a way to ensure that 'damage is avoided to unique, endemic, threatened or declining species, habitats and ecosystems; to species of high cultural value to society, and to ecosystems providing important services'.

One way in which negative impacts of waste on biodiversity and ecosystems can be avoided or minimised is by restricting

or locating waste management activities and infrastructure outside of sensitive areas. Lai, Leone and Zoppi (2018) emphasised that when siting infrastructure, it is essential that ecosystems sensitivity, multifunctionality and ecological connectivity be taken into account. Furthermore, Rodríguez-Rodríguez (2018) highlighted that waste infrastructure must be placed at 'sensible points', which are easily accessible to tourists, such as entrances to the park, viewpoints, picnic areas and other recreational areas. Waste management infrastructure should, therefore, be located in areas where it is accessible to tourists (to prevent littering), but outside of sensitive areas, buffer zones or areas where it may adversely impact on ecosystems and biodiversity (Roos et al. 2022; World Bank 2021c). Furthermore, the negative impacts associated with waste management measures must be avoided or mitigated to ensure that no negative impacts occur. This is especially difficult given that within protected areas, all impacts negatively affecting ecosystems and biodiversity may be considered as being significant.

Principle 2. Prevention and remediation of pollution

The mismanagement of waste in protected areas may pollute soil, surface water, groundwater and air. It is, therefore, important that the negative impacts of waste and the potential for pollution of protected areas are anticipated and mitigated throughout the entire waste management life cycle. This is especially important for new developments within or around protected areas, where waste will be generated as part of construction, operation, modifications and/or decommissioning phases (Brownlie & Treweek 2018). Recent South African studies concluded that waste management measures are generally not sufficiently considered in EIAs for developments affecting protected areas (Claassens et al. 2022; Sandham et al. 2020; Wylie et al. 2018). Therefore, this is an area for improvement.

Waste management in protected areas must ensure no littering and illegal dumping through clear communication and awareness, as well as through providing sufficient

TABLE 2: Extent to which principles contribute to responsible waste management in protected areas (based on 'minimum requirements' identified by authors).

Principles	Provides for characteristics of PAs	Aligns with PA objectives	Provides for operational impacts of activities of PAs	Aligns with objectives of NEMWA and NWMS	Provides for operational challenges of waste management in PAs	Provides for social and/or community benefits
1. Protection of ecosystems and biodiversity	High	High	Medium	Low	Low	Low
2. Prevention and remediation of pollution	High	High	Low	High	Low	Low
3. Implementation of the waste management hierarchy	Low	Low	Medium	High	Medium	Medium
4. Provision of effective waste services and infrastructure	Low	Low	Medium	High	Medium	Medium
5. Promotion of participation and building of partnerships	Low	Low	Medium	Medium	Medium	High
6. Contribution to wellbeing, livelihoods and capacity	Low	Low	Medium	Medium	Medium	High

PAs, protected areas; NEMWA, *National Environmental Management Waste Act (59 of 2008)*; NWMS, *National Waste Management Strategy*.

infrastructure (bags and/or bins and/or skips) for the responsible disposal of waste by visitors. 'Low levels of litter' was one of the most valued aspects of tourism management by visitors to national parks in Tanzania (Wade & Eagles 2003). To achieve this, waste management infrastructure must be suitably located (refer to Principle 1) and of high standard to prevent leakages during storage, collection and transportation (World Bank 2021c).

A more drastic step towards addressing pollution related to waste management in protected areas is zero tolerance to waste disposal (Mateer, Taff & Miller 2020). Examples include the 'leave no trace' programmes implemented by Grand Teton National Park, Yosemite National Park, and Denali National Park and Reserve in the United States (Lawhon et al. 2018; Przydatek 2019). This initiative requires visitors to take their waste with them and dispose of it outside of the protected area. This initiative may not work in South Africa because parks are often remote with no waste management infrastructure or services close by (Roos et al. 2022), leading to unintended consequences, such as increased illegal dumping outside of the protected area.

Where it is not possible to avoid the disposal of waste within the protected area, care must be taken to ensure that waste is disposed of in a responsible and lawful manner. Areas that have been contaminated or degraded because of the impacts of waste need to be rehabilitated and restored to an acceptable standard (USAID 2018). This may require assessments and rehabilitation efforts, as outlined in the *National Norms and Standards for the Remediation of Contaminated Land and Soil Quality* (RSA 2014). Lastly, waste management practices need to be cognisant of the potential to produce greenhouse gases (during transportation, incineration and/or disposal), and the potential for climate change impacts needs to be mitigated (eds. Gross et al. 2016).

Principle 3. Implementation of the waste management hierarchy

The South African regulatory environment aims to promote the 'waste management hierarchy', where waste is regarded as a resource. This hierarchy (entrenched in Section 17 of NEMWA) is often represented as a pyramid, with the most preferred waste management options at the top of the hierarchy. In this case, avoidance of waste is the most preferred option, followed by reduction, reuse, recycling, recovery and treatment, with disposal being the least preferred option (DEFF 2020). Although not much research has been done on the implementation of the waste management hierarchy in protected areas, research on the environmental performance of tourism facilities in protected areas typically considers the following areas as key performance indicators: (1) solid waste separation at source, (2) use of recycled materials, (3) composting of organic and food waste, (4) purchasing of materials with recyclable features and (5) cooperation with recycling firms (Alberts et al. 2022; Erdogan & Tosun 2009).

The NWMS promotes the use of waste as a resource through the circular economy approach. The circular economy is:

- [A]n approach to minimise the environmental impact of economic activity by reusing and recycling processed materials to minimise:
- (1) the need to extract raw materials from the environment; and
 - (2) the need to dispose of waste. (DEFF 2020:11)

Within the South African context, the circular economy aims to include the informal waste economy and local communities towards community upliftment and creating livelihoods from waste (DEFF 2020) (see Principle 6).

The separation of waste at source is an important step towards achieving the waste management hierarchy (DEFF 2020; Strydom 2018) and should be pursued within protected areas. This may require waste separation at source infrastructure (i.e. recycling bins), and communication and awareness efforts to make staff and visitors cognisant of the importance of waste separation at source (Dunjić et al. 2017). Once the waste has been separated, it should remain separated during collection and transportation, which may require vehicles with separation and/or segregation elements. This was specifically highlighted as one of the challenges towards achieving sustainable solid waste management in private nature reserves in South Africa (Roos et al. 2022).

In their research on 'Why local people do not support conservation' in protected areas in Thailand, Bennett and Dearden (2014) highlighted the importance of leveraging local community benefits (through business and other opportunities) for gaining communities' support and buy-in into conservation areas. Ideally, local businesses should be supported when waste reuse, recycling and recovery options are considered (Dri et al. 2018; World Bank 2021a) (also see Principle 6). However, as mentioned earlier, this may be challenging in the South African context, where protected areas are often located in remote settings, which may be far away from the recycling market. This means that waste may need to be transported over long distances to where waste management facilities and services for reuse, recycling and/or recovery are available, which may lead to increased transportation costs and increased carbon emissions (eds. Gross et al. 2016). Section 17 of the NEMWA emphasises the fact that the reuse, recycling and recovery of waste should only be pursued if it uses fewer resources and is less harmful to the environment than disposal (RSA 2008). A life cycle approach (where all of the impacts related to waste management and their magnitude, duration and severity are considered throughout the entire waste management life cycle) must, therefore, be followed when planning for and implementing the waste management hierarchy (DEFF 2020).

Principle 4. Provision of effective waste services and infrastructure

Many protected areas in South Africa do not receive municipal waste management services, because they are

located in remote and/or rural locations. These areas often lack infrastructure and the necessary resources needed to support municipal waste services. Providing waste services to remote locations can be expensive and these services may not be available because of lack of funding (Roos et al. 2022). Management authorities of protected areas must, therefore, plan for and implement waste management services themselves or via private partnerships (Roos et al. 2022). The institutional frameworks of parks must, thus, provide for these complexities and make provision for sufficient resource and capacity allocation towards waste management services. Waste management must be baked into the organisation by allocating its own budget and staff (Cointreau 2001).

Waste management services must provide assurance that legal requirements for storage, collection, transportation and disposal are met (especially beyond the access gate). Waste management services should also be conducted in a transparent manner, with sufficient documented evidence of compliance such as waste manifest documentation and safe disposal certificates for hazardous waste. The unique contexts of protected areas may, however, complicate legal compliance and the provision of waste management services.

Waste management infrastructure in protected areas may include waste collection bins or skips, waste separation infrastructure, composting facilities, transfer stations, incinerators, landfill sites and waste treatment facilities. Typical challenges in protected areas include animal access to waste, and the fact that certain waste management practices (such as incineration and composting) may not be compatible with the area or may be considered unacceptable by the management authority or tourists (Roos et al. 2022). Adding to the challenge is the fact that several protected areas in South Africa are too big for centralised waste services and infrastructure, such as the Kruger National Park. Furthermore, visitor behaviour and the correct use of waste management infrastructure are key considerations for the responsible management of waste in protected areas (also refer to Principle 3).

Lastly, the affordability of waste management practices and/or services is important. Although waste management services and infrastructure should be cost-effective and reasonable, they should not compromise meeting environmental criteria and legal requirements and should strive towards implementing the best practicable environmental option (BPEO) and best available technology (BAT) (Cointreau 2001). To cover the costs related to waste management practices and/or services, it may be necessary to recover user fees towards waste management services in protected areas through entrance fees, tourism-based taxes and concession fees (Crofts et al. 2020). It is, furthermore, important to ensure that fees recovered for waste management are earmarked towards waste management infrastructure, practices or services and that it is not reallocated to other areas.

Principle 5. Promotion of participation and building of partnerships

Building sustainable partnerships, which encourage meaningful participation of interested and affected parties in waste management decision-making, is essential to provide for the consideration of needs, expectations and values as it relates to waste management (Cointreau 2001). The building of sustainable partnerships is mentioned as a focus area of Pillar 1 of the NWMS, while Pillar 3 also focusses on the importance of community participation (DEFF 2020). According to the IAIA *Best Practice Principles for Biodiversity in Impact Assessment* (Brownlie & Treweek 2018), it is important to consult widely to ensure that the values of interested and affected parties are taken into account before decisions are made.

Traditional and indigenous knowledge may prove highly useful towards designing appropriate waste management systems (Mwangi & Thuo 2014). It can provide valuable insight into the local environment and culture, which can be invaluable in the design of appropriate waste management systems. This knowledge can be used to identify suitable materials and methods for waste management that are tailored to the local context and culture, and to propose viable solutions to local waste disposal challenges. For example, indigenous communities living in complex ecosystems such as rainforests have a great wealth of knowledge relating to local plant species, and their knowledge could be used to identify plants that can be used for composting or that can be used to remediate contaminated sites. Indigenous knowledge can also be used to identify and promote recycling methods that are better suited to the local environment, rather than relying on high-tech solutions and equipment from outside sources. Finally, traditional and indigenous knowledge can provide insight into local attitudes and behaviours related to waste management, allowing the anticipation of the needs and preferences of people in the area.

Therefore, sufficient stakeholder involvement, which allows for meaningful participation and consultation, provides for appropriateness and acceptability of waste management practices implemented within protected areas and increases buy-in from stakeholders.

Principle 6. Contribution to wellbeing, livelihood and capacity

Roos et al. (2022) identified 'job creation and contributing to livelihoods' as the top perceived empowerment opportunity for sustainable solid waste management within the South African protected areas context. Waste management practices implemented in protected areas should firstly aim to prevent and mitigate negative impacts related to waste management on the surrounding community's wellbeing. Secondly, community upliftment, empowerment and contribution to livelihoods should be pursued, and job creation should be promoted through waste-related opportunities, where possible (Cointreau 2001). As

mentioned in Principle 3, the inclusion of local communities and the informal waste economy in waste-related business opportunities is a focus area of the circular economy approach in South Africa (DEFF 2020). Guidance on the inclusion and integration of the informal waste economy is provided in the *Waste Picker Integration Guideline for South Africa: Building the Recycling Economy and Improving Livelihoods through Integration of the Informal Sector* (DEFF & DSI 2020). The guideline focusses on providing opportunities and livelihoods to the informal waste management sector through integration into formal waste management systems. As mentioned by Roos et al. (2022), there are, however, several challenges, such as limited justification for a business case, inadequate infrastructure and services for waste management and recycling, and/or challenges related to the location of protected areas, which need to be addressed in order for livelihood opportunities to be realised. It is, thus, important to reflect on how waste management could realistically and reasonably contribute to livelihoods.

Strydom (2018) highlighted the important role that skills, capacity and education play in waste management in South Africa. Similarly, Rodríguez-Rodríguez (2012) also highlighted the importance of education and awareness towards addressing littering in protected areas in Spain. However, insufficient awareness, knowledge and skills are highlighted as major challenges towards achieving responsible waste management in protected areas in South Africa (Roos et al. 2022). It is, therefore, important to develop competencies and skills for the management of waste in protected areas and adjacent communities through sufficient education, awareness and knowledge sharing on waste management practices (Appleton 2016). This may also contribute towards realising potential business opportunities related to waste (DEFF 2020).

Conclusions

This study suggests six key principles towards responsible waste management in South African protected areas. These principles are framed around the environmental management principles provided for the NEMA and are contextualised for waste management and protected areas contexts in South Africa. The synthesised principles for waste management in protected areas aim to provide strategic direction and to coordinate and standardise waste management practices in protected areas.

It is important to note that this study only proposes key principles towards responsible waste management in protected areas in the South African context. The evaluation of current practice against these principles, and how different principles are applicable to different waste streams and waste types, could be the focus of future research. We believe that these principles will provide a useful framework for ultimately developing more detailed guidance for the management of waste in protected areas and will serve as a measure to evaluate current practices.

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Authors' contributions

All authors played a role in conceptualising, drafting and critically revising the article for important intellectual content and approved the final version to be published.

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