# Evaluating Legislation Impacting Drone Flight Planning Compliance: Focus on the Key Points Act, Land Survey Act, and the Spatial Data Infrastructure Act

**Luvo QUMBA[1], and Siphiwe MPHUTHI[2], South Africa**

**Key words**: Drone Legislation, Geomatics, Technological Advancements, Stakeholder Engagement

## 1 SUMMARY

This paper evaluates the legislative frameworks governing drone operations in South Africa, focusing on the Land Survey, Spatial Data Infrastructure, and the associated Acts. With the widespread adoption of drone technology across various sectors, including geomatics or geospatial science, there is a critical need to assess the existing laws that regulate these technologies. The paper highlights how South Africa's legislative environment is adapting to accommodate the innovative uses of drones while ensuring safety, privacy, and compliance with international standards. The analysis reveals that while South Africa has established a comprehensive set of regulations, continual updates and reforms are necessary to keep pace with technological advancements. The study examines specific legislative requirements, operational restrictions, and the roles of different stakeholders in shaping drone policy. Key recommendations include amending certain aspects of the acts to provide clearer guidelines on drone operations, particularly in relation to airspace management, data collection, and privacy concerns. The findings suggest that a proactive approach, involving regular updates to legislation and active engagement with stakeholders, is essential for integrating drone technologies into South Africa's social and economic fabric. This will not only enhance the capabilities of drones in various applications but also ensure that their integration into civilian airspace is managed safely and effectively. The paper calls for ongoing research and dialogue to address the evolving challenges and opportunities presented by drone technology in South Africa.

## SUMMARY (optional summary in one other language in addition to English: SeSotho)

Pampiri ena e hlahloba meralo ea molao e laolang tšebetso ea li-drone Afrika Boroa, e shebane haholo le Land Survey Act**,** Spatial Data Infrastructure Act, hammoho le melao e amanang le eona. Ka lebaka la ho ata ha tšebeliso ea li-drone mafapheng a fapaneng, ho kenyeletsa geomatics kapa saense ea tlhahisoleseding ea sebaka (geospatial science)**,** ho hlokahala ka potlako ho lekola hore na melao e teng e laola thekenoloji ena ka ho lekaneng. Pampiri e bontša kamoo tikoloho ea molao Afrika Boroa e ntseng e ikamahanya kateng ho amohela tšebeliso e ncha ea li-drone, ha e ntse e netefatsa polokeho**,** boinotši, le ho latela maemo a machaba**.**

Tlhahlobo e supa hore, leha Afrika Boroa e se e thehile melao le melaoana e pharaletseng, ntlafatso le liphetoho li ntse li hlokahala khafetsa ho tsamaisana le tsoelo-pele ea thekenoloji. Boithuto bo hlahloba litlhoko tse itseng tsa molao, mefokolo ea tšebetso (operational restrictions), le karolo ea ba amehang (stakeholders) ho bopa melaoana ea li-drone. Litlhahiso tsa bohlokoa li kenyeletsa ho lokisa likarolo tse itseng tsa melao hore ho be le tataiso e hlakileng mabapi le tšebeliso ea li-drone, haholo-holo tabeng ea taolo ea sepakapaka (airspace management), pokello ea data, le litaba tsa boinotši. Liphetho li fana ka maikutlo a hore ho hlokahala mokhoa o mafolofolo o kenyelletsang ntlafatso ea melao kamehla le ho kenya letsoho ha ba amehang ka mafolofolo, e le hore li-drone li kenngoe ka katleho moruong le sechabeng sa Afrika Boroa. Sena se tla matlafatsa bokhoni ba li-drone lits'ebelisong tse fapaneng, hape se netefatse hore ho kenngoa ha tsona sepakapakeng sa baahi ho laoloa ka polokeho le ka katleho. Pampiri e boetse e khothalletsa lipatlisiso tse tsoelang pele le lipuisano ho rarolla mathata le menyetla e ntseng e fetoha e tlisoang ke thekenoloji ea li-drone Afrika Boroa.

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## 2 INTRODUCTION

Unmanned aerial systems (UAS), commonly referred to as drones, are increasingly used in geomatics for aerial mapping, cadastral support, asset inspection, and rapid data acquisition. In South Africa, compliance for drone flight planning is not shaped by aviation rules alone; it emerges from the interaction between aviation requirements, national security restrictions, privacy and property considerations, and spatial-data governance obligations. This interaction is further shaped by privacy obligations under the Protection of Personal Information Act (POPIA) and related legal interpretation (Iyer & Mothilall, 2025).

While the South African Civil Aviation Authority (SACAA) regulates operational safety through the Civil Aviation Regulations (Part 101), additional constraints arise when drones are deployed for land surveying and spatial-data collection, particularly where the data are used for official purposes or shared within public-sector information systems (Naidoo, 2018; Rodgers, 2024).

*Figure 1* provides an overview of the regulatory spatial context within which drone operations are planned and executed. It illustrates how interacting legislative requirements and geographic constraints shape operational decisions, and underscores the need for operators to integrate legal compliance and spatial considerations throughout the flight planning and implementation process.

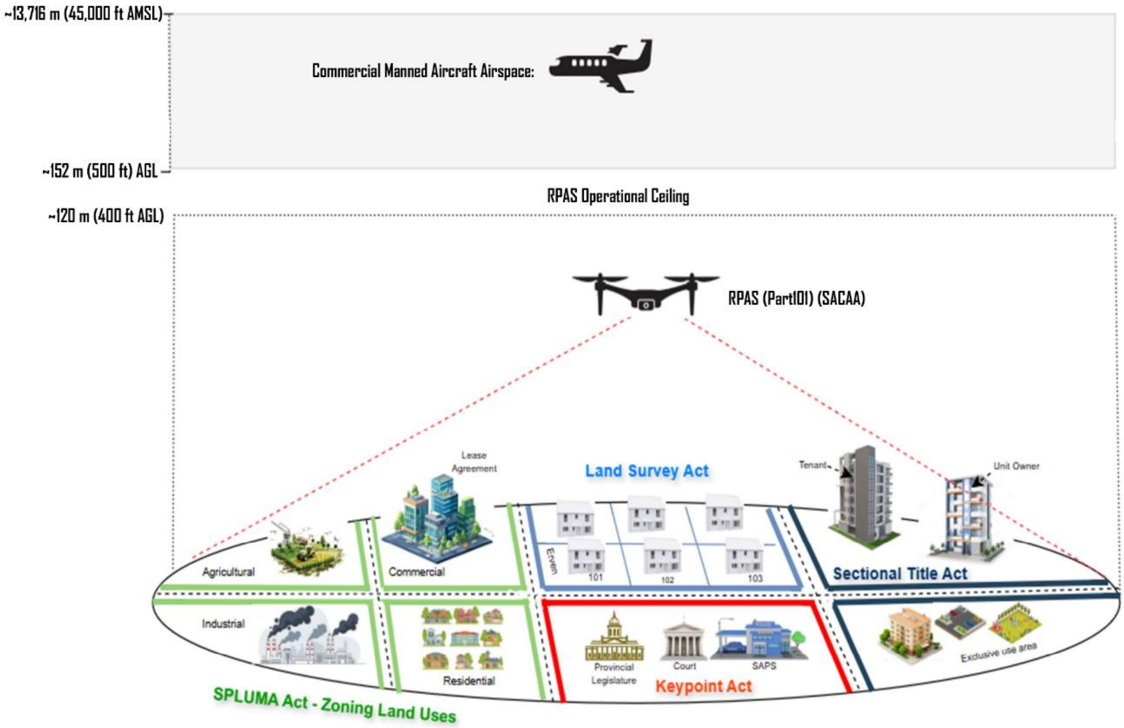


*Figure 1: Conceptual overview of regulatory and spatial constraints shaping UAV flight planning in South Africa (airspace, property rights, environmental and privacy considerations).*

South African regulatory instruments shaping UAV operations and geomatics practice. In addition to the statutes analysed in the methodology section, UAV-enabled geomatics in South Africa is shaped by a set of cross-cutting aviation, privacy, and environmental instruments that directly affect flight planning, operational permissions, and downstream handling of captured data:

1. Civil Aviation Regulations (CARs), Part 101 (UAS): Part 101 constitutes the primary aviation regulatory basis for unmanned aircraft operations in South Africa. It sets operational and administrative requirements relevant to flight planning (e.g., safety obligations, operational limitations, operator responsibilities, and airspace compliance), and provides the regulatory basis for approvals where operations exceed baseline conditions.
2. Remote Pilot Licence (RPL) requirements: Depending on the class and nature of operation, operators may be required to hold an RPL, reflecting competency requirements in air law, flight planning, and operational procedures. From a geomatics practice perspective, this requirement influences who can lawfully conduct surveys and under what operational conditions.
3. Airspace restrictions and controlled-area permissions: UAV operations are constrained near aerodromes and within controlled airspace, where permission from the SACAA (and, where applicable, relevant air navigation services) is typically required. Strategic

and sensitive areas may also be subject to additional restrictions, shaping feasible flight corridors and mission design.

4. Protection of Personal Information Act: While not UAV-specific, POPIA is central where UAV imagery or video constitutes personal information (e.g., identifiable individuals, private premises in context). POPIA therefore introduces governance requirements for collection, storage, processing, and dissemination of UAV-derived data, and is critical for managing privacy risk in geomatics workflows.
5. Specific operating permissions for advanced operations: Higher-risk operations, such as certain commercial activities, operations beyond visual line of sight (BVLOS), or other non-standard profiles, typically require explicit approvals/permissions. These requirements affect project timelines, operational feasibility, and liability allocation in UAV-enabled surveying.
6. National Environmental Management: Protected Areas Act (NEMPAA): UAV operations in protected areas (e.g., national parks and conservation areas) often require additional permissions to mitigate disturbance to wildlife and sensitive ecosystems. This becomes relevant where geomatics work is conducted for environmental monitoring, conservation mapping, or infrastructure planning near protected areas.

This set of instruments provides the immediate compliance envelope for UAV flight planning and data capture, and it interacts with the broader legislative framework assessed later in the paper (property rights, professional practice, spatial data governance, and planning).

This paper evaluates the extent to which selected South African legislative and regulatory instruments enable (or constrain) compliant UAV-enabled geomatics and drone flight planning, and identifies specific regulatory gaps that increase operational, legal, and societal risk. The study develops and applies a structured legislative assessment framework to derive amendment-ready recommendations grounded in safety, privacy, security, professional liability, and land administration practice.

This would be conducted based on three objectives: (i) to define a transparent set of evaluation criteria for assessing how non-aviation legislation affects drone flight planning and geomatics workflows; (ii) to evaluate selected South African Acts that frequently intersect with geomatics-oriented drone use; and (iii) to propose targeted, evidence-informed amendments or implementation guidance that reduce ambiguity while protecting safety, privacy, and national security.

The manuscript's contribution is primarily methodological and analytical. The evaluation criteria are made explicit, applied consistently across the selected instruments, and used to synthesise where the regulatory framework provides clear operational guidance, where it is ambiguous or silent, and where material compliance gaps arise in representative UAV-enabled survey and mapping scenarios.

## 3 THEORETICAL FRAMEWORK

This study adopts a risk-based regulatory governance lens to evaluate whether existing legal instruments adequately enable lawful, safe, and socially acceptable UAV (drone) operations in geomatics practice. Under this lens, legislation is assessed not only for the presence of relevant provisions, but for how effectively it mitigates identifiable risks associated with UAV deployment. The analysis therefore operationalises a consistent set of evaluation criteria that link regulatory gaps to practical risk and to appropriate mitigation instruments (e.g., amendment to primary legislation, subordinate regulations, standards/guidelines, or institutional procedures).

The framework treats a "regulatory gap" as any feature of the legal environment that creates uncertainty or undermines compliance in practice. Four gap types are used throughout the paper:

- **Omission**: a relevant issue is not addressed (e.g., no clear rule for a common operational scenario).
- **Ambiguity**: the rule exists but is unclear or difficult to interpret consistently.
- **Misalignment/conflict**: provisions across instruments impose inconsistent obligations or create duplicative/contradictory requirements.
- **Outdated assumptions**: the instrument presumes workflows, technologies, or operational contexts that no longer hold for UAV-enabled surveying.

Each identified gap is then linked to a risk statement describing how the gap can manifest during flight planning, data capture, processing, or dissemination in typical UAV mapping and survey projects.

### 3.1 Risk domains relevant to UAV-enabled geomatics

The need for risk-calibrated legal frameworks that balance enabling benefits with safety, privacy, and liability concerns is well established in the drone law literature (Smith, 2015). Consistent with common concerns raised in the drone governance literature, particularly around small and micro-drones and their accessibility, the framework evaluates legislation across five risk domains that are directly relevant to geomatics practice (Clarke & Bennett Moses, 2014; Zenz, 2023):

1. Aviation safety and airspace governance: risks arising from unsafe operations, inadequate separation from manned aircraft, and non-compliance with operational limitations and approvals.
2. Privacy and data protection: risks linked to capturing imagery or other geospatial data that can identify individuals or reveal sensitive private information, including downstream processing and sharing (Finn & Wright, 2016).
3. Security and misuse: risks of malicious or unlawful uses (e.g., surveillance of critical infrastructure, illicit activity), and the adequacy of restrictions in sensitive contexts.
4. Property and access rights: risks associated with operating from, over, or near private or controlled land, including consent, liability, and disputes regarding lawful access.
5. Professional accountability and evidentiary integrity: risks affecting the reliability, auditability, and accountability of UAV-derived survey products when used for land administration, engineering, or cadastral purposes.

These domains provide the analytical basis for the evaluation criteria applied later in the paper and ensure that recommendations are grounded in clearly articulated hazards rather than presented as generalised "wish lists".

### 3.2 Contextual grounding and institutional practice

The framework is applied in the South African context, where UAV adoption is increasingly visible in public-sector workflows. For example, the eThekwini Municipality City-Wide Drone Strategy presents a structured approach to deploying drones for municipal functions such as disaster response, infrastructure monitoring, environmental management, and the production of geospatial information for GIS-enabled planning and governance (eThekwini Municipality, 2023). This illustrates that drone use in urban governance is not hypothetical, it is already embedded in operational systems that depend on legal clarity and institutional accountability.
A second contextual strand relates to data governance and stewardship. Heimann (2023) proposes a model for strengthening geospatial data ecosystems through decentralised, community-oriented data hubs and improved local ownership of geospatial information. While not a legislative proposal, this perspective reinforces why regulatory coherence matters beyond flight permissions: UAV-enabled geomatics also raises questions of data stewardship, interoperability, and responsible use, issues that become salient when UAV products are integrated into spatial data infrastructures and land administration processes.
Sectoral uptake also underscores the need for regulatory clarity. (Hogan et al., 2017) describe the rapid expansion of UAS applications in domains such as agriculture and environmental monitoring, signalling that regulatory frameworks must keep pace with evolving operational realities. In the present study, this motivation is translated into a structured assessment that asks whether the legal framework provides sufficiently clear and coherent requirements to manage safety, privacy, and accountability risks while enabling legitimate geomatics applications.

### 3.3 Implications for the legislative evaluation

The theoretical framework is used as a rubric for the legislative evaluation: each instrument is assessed against the stated risk domains and gap types, and findings are synthesised into gap - risk - mitigation statements. The analysis also recognises that legal governance operates as an integrated system; therefore, cross-cutting obligations (especially privacy and confidentiality) are considered in relation to overarching frameworks and not assumed to require duplication within each sector-specific Act. Finally, consistent with stakeholder-oriented public policy approaches, the framework recognises that durable regulatory reform depends on multi-stakeholder engagement across aviation authorities, geomatics professionals, data custodians, municipalities, and affected communities (Hutahaean, 2017).

## 4 METHOD AND ANALYTICAL FRAMEWORK

Each instrument is assessed against a common set of criteria reflecting typical compliance checkpoints in a UAV-enabled geomatics mission. Similar operational-policy framings have been used in geomatics contexts to connect UAV regulation to practical compliance questions (Riopel et al., 2015). The criteria are used to: (a) identify provisions that directly constrain flight planning or downstream data handling; (b) diagnose ambiguity, duplication, or misalignment across instruments; and (c) support recommendations that distinguish between legislative amendment (where statutory clarity is required) and implementation guidance (where the legal basis exists but practice is inconsistent).

A structured document-analysis approach (doctrinal and policy review) is applied to examine how legislative provisions translate into practical compliance requirements for geomatics-oriented drone flight planning. The source set comprises primary legislation, associated regulations, and selected organisational policy documents and guidelines where they clarify implementation.

The evaluation followed four steps: (1) identification and extraction of provisions relevant to UAV-enabled geomatics and flight planning (permissions, restrictions, responsibilities, and data governance requirements); (2) coding of extracted provisions against the criteria in Table 1; (3) classification of each issue by gap type (omission, ambiguity, duplication, misalignment/conflict, or outdated assumption); and (4) synthesis of findings into gap-risk-mitigation statements. For each gap, a concise risk statement is recorded (e.g., aviation safety exposure, privacy intrusion, security misuse, or accountability failure) to provide an explicit justification for the recommended remedy.

**Table 1: Legislative evaluation criteria for geomatics-oriented drone flight planning.**

| Criterion | What is assessed | Typical compliance question |
|---|---|---|
| **Operational authority** | Whether the instrument creates permissions/approvals affecting UAV missions | Is an approval/authorisation required before data capture? |
| **Safety & restricted areas** | Restrictions around aerodromes, controlled airspace, and sensitive/regulated locations | Does the mission intersect with restricted, controlled, or strategically sensitive areas? |
| **Security & misuse** | Prohibitions/controls addressing surveillance, critical infrastructure sensitivity, and misuse | Could the mission enable misuse or surveillance, and what controls/prohibitions apply? |
| **Privacy & lawful processing** | Rules affecting collection/processing of personal information (imagery/video) | Could the mission capture identifiable individuals, and what safeguards apply? |
| **Property & access rights** | Requirements relating to consent/access for launch/landing and operations near private premises | Is consent/access required for launch/recovery or operation over/near private premises? |
| **Data governance & standards** | Requirements for accuracy, metadata, custodianship, retention, and sharing | How must data be documented, stored, and shared to be usable and traceable? |
| **Professional accountability** | Roles/responsibilities of practitioners and quality assurance expectations | Who is accountable for correctness, integrity, and legality of outputs? |

The outputs of this method are a set of instrument-level assessments and a cross-instrument synthesis that summarises (i) the applicable provisions, (ii) identified gaps and their practical implications, and (iii) a justified mitigation pathway (statutory amendment versus implementation guidance). The analysis is conducted with a whole-of-framework perspective to identify where cross-cutting obligations are already addressed in broader law and where sector-specific clarification is genuinely required. These outputs structure the legislative evaluation and findings presented in Section 5.

# 5 LEGISLATIVE EVALUATION AND FINDINGS

This section applies the criteria in Table 1 to selected Acts and related instruments that commonly intersect with geomatics drone missions as depicted in *Figure 1*. For each instrument, we summarise (a) relevance to drone flight planning and/or data handling, (b) practical compliance implications, (c) observed gaps, and (d) targeted recommendations.

## 5.1 Land Survey Act (Act No. 8 of 1997)

Relevance. The Land Survey Act regulates surveys of land in the Republic, including standards for accuracy, approval, and submission to the Surveyor-General. When drone-derived products are used to support cadastral decisions (e.g., boundary evidence, control verification, or official mapping), the Act becomes a central accountability and quality-assurance layer.

Key compliance implications:

- Drone-based surveys intended for legal or cadastral use should be undertaken under the supervision and sign-off of a professional land surveyor.
- Quality assurance should demonstrate that drone-derived measurements meet prescribed accuracy and error limits, with traceability to control.
- Submission and archiving procedures should clarify how drone-derived datasets and processing reports are packaged for Surveyor-General review.

Targeted recommendations (statutory / regulatory clarification):

- Section 1 (Definitions): include definitions for drone/UAS and aerial surveying outputs used for survey evidence.
- Regulations on field measurements and allowable error: add explicit guidance for UAS-derived observations (control, calibration, accuracy reporting, and audit trail).
- Surveyor-General testing powers: explicitly include verification of UAS survey products and associated metadata.

Illustrative example. A drone orthomosaic and point cloud used to support a boundary re-establishment should be accompanied by a processing report documenting GCP/control, camera calibration, error statistics, and datum definition so that the Surveyor-General can audit fitness-for-purpose.

## 5.2 National Key Points Act (Act No. 102 of 1980)

Relevance. Drone missions for geomatics may involve imagery capture over or near strategic infrastructure (e.g., utilities, transport nodes, or government sites). Where a site is designated as a national key point, additional security restrictions can apply that affect whether flights and data capture are permitted.

Key compliance implications:

- Flight planning must screen for proximity to strategic or security-sensitive sites and confirm applicable restrictions and permissions.
- Data products (imagery/video) may be subject to limitations on dissemination where they reveal sensitive infrastructure details.

Observed gap. In practice, operators may be uncertain about how key-point considerations integrate with aviation authorisations and municipal permissions. A harmonised guideline (SACAA + security authorities + relevant custodians) would reduce ambiguity for legitimate survey and inspection work. This is consistent with broader governance arguments that UAV regulation in sensitive contexts must move beyond airspace safety and generic privacy compliance to address legitimacy, accountability, and proportionality in surveillance-adjacent uses and the downstream handling of imagery (Dolata & Schwabe, 2023).
Illustrative example. A routine bridge-inspection mission may be technically authorised under SACAA approvals, yet still be unlawful if it captures high-resolution imagery of a designated strategic facility without the required security clearance and dissemination controls; the compliance failure arises at the security–data layer rather than the aviation layer.

### 5.3 Sectional Titles Act (Act No. 95 of 1986) and privacy considerations

Relevance. Drone operations in sectional title schemes raise privacy and co-ownership concerns, especially where flights occur over common property and capture imagery of private spaces. While confidentiality and lawful processing are primarily addressed through the Protection of Personal Information Act (POPIA) and common-law privacy, sectional scheme governance (management rules and body corporate decisions) influences what is practically permissible on-site.
Key compliance implications:

- Operators should obtain permission from the body corporate (or relevant authority) for take-off/landing on common property and for activities that could reasonably impact residents' privacy.
- Data-handling safeguards should be explicit (purpose limitation, secure storage, controlled sharing), particularly for video or high-resolution imagery.

Refined recommendation. Rather than duplicating privacy provisions in the Act, clearer practice guidance should be incorporated into scheme rules/by-laws (or standard management rules) to define permissions, notice requirements, and acceptable use cases for drones in communal properties.

### 5.4 Spatial Data Infrastructure Act (Act No. 54 of 2003)

Relevance. The SDI Act establishes governance for spatial information standards, metadata, custodianship, and access. Drone-collected datasets used by public entities, or shared into national or municipal spatial data infrastructures, must be curated to meet interoperability and traceability expectations.
Key compliance implications:

- Drone datasets should be accompanied by complete metadata describing provenance, accuracy, processing workflow, coordinate reference system, and usage constraints.
- Where data are shared, custodianship and access rules should address privacy and sensitivity (e.g., restricted access for sensitive infrastructure imagery).

Targeted recommendations:

- Section 11 (Standards): explicitly include UAS-derived data products and minimum metadata/quality reporting for common outputs (orthomosaics, point clouds, DSM/DTM).
- Section 12 (Metadata): specify UAS-relevant metadata fields (sensor, GSD, flight parameters, control strategy, processing software/version, and accuracy reporting).

### 5.5 Spatial Planning and Land Use Management Act (SPLUMA) (Act No. 16 of 2013)

Illustrative example. If a municipality ingests an orthomosaic for infrastructure planning, the dataset should include metadata capturing sensor type, ground sampling distance, control strategy, processing workflow and versioned software outputs, and accuracy statistics so the product can be audited and reused across departments.

Relevance. SPLUMA does not regulate aviation or airspace, but it shapes the planning context in which drone-derived spatial data are collected and used. In practice, geomatics drone missions often support land-use applications, compliance monitoring, or municipal planning evidence, and therefore intersect with municipal planning procedures and access to sites. In practice, this linkage is mediated through municipal permissions/by-laws and the evidentiary use of drone products in planning processes.

Key compliance implications (clarifying the linkage):

- Municipal access permissions for take-off/landing or surveying activities on municipal land may be tied to planning approvals and land-use rights.
- Drone-derived evidence used in planning processes should be defensible (data governance, metadata, and purpose specification) to reduce disputes in approval/appeal contexts.
- Sensitive zones (e.g., conservation or heritage areas) may introduce additional permitting layers through municipal by-laws or environmental legislation.

## 6 CONCLUSION

The analysis demonstrates that geomatics-oriented UAV flight planning compliance in South Africa is best understood as an interacting set of legal layers, aviation safety and airspace governance, security restrictions around strategic sites, privacy and co-ownership controls, and spatial-data standards and custodianship requirements. Applying explicit evaluation criteria enables a transparent comparison across instruments and anchors recommendations in identifiable gap types (omission, ambiguity, and cross-instrument misalignment), reducing the risk of presenting reforms as an unmotivated “wish list”.

The legislative evaluation highlights three priority areas. First, under the Land Survey Act and associated regulations, the primary gap is insufficiently explicit guidance on how UAS-derived survey products should be documented, validated, and submitted for audit, which creates avoidable uncertainty over evidentiary adequacy and professional accountability in cadastral and legal contexts. Second, where security restrictions intersect with lawful survey and inspection work, the main challenge is practical misalignment between aviation permissions and security/data dissemination controls; harmonised guidance would reduce inadvertent non-compliance while safeguarding sensitive sites. Third, for drone-derived spatial data products, the SDI framework requires stronger and more specific metadata and quality prescriptions to support interoperability, traceability, and lawful access decisions, particularly where datasets may be sensitive or privacy-implicating. In sectional title environments, the analysis suggests that risk is best managed through POPIA-aligned data handling and scheme-level operational rules, rather than duplicating privacy provisions in specialist statutes.

Future work should extend the instrument set (including POPIA-related implementation and enforcement practice, municipal by-laws, and sectoral policies) and test the criteria on additional empirical cases beyond a single municipality, thereby strengthening generalisability and supporting the development of implementation-ready guidance for stakeholders.

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## BIOGRAPHICAL NOTES

Luvo Qumba is a Geospatial Professional with more than 10 years of experience in the Geospatial sciences. He is a seasoned professional with a rich academic foundation in Geomatics and a well-established track record spanning various facets of this dynamic field. With over a decade of dedicated experience, he consistently showcases exceptional leadership and technical prowess, enabling him to thrive in diverse roles, including lecturing, consulting, and overseeing extensive geospatial projects. His educational journey includes a Bachelor of Science (BSc Hons) in Geomatics from the University of Cape Town. He is a registered Professional Land Surveyor and Sectional Title Practitioner. His primary professional focus revolves around his role as Manager for Photogrammetry, specializing in LiDAR and Ortho Imagery, and Manager (GIS Projects), focusing on tailor-making GIS solutions for internal business units at eThekwini Municipality. In these capacities, he has formulated a City-wide Drone Strategy and is actively working on its policy implementation. He is also a Licensed Drone Pilot.

Siphiwe Mphuthi is a Senior Lecturer in the Division of Geomatics at the University of Cape Town (UCT). With a rich academic foundation in Geomatics and a well-established track record spanning various facets of this dynamic field. With more than 14 years of dedicated experience, he consistently showcased exceptional leadership and technical prowess, enabling him to thrive in diverse roles, including lecturing, consulting, and overseeing extensive geospatial projects. He holds a PhD in Geomatics, an MSc (Eng) in Geomatics, and a BSc in Geomatics, and is a registered Professional Land Surveyor and Sectional Title Practitioner with SAGC. His research focuses on physical geodesy, with particular emphasis on gravimetric geoid modelling, vertical datum realisation, and the modernisation of horizontal and vertical geodetic reference frames, including gravity data adjustment and analysis.

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