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South African legislation pertinent to building practice: A review in the context of inherent dolomite land hazard

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Abstract— *Dolomite land occurs across five of the nine South Africa provinces and its vast occurrence and distribution makes it difficult to avoid when planning for building projects. Such terrains are generally associated with the formation of ground instability events (sinkholes & subsidences) causing widespread damage to infrastructure or loss of life. Under section 24 of the Constitution of South Africa, (Act 108 of 1996), safe environment and protection thereof has been elevated to a basic human right. In the context of safe land use planning and sustainable infrastructure development, more particularly post-1994, a series of statutes have been promulgated to provide a legislated framework for building practice in South Africa.*

The National Building Regulations and Building Standards (Act 103 of 1977) as amended, and the current National Building Regulations (NBR's), have been promulgated to promote uniformity in the law relating to the erection of buildings in South Africa including prioritizing safe land for human settlement. A key principles is that if conditions of the land on which a building was or is being or is to be erected, shows signs of becoming dangerous to property and/ or life, such conditions must be investigated and secured. However, there seem to be challenges in the practical implementation.

This paper therefore presents a review into the legislation pertinent to building practice to identify possible gaps, implementation challenges and damaging effects due to inappropriate development of dolomite land. The research further scrutinizes an influence or lack thereof, of the technical requirements aimed at ensuring sustainable development on geologically hazard prone terrains.

Keywords— ***dolomite land, hazard, legislation, implementation, negative effects.***

I. INTRODUCTION

The local and international experience has demonstrated that advancement in scientific knowledge and strict implementation of legislated disaster mitigation measures have the potential to encourage safe development of geologically unsuitable areas like dolomite (karst) land.

In South Africa, the term "Dolomite Land" refers to areas underlain directly or at shallow depths (<100 m) by karst, e.g. dolomite rock of the Chuniespoort and Ghaap Groups of the Transvaal Supergroup. It includes areas where dolomite is covered by younger deposits of Pretoria Group and Karoo Supergroup or unconsolidated deposits of the Cenozoic age (Buttrick et al, 2001). Dolomite land has a negative connotation due to its association with damaging effects of sinkhole and subsidence formation (Buttrick et al, 2001).

Random occurrence of these ground instability events in densely populated urban areas is costly and may result in damage to infrastructure and in extreme cases the forced relocation of communities or even loss of life (Brink, 1979). According to Guitierrez et al. (2014), impacts and hazards associated with karst are rapidly increasing as development expands upon these areas without proper

planning taking into account the inherent hazards associated with these environments. However, avoiding development on such land is practically impossible given its distribution across five of the nine provinces in South Africa. Buttrick et al. (2011), stated that between 4 and 5 million South Africans reside or work on dolomite land, and that the costs to repair karst features far exceeds the cost of implementing appropriate annual dolomite risk management and maintenance interventions.

It is in this context therefore, that this research considered a review into the South African legislation pertinent to building practice and its influence or lack thereof, to sustainable development of cities on geologically hazard prone terrains like dolomite land.

II. OCCURRENCE AND DISTRIBUTION OF DOLOMITE LAND

According to Ford and Williams (1992), sinkholes are the most diagnostic surface expression of karst landscapes and can be found extensively throughout the world (approximately 7–10% of the earth land surface has been classified as karst terrain).

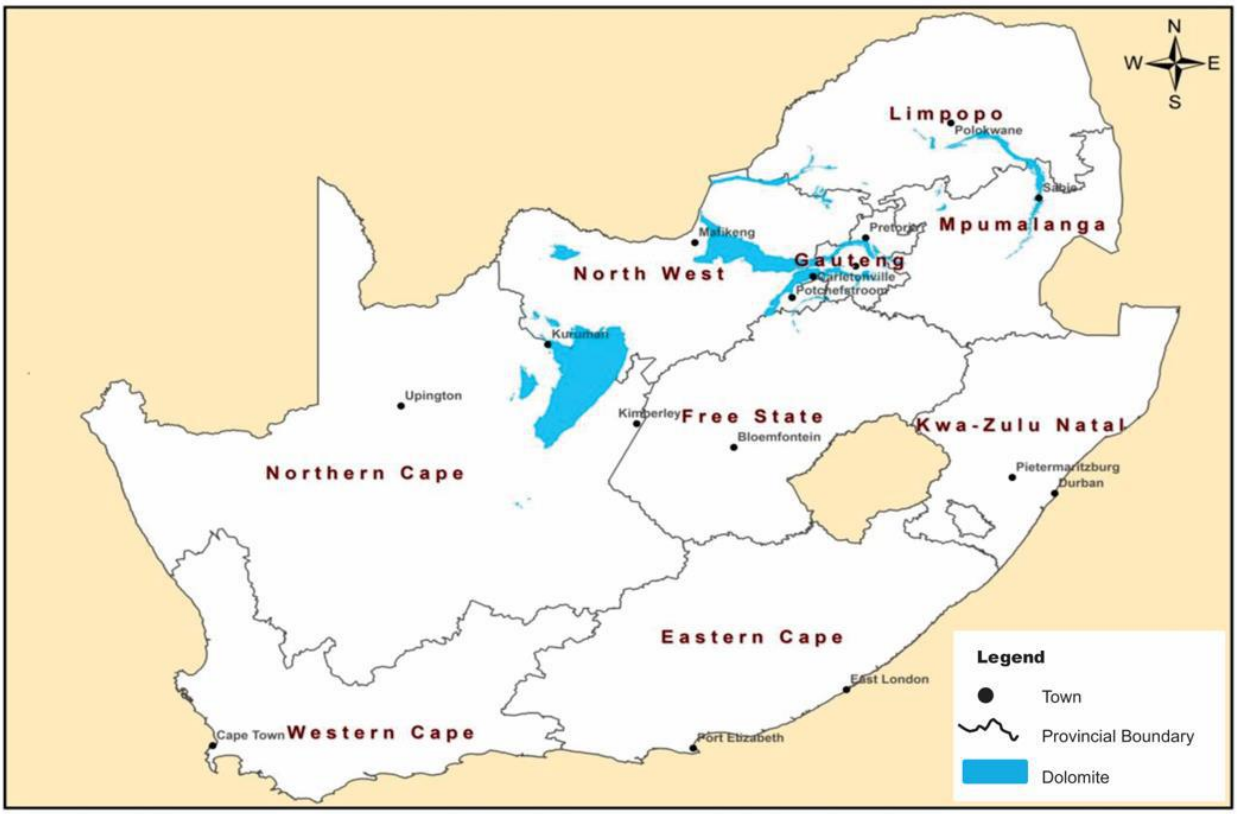

Fig.1: The occurrence and distribution of dolomite land in South Africa (© CGS,2013)

Given the dolomite land distribution, therefore, avoiding it is not practically possible. However, undue acceptance of the risk is also not an option subject to the state's obligation in terms of the Constitution. This brings about a critical question of how the current South African building legislation has influenced the sustainable land use planning and infrastructure development on dolomite land including mandatory reporting of ground instability events.

III. REVIEW OF THE BUILDING LEGISLATIVE FRAMEWORK

3.1 The Consitution – Protection of Basic Human Rights

Section 24 of the South African Constitution (Act 108 of 1996), affords all South Africans the right to an environment that is not harmful to their health or well-being, and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures. This is a legislative obligation of the state to its citizens. In the broader context of creating safer environment for the citizens, the local authorities (municipalities) have a mandate to deliver basic services (housing, roads, water, etc.) in a sustainable manner and ensure adherence to disaster risk reduction principles. A selected list of critical statutes is presented in Fig. 2.

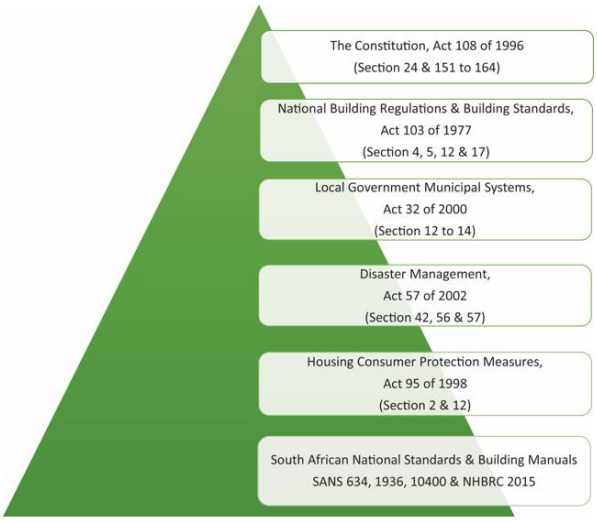

Fig.2: A selected list of critical statutes governing the building practice in South Africa.

In terms of Section 151(2), the executive and legislative authority of a municipality is vested in its Municipal Council and Section 151 (3) further state that a municipality has the right to govern, on its own initiative, the local government affairs of its community, subject to provincial and national legislation. Municipal status, objectives, duties and categories are prescribed in Section 151 to 164 of the Constitution. Therefore, municipalities have the executive and legislative authority to ensure that their communities are not exposed to an environment that is harmful to their health or well-being.

3.2 Supporting statutes to the Consitution

To give effect to the state constitutional obligation, a series of statutes have been promulgated to provide a legislative framework within which building practice operates in South Africa and their legislative intent are as follows:

- The National Building Regulations and Building Standards (Act 103 of 1977 – NBRBS), as amended is the principal building law in South Africa with a primary objective to promote uniformity in the law relating to erection of buildings.
- Local Government Municipal Syatems (Act 32 of 2000 - LGMS), provide for the core principles, mechanisms and processes that are necessary to enable municipalities to move progressively towards the social and economic upliftment of local communities, and ensure universal access to essential services.
- Housing (Act 107 of 1997), provide for the facilitation of a sustainable housing development process; for this purpose to lay down general principles applicable to housing development in all spheres of government.
- Disaster Management (Act 57 of 2002 – DM), provide for an integrated and co-ordinated disaster management policy that focuses on preventing or reducing the risk of disasters, mitigating the severity of disasters, emergency preparedness, rapid and effective response to disasters and post-disaster recovery.
- Housing Consumer Protection Measures (Act 95 of 1998 – HCPM), make provision for the protection of housing consumers; and to provide for the establishment and functions of the National Home Builders Registration Council; and to provide for matters connected therewith.
- Infrastructure Development (Act 23 of 2014 – ID), provide for the facilitation and co-ordination of public infrastructure development which is of significant economic or social importance to the Republic, to ensure that infrastructure development in the Republic is given priority in planning, approval and implementation.
- Standards (Act 8 of 2008), provide for the development, promotion and maintenance of standardization and quality in connection with commodities and the rendering of related conformity assessment services. This act provide the basis for the compilation and publication of national standards.

IV. CHALLENGES FACING THE BUILDING LEGISLATION

4.1 The Building Legislation and Regulatory Process

Various sections of Act 103 of 1977, provide the basis for the establishment of regulatory process(es) in the building practice. In the context of regulating the building process, Section 4 stipulates that "*no persons shall without prior approval by local authority, erect any building*", Section 5 states that "*local authority shall appoint a person as building control officer*", Section 12 states that "*if conditions of the land poses danger to life or property, such condition must be investigated and secured*" and finally, Section 17 *"provide for the establishment/ publication of the National Building Regulations (NBRs)*".

The NBRs stipulates functional requirements that the proposed design or construction of the building must satisfy prior to approval by the local authority. According to the current deemed-to-satisfy standard for development of dolomite land, the South African National Standard

(SANS) 1936:2012, "An application for land use rights, made to any relevant authority, shall include a sufficient level of information to provide confidence in the presented determinations" and "The philosophy to be applied in the design of the foundations is that there shall be sufficient structural integrity and stability to allow occupants to safely escape in the event of sudden loss of support below the foundations of the structure". This is based on the requirement to identify a hazard, determination of an Inherent Hazard Class (IHC), selection of permissible land use types and appropriate risk mitigation measures for each dolomite site to be developed.

South Africa's past experience on the impact of sinkhole and subsidence formation has enabled the formulation of scientifically based building principles. These principles are detailed in scientific publications like Jennings et al. (1965), Brink (1979), Buttrick and van Schalkwyk (1995), Buttrick et al. (2001) and Buttrick et al. (2011), and have since been adopted into the relevant deemed-to-satisfy standards like SANS 1936 and SANS 10400. These are published under the Standards (Act 8 of 2008), giving them the mandatory status. In addition, the National Home Builders Registration Council (NHBRC) has been established under Section 2 of the Housing Consumer Protection Measures Act (Act 95 of 1998) to ensure added protection of housing consumers. Section 12 of this act states that the NHBRC must publish a Home Building Manual containing technical requirements and guidelines with which registered home builders shall comply, i.e. Part 13 of the NHBRC 2015 Home Building Manual.

The current South African building regulatory system is generally a "Performance-Based System" in nature and it prescribes a set of principles needed to satisfy the functional requirements. Deemed-to-satisfy standards define the technical requirements (investigation, analysis, mitigation measures and risk management, design and construction methods) for a building project to satisfy, which if enforced and complied with, will ensure adherence to functional requirements and ultimately, the protection of basic human rights. Watermeyer et al (2008) described a four level performance based regulatory system which has formed the basis for the development of a national standard for the development of dolomite land. A summary of the current performance-based building regulatory system in as far as it relates to building on dolomite land is presented in Fig. 3.

The challenge is however that not all areas are the same in terms of the geological, geotechnical, hydrological or climate conditions that may influence impact of sinkholes and subsidence formation, and neither are all areas equal in terms urbanisation or development density. Accordingly, Section 4 and 12 of the Act 107 of 1977 establish a single building approval authority (the local sphere of government) aimed at ensuring consistent compliance to the functional requirements to investigate dangerous ground conditions. Furthermore, Section 5 gives only the local sphere of government the authority to a person "building control officer" to administer the NBRs functional requirements, and control the on-site activities on building projects within their area of jurisdiction. In this context, only the local sphere of government has the executive and legislative authority to approve building projects or enforce the NBRs.

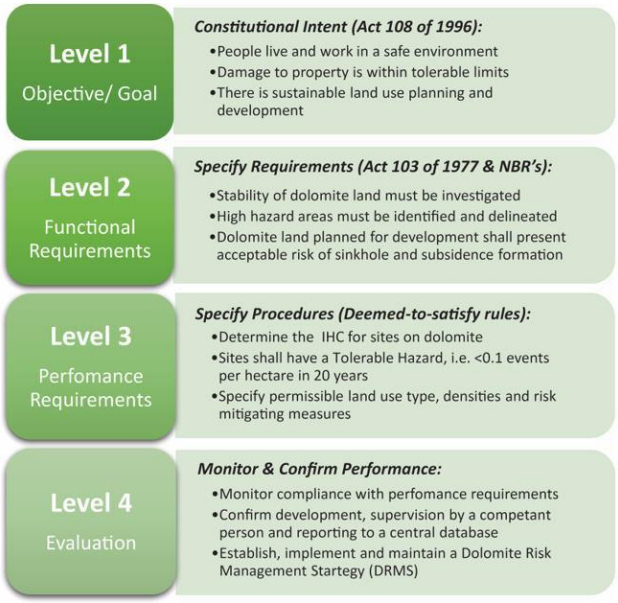

Fig.3: Summary of a performance-based regulatory system (modified from Watermeyer et al., 2008)

However, other provincial and national departments including private entities may implement "Strategic Integrated Projects (SIPs)" under the Infrastructure Development (Act 23 of 2014) without prior consultation or approval by the local authority. Therefore, this duplication of responsibilities in the building regulatory process suggests that the current legislative framework contains some gaps and/ or conflicting legislative authority. In practice, this may lead to a dereliction of some building functional requirements as stipulated in the NBRs, which could potentially give rise to implementation challenges and negative effects due to inappropriate development on geologically hazard prone areas including dolomite land.

4.2 The Building Legislation and Regulatory Gaps

Despite the constitutional intent in terms of Section 24 of the Constitution and Section 12 of Act 103 of 1977 to give effect to the constitutional principles as these relates to safe erection of buildings or a requirement to investigate dangerous land conditions, but there are problems in the

building practice. These problems are characterised by either inconsistent enforcement of the NBRs functional requirements at the decision making level and/ or the duplication of responsibilities in the building regulatory process.

For example, the deemed-to-satisfy rules like those stipulated in SANS 1936 or NHBRC 2015 Home Building Manual are generally not enforced during the formulation of Integrated Development Plans (IDPs) by the relevant state authorities. This often leads to the proclamation of townships on geologically hazard prone terrains without prior due considerations of the prevailing ground conditions. A review into the pertinent building legislation, therefore, suggests that there are gaps in the current building legislation and regulatory process as summarised in a schematic representation, Fig. 4.

In broad terms, the acceleration or exemption of the SIP's from the normal building regulatory process suggests possible omission of some functional requirements as stipulated in the principal building law. As such, the building practice is exposed to a risk of having building projects endorsed under the provisions of the Act 23 of 2014 and without prior due considerations of the possible dangerous ground conditions.

However, SIPs are not the only building projects implemented under an accelerated approach, subsidy housing built under the Reconstruction and Development Programme (RDP) are often exempted from adhering to the normal building regulatory process because political targets often supersedes the legislative intent, especially during election periods.

Therefore, the dereliction of a legislative intent across all spheres of government based on economic, social or political importance has the potential to render NBRs functional requirements redundant. Such gaps in the regulatory process could mean that, although the pertinent building legislation prescribes necessary functional requirements for civil engineering or building projects, but in practice, infrastructure and human exposure to risks associated with development of geologically hazard prone terrains, including dolomite land, is not adequately addressed.

4.3 The Building Legislation and Implementation Challenges

The past building legislation failed to force the state to invest into the geological or geotechnical studies aimed at reducing the impact of disaster risks on geologically hazard prone areas earmarked for development. In reality, the problem still persists today meaning that the current constitutional intent to articulate societal needs and expectations is deferred. Geological unsuitable areas are being developed without prior due considerations of the prevailing ground conditions. This situation has created and continues to create hostile legacies for citizens to bear and the State to address. In the context of safe development of dolomite land, Buttrick et al. (2001), published a modified version of the "Method of Scenario Supposition", which has since been adopted into the SANS 1936 for development of dolomite land. This method requires that a hazard be identified, associated risk assessed and quantified, i.e. Inherent Hazard Class (IHC 1-8) and a D-Classification (D1-D4) be assigned prior to a decision on appropriate development types on dolomite land.

SANS 1936 demonstrates great scientific advancements which strive to bridge the gap between the existing scientific knowledge and the applicable legislation for consideration during the compilation of IDPs driving the spatial planning process.

According to SANS 1936 any organisation, department, state entity or individual owner that develops a parcel of dolomite land shall ensure compliance with the provisions of the relevant sections in Part 4.

Therefore, there is a need to discuss possible sources for non-compliance to functional requirements and to evaluate how these can be managed. As such, the capacity (fiscal & technical) of the approving organs of state and local authorities to implement NBRs functional requirements needs urgent attention and any identified capacity gaps must be addressed. As discussed above, building legislation in its current form is not particularly effective when used for decision making in land identification for development and is not responsive to pre- and post-developmental requirements for geologically hazard prone terrains.

This results in authorities identifying terrains like dolomite land unsuitable for certain land use types where risks cannot be economically mitigated years after a completed construction phase. However, avoiding dolomite land for development is also not an option. In practice, lack of consistent implementation of building legislation is considered to emanate from challenges set out in Table 1.

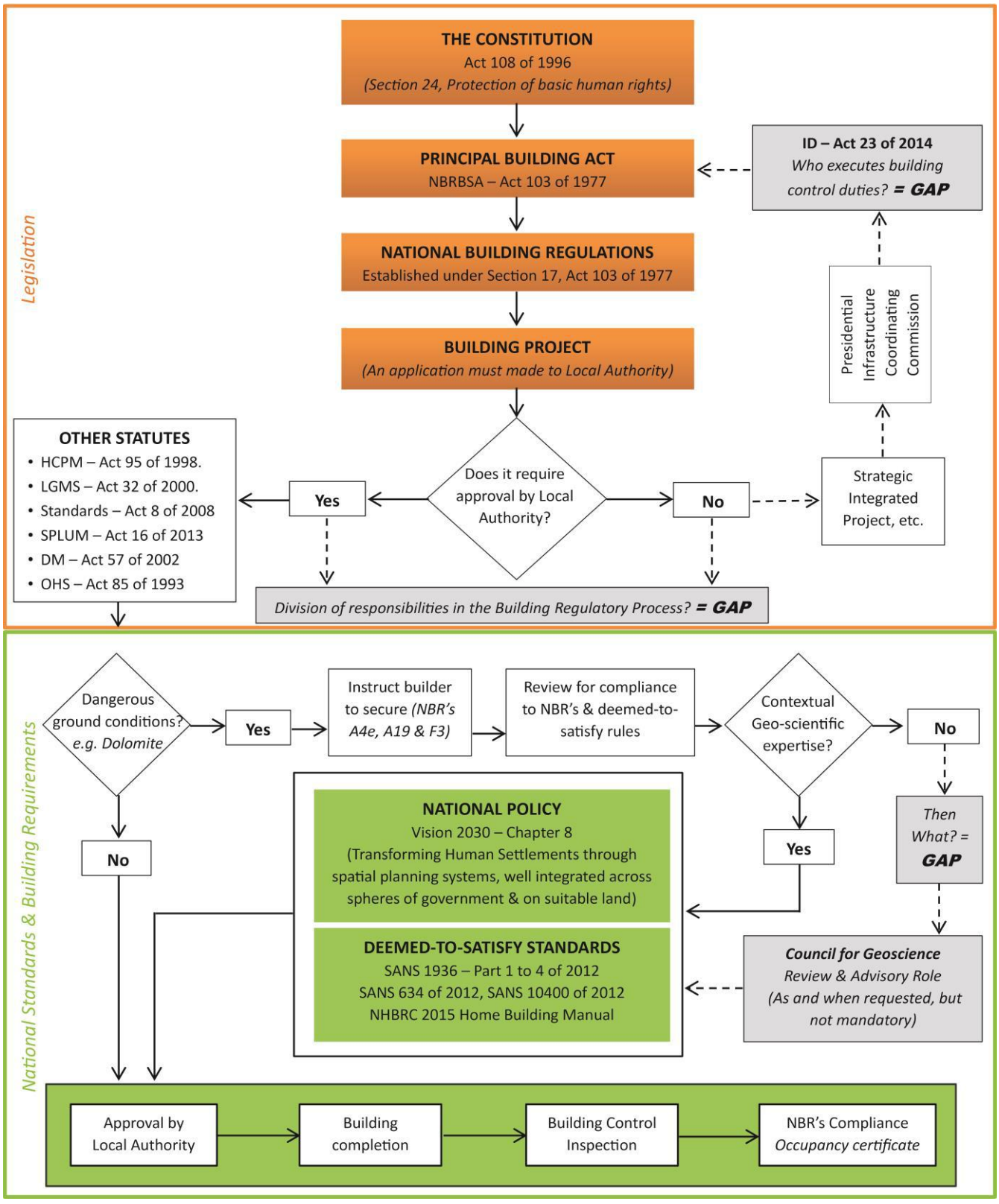

Fig.4: Summary of the building legislation and regulatory process

4.4 The Building Legislation and Damaging Effects

According to Buttrick et al. (2011), 4 to 5 million South Africans reside or work on dolomite land. In addition, South Africa has 46 of its 278 (17%) municipalities either directly underlain by dolomite rock at surface or have a portion of dolomite land within their area of jurisdiction.

The latent danger of such terrain on infrastructure, including impact on the social well-being of citizens and

exposure to elevated frequency of ground instability events are well established in the scientific literature like Jennings et al, (1965), Bezuidenhout and Enslin (1969), Brink (1979), Kleywegt and Pike (1982), De Bruyn and Bell (2001) and Buttrick et al, (2001).

Buttrick et al, (2011), also refer to the relocation of a community of 30,000 households on dolomite land being relocated to safer ground in an area west of Johannesburg. Furthermore, South Africa should have gained adequate experience from the sinkhole and subsidence catastrophes of the 1960's to 1970's as detailed in Brink (1979), Wolmarans (1984 & 1996) and Richardson (2013) to justify appropriate amendments to the current building legislative framework.

Identified gaps in the legislation and implementation challenges may have contributed to the continued destruction of infrastructure in particular, due to the formation of sinkholes as shown in Fig. 5.

Table.1: Challenges prohibiting the consistent implementation of building legislation.

No.	Description of Challenge	Comment
1	Silo Practice	Lack of a broad partnership across spheres of government, departments or state entities involved in building projects.
2	Capacity	Lack of capacity (fiscal & technical) at the local sphere of government, i.e. local authority responsible for administration of the NBR's requirements, control of the on-site activities and compliance to building regulatory process.
3	Division of Responsibilities	More than one state entity or department has the legislative authority to implement building projects using the provisions of different statutes, i.e. Act 103 of 1977 versus Act 23 of 2014.
4	Political and administrative Issues	Interference by executive authority on building processes and administrative instability at key organs of state like municipalities or implementing departments could lead to the dereliction of critical regulatory requirements.
5	Public Awareness	Lack of understanding of the dolomite land by the general public (planners, policy & decision makers, developers, etc.) often leads to difficulties in regulating a building process. Any effort to regulate dolomite impacts must begin with data collection and education.

Fig.5: Examples of sinkhole impact associated with dolomite land in South Africa (© CGS Database)

V. CONCLUSION

A comprehensive legislative framework established to regulate and promote uniformity in law relating to erection of buildings including the associated infrastructure exists

in South Africa. This is in accordance with the constitutional intent to protect basic human rights and to create an environment that is not harmful to the health or well-being of the citizens. Therefore, good legislation and policies have been promulgated in South Africa post-1994. However, it is also imperative to consider that without proper implementation good legislation serves no useful purpose.

A review of the applicable legislation in the context of building practice suggests that building legislative framework in its current form contains some gaps. These may have led to the implementation challenges and the continued damaging effects to property or infrastructure as summarised in Fig. 6. Buttrick et al. (2001), stated that sinkholes are generally of limited areal extent (diameter <100 m), but can manifest within minutes and without warning. In light of the identified gaps in the building legislation and implementation issues, it is concluded that communities residing on or cities built on dolomite land without due consideration of the pertinent functional requirements may be exposed to an unexpected risk of sinkhole formation. It is also crucial to consider that avoiding dolomite land for development is not practical and therefore, amendments to the current building law, promulgation of unambiguous policies and by-laws preventing approval of small (<1000 m^2) residential stands within 50 m distance from high risk areas or known ground instability events is necessary.

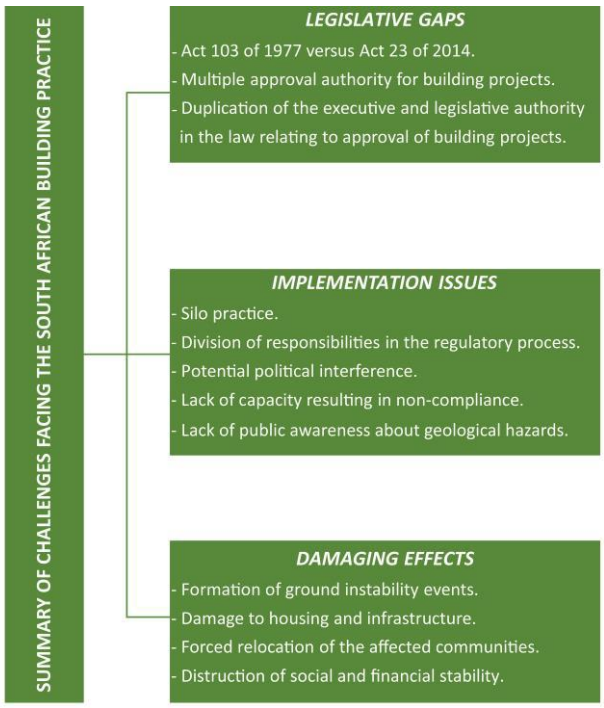

Fig.6: Summary of possible challenges facing the building industry in South Africa

In conclusion, a commitment to implement legislated functional requirements by decision makers, state organs, bulk service providers, contractors and individual site owners is central to the idea of sustainable development. Effective influence of the building legislation is also dependent on this commitment and failure by those involved to agree on the appropriate solutions could mean that the constitutional intent to protect basic human rights remains an academic concept. A closer interaction between geo-scientists and the decision makers (officials), more specifically at local sphere of government, is crucial in order to improve their mutual understanding of building regulatory processes and reduction of disaster risks on geologically hazard prone terrains. Furthermore, the interactions shall be aimed at improving the understanding of the link between spatial planning, sustainable infrustructure development, geohazards and disaster risk reduction.

Therefore, the recommendation is that, relevant sections in the Act 103 of 1977 be amended to stipulate that "no major development, expansion of existing development or township proclamation is permitted unless appropriate geohazard assessment studies have been conducted" and Act 57 of 2002 be amended to stipulate "guiding principles for funding of pre-disaster Geological Hazard Mitigation Plans" in response to the United Nations disaster risk reduction principles. The recommendations are made with an observation that the current building legislation has rather created a situation where the state responsibility to secure dangerous ground conditions has been relegated to an individual site developer. Relegating government functions to the private sector (property developers) and individual home/ site owners is dangerous.

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