ZIMBABWE

Zimbabwe Economic Policy Analysis and Research Unit

ZEPARU

Reconfiguration of the ZIMBABWE Geological Survey

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FOREWORD

The role of geological surveys in the socio-economic development of any country can never be overemphasized. Geological surveys collect, monitor, update, archive, process and provide national geo-scientific information which is fundamental for the economic, social, and environmental development of a country. For instance, they provide information which is necessary for the exploration, development and exploitation of mineral wealth; the development of infrastructure such as railroads, dams and cities; the understanding and prevention of geo-hazards such as earthquakes, landslides and volcanoes. Geoscientific information is also required for land use and land use planning.

A well-developed and equipped Geological Survey is required for the generation of geoscientific information and knowledge that will inform policies that foster development of the minerals sector and influence investment decisions in the sector. The Zimbabwe Geology Survey (ZGS) is one of the oldest scientific institutions in the country established in 1910. Its good performance in the past stimulated mineral exploration interest in the country leading to discoveries of some of the world-class mineral deposits. However, the current state of ZGS is in stark contrast with past performance when it was well resourced, and is not consistent with the ZGS vision of becoming a world class geological survey. Among other challenges that the ZGS face include lack of a statute that establishes and clearly defines its mandate, difficulties in retaining qualified and experienced geoscientists, inability to efficiently service, maintain and replace aging equipment, and a huge backlog of published research, including research conducted decades ago.

Inadequate human, material and economic resources have handicapped the ZGS to fully discharge its mandate especially field mapping. It is in this regard that my Ministry with financial support from African development Bank partnered ZEPARU to undertake a study on the Reconfiguration of the Zimbabwe Geological Survey. The findings and recommendations of this study will inform the processes that are underway to review the Mines and Minerals Act and development of a new Mining sector policy. We will look at the study's recommendations and other country experiences with keen interest to glean insight on how to reconfigure the ZGS and set it on a higher development trajectory which will enable it to achieve its vision of becoming a world class geological survey.

I would like to appreciate the financial and material support that the African Development Bank is giving to the Ministry of Mines and Mining Development and the ZGS under the Governance and Institutional Support Project, which has enabled the ZGS to acquire equipment and also made this study possible. My gratitude also goes to the ZEPARU research team that undertook this study and the stakeholders who participated through providing

valuable information during the course of the study. As we implement the recommendations of this study we count on the support of diverse stakeholders within government, private sector and development community to reconfigure the ZGS into a vibrant and well resourced institution.

Thank you and God bless you.

Hon. W. Chidakwa
Minister of Mines and Mining Development

EXECUTIVE SUMMARY

The original purpose of Geological Survey Organisations (Geological Surveys), namely to map the geology and mineral resources of nations, remains the primary role of most Geological Surveys today. Two of the oldest Geological Surveys in the world are the British Geological Survey which started off in 1835 as the Ordinance Geological Survey, and the Geological Survey of India which was established in 1851 on foundations laid down in 1836. The essentiality of mineral resources to humanity is the very reason why virtually all countries have or have had Geological Surveys or other entities that perform Geological Survey functions. As Geological Surveys are clearly strategic institutions, they are generally government departments, state agencies or state controlled companies. In Zimbabwe, the Geological Survey was established by the colonial administration in 1910, but agitation for its establishment had begun not long after the colonisation of the country in 1890.

The Zimbabwe Geological Survey (ZGS) and its legal predecessors earned a good reputation in mapping the country's geology and mineral resources. The ZGS produced excellent maps and reports documenting and interpreting the country's geology and mineral resources thereby stimulating mineral exploration interest in the country leading to discoveries of world-class mineral deposits. Early discoveries include Hwange Coal Fields, Cam and Motor Gold Mine, Globe & Phoenix Gold Mine, Sandawana Emerald Mine, Shabanie and Mashawa asbestos mines,Shurugwi Chromite mines and many others. When Zimbabwe attained independence from Britain in 1980, the new government considered mining development among priority economic drivers and ensured that the ZGS remained intact, churning out geoscientific information which attracted mining and mineral exploration investment inflows. Foreign governments jubilantly offered technical cooperation partnerships in the mining sector and significant technical cooperation agreements were signed with the British, German, Canadian, Japanese, French and North Korean governments or their agencies.

In the early 1990s when the Economic Structural Adjustment Programme was being implemented in Zimbabwe, the economy was adversely affected, so were many state institutions such as the ZGS. Equipment and infrastructure maintenance became more and more difficult and ultimately became neglected. Experienced geoscientists left the ZGS in droves to join the better-paying private sector and geological mapping had come to a halt by 1991. Geological mapping, the primary purpose of geological surveys, is the driver of many other activities such as geochemical analyses, cartography, editing & publishing, and rock cutting & polishing. By 1997, all technical cooperation projects had wound down and the ZGS was on its knees, barely surviving. Meanwhile dereliction of equipment due to aging and lack of maintenance accelerated.

The economy of Zimbabwe further declined by an estimated annual rate of 6.4% over the period 2000 to 2008 owing to a number of factors including hyperinflation, financial sector instability, declining industrial capacity utilisation, among others. This adversely affected budgetary allocations to the Zimbabwe Geological Survey which declined from 0.03% of the

total national budget in 2009 to largely 0.01% since 2012. However, in 2003 the government embarked on the 'Look East Policy'. This policy drew some new technical cooperation initiatives and minimal mining and mineral exploration investment from countries like China and Russia. Thus, the ZGS remained in a dire situation and in 2013, the Ministry of Mines and Mining Development and the ZGS secured funding from the African Development Bank under a specified grant to: (i) provide geological equipment; (ii) provide cartography equipment; (iii) provide training for ZGS personnel; (iv) fund the editing and printing of bulletins and maps; (v) support to the Mines and Minerals Act review process; and (vi) support the Zimbabwe Economic and Policy Analysis Research Unit (ZEPARU) to undertake mining sector analytical and advisory activities to strengthening mining sector policies and governance arrangements.

This study, 'Reconfiguration of the Geological Survey', which falls under item (vi) above, focuses on the ZGS which is currently not in its best shape or form and which may need some redirection, transformation or reconfiguration. The report draws from literature research, interviews, questionnaires and study tours. Inadequate funding of Geological Surveys is not unique to Zimbabwe; many wholly-government funded Geological Surveys the world over consider themselves to be under-funded. This has raised three interrelated questions over the years. First, should a nation's Geological Survey solely rely on government funding? Second, should the Geological Survey ideally be a government department or a semi-autonomous state agency? Third, what other roles apart from traditional mapping of geology and mineral resources can Geological Surveys perform?

The above questions reflect the underlying desire for reconfiguration within Geological Surveys. The Algerian Geological Survey Agency and the Geological Survey of Tanzania have transformed into semi-autonomous state agencies. Some more established Geological Surveys such as the British Geological Survey, the Geological Survey of Finland the Geological Survey of the Netherlands and South Africa's Council for Geoscience supplement government funding by as much as 30% earned from consultancies and commissioned research. The semi-autonomous status reduces bureaucratic layers, permits creation of innovative revenue streams, such as through international partnership projects and contracts, and permits expansion of functions. Given the unenviable situation that the ZGS currently finds itself in, the most immediate concern for stake holders interviewed in this study was not about what sort of entity the ZGS should be, but getting the ZGS working again. However, in the long run, it is pertinent to consider whether the ZGS can work more effectively as a state agency rather than as a government department. Although the post-independence technical cooperation projects represented a major accelerator of geological work at the ZGS, this kind of funding proved to be unsustainable and there is need to create sustainable revenue streams.

Apart from basic traditional Geological Survey functions, many transformed Geological Surveys undertake work and consultancies in engineering geology, hydrogeology,

environmental management, geo-hazards mapping, climate change and many other areas. Although respondents in this study generally supported the expansion of functions at the ZGS, they emphasized that the ZGS must re-establish the primary services and functions before any expansion or reconfiguration can be meaningfully instituted. Most geologists currently at the ZGS have no geological mapping experience and establishment of a 'Field School' such as that offered by South Africa's CGS to equip early career geologists with geological skills, mainly field mapping skills, will help resuscitate geological mapping at the ZGS. In interviews, several experienced former field mapping geologists in Zimbabwe expressed readiness to assist the ZGS with field mapping training. Incidentally, at least two former ZGS geologists are involved in the running of the CGS Field School in South Africa.

Another in-built crippling limitation to the growth and success of the ZGS is the poor definition of its legal status and mandate. Although legally recognized under Section 387 of Zimbabwe's Mines and Minerals Act (Chapter 21:05) of 1996, the Act does not spell out fully the functions or mandate of the ZGS. This is in sharp contrast to South Africa's CGS which was established under the Geoscience Act (Act No. 100 of 1993) which states in detail functions of the CGS, composition of the CGS management Board, CGS powers, and CGS funding sources and defines the CGS as a 'juristic person' at law.

The recent decentralisation of the Ministry of Mines and Mining Development which took away Mining/ Regional geologists from the ZGS to the provinces, stripping the ZGS of its most experienced geologists, posed an internal threat to the existence of the ZGS. The ZGS responded by creating the Applied Geology Section, charged with collation of provincial data, coordination of provincial activities, and looking into the establishment of non-traditional Geological Survey roles such as geo-hazard mapping, environmental geology, engineering geology at the ZGS. This initiative can strengthen the ZGS and must be supported and if necessary, revised and revamped.

In conclusion, the ZGS vision of becoming a world geoscience research and information centre in the near future can be realized. This requires some reconfiguration, which entails several elements: (i) the legal status and mandate of the ZGS must be clearly re-defined, (ii) the ZGS must re-establish its primary geological mapping function and, at a later time, expand its functions guided by its redefined mandate, and (iii) the ZGS should revise its funding model; there is flexibility if the ZGS becomes a state agency rather than a government department.

1. INTRODUCTION

Most countries have Geological Surveys originally established to map the geological and mineral resources in those countries. Today the geological map and the mineral resources map are major mining investment decision making tools and must therefore be kept up to date. Being such an important institution, questions have been asked if a nation's Geological Survey can solely rely on government funding, and whether the Geological Survey should be a government department or transform into a semi-autonomous State Agency. Some more established Geological Surveys such as the British Geological Survey, the Geological Survey of Finland and the Geological Survey of the Netherlands supplement government funding by as much as 30% earned from consultancies and commissioned research. In attempts to become more effective and to reduce decision-making bureaucratic layers, some Geological Surveys, such as the Algerian Geological Survey Agency and the Geological Survey of Tanzania have transformed into semi-autonomous State Agencies.

Whatever entity a Geological Survey is, its existence must be underpinned by a clear statute defining its legal status, mandate and functions. Every Geological Survey should have the capacity to at least carry out the basic traditional functions. This study, 'Reconfiguration of the Zimbabwe Geological Survey', focuses on the Zimbabwe Geological Survey (ZGS) which has historically earned a reputation for geological mapping, but due to lack of adequate human and financial resources over the years, is currently not in its best shape or form and may need some redirection. The study was funded by the African Development Fund as a subcomponent of a grant extended to the Republic of Zimbabwe under the Governance and Institutional Support Project (GISP). The study has been implemented by Zimbabwe Economic Policy Analysis and Research Unit (ZEPARU) in conjunction with the Ministry of Mines and Mining Development. The numerous challenges that have compromised the institutional capacity of the ZGS include difficulties in recruiting suitably qualified and experienced geoscientists, inability to efficiently service, maintain and replace aging equipment, and a huge research publishing backlog, including research conducted decades ago. In an effort to re-tool the ZGS, a component of GISP has recently assisted the ZGS to procure equipment for cartography, geophysics and rock cutting/ thin section preparation.
Lack of a clear legal status of the ZGS is an overarching limitation to the ZGS's functioning, growth and innovativeness. Thus, the proposed amendments to Zimbabwe's Mines and Minerals Act (Chapter 21:05) of 1996 should include sections which clearly spell out the legal status, functions, mandate and powers of the ZGS.

1.1 Objectives of the Study

The overall objective of this study was to identify institutional gaps and capacity challenges that undermine the fulfilment of ZGS's mandate and to explore the possibility of enhancing that mandate to propel the ZGS to become an effective

and efficient world class organisation. The specific objectives of the study include the following:

- To understand the current mandate, legal status, functions and powers of the ZGS.
- To identify historical and current capacity challenges that the ZGS faces or has faced in executing its mandate.
- To identify key tenets (human resources, funding model, legal status, mandate, functions, etc.) that permit reconfiguration of the ZGS into a world-class Geological Survey.
- To explore ways in which the ZGS can contribute to increasing the country's competitiveness as a destination for mining capital.

1.2 Outline of the Study

Section 2 summarises research methods which included the review of relevant literature from which the legal status of the ZGS, historical development of ZGS and its rich key lessons, spelt out in sections 3 to 5, are drawn. Section 6 presents the current structure of ZGS and sections 7 to 10 discuss the findings from qualitative analysis of the questionnaires administered to current employees of the ZGS; former employees of the ZGS; members of the public and members of the Geological Society of Zimbabwe. Section 10 additionally discusses the findings from the study tour to the Council for Geoscience of South Africa. Section 11 concludes the paper by discussing the proposals for the reconfiguration of the ZGS.

2. METHODS OF RESEARCH

Before the onset of data collection, a stakeholder inception workshop was held to inform stakeholders of the commencement of the study and solicit information and insights that would help shape the research by taking into account their different views and perspectives. Participants were drawn from former and current employees of the ZGS, the Chamber of Mines, the Geological Society of Zimbabwe and the Ministry of Mines and Mining Development. Their contributions helped in identifying Geological Surveys to study and visit, and key informants to target in questionnaire surveys and interviews.

For data collection, this study relied on literature research, questionnaires, interviews and study tours to selected Geological Surveys. Most of the literature was accessed through websites of the studied Geological Surveys. This information would be of a general nature and to glean specific internal details, questionnaires were designed and sent to key personnel in selected Geological Surveys. The next level was to actually visit selected Geological Surveys to interact with personnel and to tour their facilities. For this purpose, the research team visited the Council of Geoscience (South Africa) and the Geological Survey of Namibia. Views of current employees of the ZGS, former employees of the ZGS, members of the public and members of the Geological Society of Zimbabwe were collected through questionnaires. Except for members of the public who completed and returned hardcopy questionnaires, the rest of the questionnaires were distributed, completed and received electronically.

Views of former employees of the ZGS were sought in order to capture their perspectives on how, why and when the ZGS has historically scored successes, and how and when the ZGS dealt with any significant challenges. Similarly, current employees add to the story the immediate past, current and projected future successes and challenges at the ZGS. Public clients of the ZGS, mainly small-scale miners and prospectors, are an important group as they provide a view of the ZGS from an interested outsider's perspective. The Geological Society of Zimbabwe is mainly made up of geoscience professionals who interface with the ZGS and many are themselves practicing geoscientists, permitting them to contribute from an informed professional point of view that would, in some cases, be influenced by their experiences in other organisations or jurisdictions.

Interviews with officials of the Ministry of Mines and Mining Development, including the ZGS helped gain some insight into their perspectives on the future of the ZGS and the parent ministry.

3. LEGAL STATUS OF THE ZIMBABWE GEOLOGICAL SURVEY

The Zimbabwe Geological Survey (ZGS) was founded in 1910 as the Rhodesia Geological Survey. Presently, the ZGS is legally recognized under Section 387 of Zimbabwe's Mines and Minerals Act (Chapter 21:05) of 1996. However, the Act does not spell out fully the functions or mandate of the Geological Survey, except to confer upon the ZGS staff authority to enter upon any land for the purposes of exploration, sampling or inspection without hindrance. From this perspective, it seems that the Zimbabwe Geological Survey's legally recognized mandate is very limited and poorly defined. This is in sharp contrast to the legal basis of the Council for Geoscience (CGS), the legal successor of the Geological Survey of South Africa. The CGS was established by the Republic of South Africa under the Geoscience Act, Act No. 100 of 1993 which, among other aspects, states in detail functions of the CGS, composition of the CGS management Board, CGS powers, and CGS funding sources. The CGS is clearly defined at law as a 'juristic person'. Table 1 compares and contrasts the definitions of legal status, management and functions of the CGS and ZGS as respectively conferred upon these institutions by the Geoscience Act, Act No. 100 of 1993 and the Mines and Minerals Act (Chapter 21:05) of 1996.

Table 1 A comparison of legal status, management, and functions of the CGS and ZGS as spelt out in the respective Acts

	Council for Geoscience (Geoscience Act (No. 100 0f 1993)	Zimbabwe Geological Survey (Mines & Minerals Act (Chapter 21:05 of 1996)
Legal status	'There is hereby established a juristic person to be known as the Council for Geoscience'	For purposes of this Act, there shall be –…(d) Director of Geological Survey…'
Management	(1) With a view to the achievement of the objects of the Council its affairs shall be managed by a Management Board, which shall, subject to the provisions of this Act, determine the policy and goals of the Council and exercise control over the performance of the functions of the Council. (2) The Management Board shall consist of- (a) the chairman, who shall be appointed by the Minister; (b) at least eight but not more than ten other members appointed by the Minister, after consultation with the chairman and the executive officer, of whom- (i) one shall be an official of the Department of Mineral and Energy Affairs nominated by the Director-General: Mineral and Energy Affairs; (ii) one shall be an official of the Department of Environment Affairs nominated by the Director-General: Environment Affairs; (iii) one shall be an official of the Department of Regional and Land Affairs nominated by the Director-General: Regional and Land Affairs; (iv) one shall be an official of the Department of Water Affairs and Forestry nominated by the Director-General: Water Affairs and Forestry; (v) one shall be a person who is involved in the mining industry and was nominated by the Chamber of Mines; (vi) one shall be a person who is involved in geoscientific education or training and was nominated by the Geological Society of South Africa; (vii) one shall be a person who is involved in commerce; and (viii) one shall be a person with knowledge or experience of mineral activities who is involved in industrial development and was nominated by the Industrial Development Corporation; and (c) The executive officer, who shall serve ex officio as a member of the Management Board. (3) After the expiry of the term of office of the first chairman the Minister shall appoint the chairman after consultation with the other members of the Management Board. (4) The Minister may, whenever he deems it necessary or expedient, subject to the provisions of subsection (1), appoint an alternate member for any member of the Management Board. (5) The members or alternate members of the Management Board shall be persons who- (a) have special knowledge of or experience in any aspect of the Council's functions; or (b) By virtue of the offices occupied by them are able to make a contribution to the achievement of the objects of the Council.	(1) The Secretary shall be and is hereby vested with authority generally to supervise and regulate the proper and effectual carrying out of this Act by mining commissioners or other officers of the Public Service duly appointed thereto, and to give all such orders, directions or instructions as may be necessary. (2) The Secretary may at his discretion assume all or any of the powers, duties and functions by this Act vested in any mining commissioner, and may lawfully perform all such acts and do all such things as a mining commissioner may perform or do, and is further empowered in his discretion to authorize the correction of any error in the administration or in the carrying out of the provisions of this Act, or to perform any other lawful act which may be necessary to give due effect to its provisions. (3) The Secretary may exercise such of the powers by this Act vested in the Minister as may be delegated to him by the Minister.

Functions	(1) For the purpose of achieving its objects, the Council may perform the following functions: (a) Undertake geoscientific research; (b) compile and develop a comprehensive and integrated collection of knowledge of geology, geochemistry, geophysics, engineering geology, economic geology, geochronology, marine geology and geomagnetism; (c) serve as the national custodian of all geoscientific information relating to the earth, the marine environment and geomagnetic space; (d) study mineral resources; (e) study the use of the surface of land, and from a geoscientific viewpoint advise government institutions and the general public on the judicious and safe use thereof; (f) develop and maintain the National Geoscientific Library, the National Borehole Core Depository, the National Geophysical and Geochemical Test Sites, and the Geological Museum as part of the Transvaal Museum; (g) conduct investigations and render specialized services to public and private institutions; (h) (i) undertake research of its own accord; or (ii) undertake research on behalf of the State or any other government institution, or on behalf of any person or institution, or support such research financially; and (iii) do anything that is necessary for or conducive to the achievement of the said objects. (2) In order to promote relevant research and to support its objects the Council may- (a) make grants to universities, technikons, colleges and other educational and scientific institutions in aid of research by their staff or for the establishment of facilities for such research; (b) undertake joint research projects with departments of State, universities, technikons, colleges, other educational and scientific institutions and other persons; (c) co-operate with educational authorities and scientific or technical societies for the promotion of the education and training of researchers, technical experts and other supporting personnel in schools, technikons, colleges and universities; (d) grant study bursaries and loans to researchers, and make monetary contributions for research programmes in support of its own manpower requirements; and (e) co-operate with persons and institutions undertaking research in other countries by the exchange of geoscientific knowledge by means of international meetings and research projects. (3) In order to perform the functions and to achieve the objects of the Council, the executive officer may- (a) on behalf of the Council conclude agreements with any person or institution or, subject to the provisions of section 8, with any government or administration, on the conditions upon which the Management Board and that person, institution, government or administration may agree; (b) act as the official representative of the Council at all national and international organizations and meetings; (c) defend legal proceedings instituted against the Council and institute legal proceedings connected with its functions; (d) with the approval of the Minister, granted with the concurrence of the Minister of State Expenditure, for or on behalf of the Council purchase or otherwise acquire or possess or hire immovable property, and alienate, let, pledge or otherwise encumber such property; (e) with the approval of the Minister, granted with the concurrence of the Minister of Finance, raise money by way of loans on such terms and conditions and against such security as the Management Board may deem expedient;	The Director of Geological Survey and any person duly authorized in writing by him may for the purpose of carrying out any prospecting or exploration work on behalf of the State or a geological survey of Zimbabwe or any part thereof— (a) enter at all reasonable hours upon any land with such persons, animals, vehicles, appliances, instruments and materials as are necessary for such survey; (b) break up the surface of any part of such land for the purpose of ascertaining the rocks, strata or minerals within or under the same; (c) take and carry away samples and specimens of the rocks, strata or minerals found therein; (d) fix any post, stone, mark or object to be used in the survey in any such land; (e) dig up any ground for the purposes of fixing any such post, stone, mark or object; (f) enter into or upon any land on which it is proposed to carry out such prospecting or exploration work, or through which it may be necessary to pass for the purposes of such survey or such work: Provided that— (i) it shall not be lawful to fix any object, post, stone or mark within any walled garden, orchard or pleasure ground without the consent of the owner or the occupier thereof; (ii) reasonable notice of the intention to exercise any of the powers conferred by this subsection shall be given to the owner or the occupier of such land unless such land is unoccupied State land; (iii) as little damage and inconvenience as possible shall be caused by the exercise of any of the powers conferred by this section and such owner or occupier shall be entitled to compensation for any damage sustained in the execution of the powers conferred by this subsection. (2) Any prospecting or exploration work carried out in terms of subsection (1) shall be subject to the provisions of sections thirty-one and thirty-four, save those of paragraph (b) of subsection (1) of section thirty-one.

Functions	(f) hire or let services against payment; (g) produce and sell reports, maps, computer programs and other intellectual property which the Council generates in the course of its research; (h) do everything that is conducive to the performance of the functions or the achievement of the objects of the Council or is calculated, directly or indirectly, to enhance the value of or render profitable the property or rights of the Council. (4) The Council shall, in addition to its other functions in terms of this Act or any other law- (a) perform such functions and undertake such investigations or research as the Minister may assign to it; and (b) advise the Minister on research in the field of geoscience. (5) The functions of the Council mentioned in this section shall be performed by the executive officer, except in so far as they have been assigned by this Act or by the Minister to any other person. Exercise of powers of Council outside Republic of South Africa (1) The Council may at the request of or with the prior approval of the Minister undertake geoscientific research and perform generic geological functions in any country or territory outside the Republic on behalf of any person, institution, government or administration. (2) Subject to the provisions of subsection (3), the provisions of this Act shall, in so far as they can be applied, apply mutatis mutandis to the exercising by the Council of its powers in terms of this section as if the country or territory in which it so exercises its powers were within the Republic. (3) Notwithstanding anything to the contrary contained in this Act, geoscientific research and the performance of generic geological functions under subsection (1) shall be undertaken on such terms and conditions as may be agreed upon between the Management Board and the person, institution, government or administration on whose behalf the research and the performance of functions are to be undertaken, and as approved by the Minister. (4) The Minister may, with the concurrence of the Minister of Finance, indemnify the Council against any losses which it may incur in consequence of any act or omission of a person, institution, government or administration contemplated in subsection (1).	(3) No prospecting or exploration work shall be carried out on a mining location pursuant to the powers conferred by subsection (1) without prior consultation with the holder of such location. (4) Any person who in any way whatsoever prevents, obstructs or impedes the exercise of any of the powers conferred by subsection (1) or who displaces, defaces or destroys any stone, post, mark or object set up and placed for the purposes of any geological survey shall be guilty of an offence and liable to a fine not exceeding level three. [amended by Act 22 of 2001, with effect from the 10th September, 2002.] (5) If any dispute arises as to the amount of compensation payable under this section, the matter shall be referred to the Administrative Court for determination.

	(1) Notwithstanding the provisions of any other law, the Council shall have the right to inspect any information of the Department of Mineral and Energy Affairs which the Minister, or an officer of the said Department designated by the Minister, may approve on such conditions as the Minister or the said officer may determine. (2) The Council may take into its custody and use information contemplated in subsection (1) or a copy thereof, but any provision of any law whereby any restriction is imposed on the publication or display of such information, shall mutatis mutandis apply to any information or copy thereof which is in the custody of the Council in terms of this section.	(1) The miner of a registered mining location shall submit annually to the Director of Geological Survey any information of a geological nature, including logs and assay results of drill cores from surface diamond drill holes, and reports on any geological, Geo-chemical and geophysical work, obtained by him during the course of his prospecting or mining operations. (1a) Any person who contravenes subsection (1) shall be guilty of an offence and liable to a fine not exceeding level four or to imprisonment for a period not exceeding three months or to both such fine and such imprisonment [inserted by Act 22 of 2001, with effect from the 10th September, 2002.] (2) The Director of Geological Survey shall not, without the consent of the holder, disclose any information submitted in terms of subsection (1) to any person, or allow any person to inspect it unless the mining location to which it relates is forfeited, abandoned, or has been cancelled: Provided that the Minister may, after consultation with the miner, disclose such information if he considers it necessary in the public interest to do so. (3) In addition to the information specified in subsection (1), the miner of a registered mining location shall submit to the Director of Geological Survey, if called for, any representative rock samples obtained by him in the course of his prospecting and mining operations.

4. HISTORY OF THE ZIMBABWE GEOLOGICAL SURVEY

In keeping with the country's changing name due to historical circumstances, the entity currently known as the Zimbabwe Geological Survey (ZGS) has variously been known by different names reflecting the changes to the country's name. Between 1910 and 1964, the ZGS was known as the Southern Rhodesia Geological Survey and the Rhodesia Geological Survey between 1964 and 1979. In the brief transitional 1979-1980 period, the ZGS was known as Zimbabwe-Rhodesia Geological Survey, after which it became the ZGS when the country officially changed its name to Zimbabwe at independence in 1980. This section summarises the progress, challenges, opportunities and successes witnessed by the Geological Survey over more than a century of its existence since 1910.

Subsections 4.1 – 4.3 which cover the first fifty years of the existence of the Geological Survey are based on Tyndale-Biscoe (1972). Tyndale-Biscoe worked for the Geological Survey as mineralogist (1924-1926) and geologist (1926-1959) his is an insider's account. For the Survey's history beyond 1960, this compilation relied heavily on Fey (1997) supplemented by Broderick (2010). Peter Fey worked for the Survey as geologist (1971-1976), Regional Geologist (1976-1980) and Chief Field Geologist (1992-1995). Tim Broderick was geologist at the Survey from 1972 to 1980, becoming Chief Field Geologist between 1980 and 1988.

4.1 1910-1929

Within the first decade (1890-1900) of colonial occupation of Zimbabwe, gold prospecting and mining activities by the settlers had gathered such momentum that the need for a Geological Survey became apparent. From around 1900 the mining community, the press and mining professionals increasingly agitated for establishment of a Geological Survey. An early proposal was for the Rhodesia Chamber of Mines to lead the process with mining companies subscribing on a pro rata basis and the British South Africa Company (BSAC) paying pound-for-pound. The final resolution was that government, not the Chamber of Mines, should establish the Geological Survey. In the end a budgetary allocation of £4,000, one fifth from the BSAC's commercial branch and four fifths from the Legislative Council, was provided for the setting up of the Rhodesia Geological Survey in 1910. The then leading mining journal, the Rhodesia Mining Review dismissed the allocation as woefully inadequate and implored the need for close cooperation of, and pooling of resources by the Geological Survey, Resident Mining Engineer and the Rhodesia Museum to enhance chances of any viability of the new venture. Herbert Brantwood Maufe a geologist with the Scottish Geological Survey, who had also worked in Kenya, was appointed the inaugural director and resumed work in September 1910. The first offices of the Rhodesia Geological Survey were in Bulawayo to foster ties with the Rhodesia Museum and Resident Mining Engineer's offices which were both in Bulawayo.

By November 1910, Maufe had initiated geological mapping of the Harare arm (Enterprise belt) of what is now known as the Harare-Bindura-Shamva Greenstone Belt. In May 1911

two new geologists, Arthur Edward Victor Zeally and Ben Lightfoot joined the Geological Survey and in the same year the three geologists embarked on geological mapping of the Shurugwi (formerly Selukwe) Greenstone Belt where there was booming mining activity. Using donkey waggons as their transport, they completed their mapping in 1912. By 1914, the team had collectively covered mapping of Shurugwi, Harare (Enterprise), Effel Flats (Kadoma), Golden Valley (Chegutu), Wankie (Hwange) Coalfield and had embarked on mapping the Karoo north of Bulawayo diamond deposits, north of Mbembesi (kimberlites) and the Somabula deposits (gravels).

To about 1924, the number of geologists at the Survey ranged from two to four. The number increased to four by July 1914, following recruitment of Alexander Miers Macgregor, but onset of the First World War took its toll. Lightfoot resigned in 1914 to take up a scholarship but was immediately conscripted into the army, and Macgregor resigning in 1916 to join the army. Field mapping was suspended in 1916-1917 so that the only two remaining geologists, Maufe and Zealley, could concentrate on appraisals of strategic and base mineral prospects as well as determinations of these minerals for prospectors following a spike in demand from war industries. The task of mineral determinations was eventually given to the Resident Mining Engineer. Minerals discovered during this period include microlite in Mutare, widely distributed tungsten ores, asbestos deposits at Shabanie Mine, Barytes in Gweru, and graphite and fluorite in Hwange. Fieldwork resumed following the appointment of geologist Arthur John Charles Molyneux in April 1918 but the team was cut back to two when Zealley succumbed to influenza in October 1918.

From the second half of 1918, the Secretary for Mines and Roads began to express dissatisfaction with Maufe over slow progress in mapping and publishing. He recommended to the Administrator that the Geological Survey's offices be moved to Salisbury (Harare) and be placed as a department under Secretary for Mines and Roads as hitherto Maufe had been 'a power unto himself' reporting directly to the Administrator. In response Maufe explained that the Survey was under-resourced and recommended the appointment of two typographers, a draughtsman, a petrologist, chemist and laboratory assistant. The Geological Survey was moved to Salisbury at the end of May 1918.

Macgregor returned to the Survey in 1919 and Lightfoot in 1921. Maufe and Macgregor undertook a quick reconnaissance of the country to compile the first edition of the 1: 1 million geological map of Southern Rhodesia which was published in 1922. A mineral map of the same scale was published in 1924. Between 1924 and 1926, several new appointments were made: two mining geologists, one mineralogist, one assistant draughtsman, two topographers, and one chemist. The post of mineralogist changed hands three times during this period. Mineralogist John Reekie who had been appointed in 1921 resigned in 1924 and was replaced by geologist Ronald McIver Tyndale-Biscoe who moved to the field mapping section in 1926 when Dr. James Watson Lunn took over as mineralogist.

The year 1925 marked the first use of motorised transport during Lightfoot's excursion to the Great Dyke to investigate the presence of platinum ore reminiscent of a then recent discovery on the Bushveld Complex of South Africa. Lightfoot's was a one tonne Ford motor waggon; a fleet of six Chevrolet half-tonne vans procured for the 1926 field season marked the permanent replacement of mule/ donkey waggons with motorised transport.

In 1929, Maufe, Lightfoot, Macgregor and Dr. Francis Eric Keep (mining geologist appointed on a three year contract in 1926) successfully led Rhodesian excursions of the International Geological Congress held in Pretoria. This congress resolved to create a Commission of African geological Surveys to exchange notes on activities and share results. In this period, Lightfoot was the main representative of the Geological Survey at international conferences and he was President of the Geological Society of South Africa for several years until 1940. Thus, the major highlights of the 1910-1929 periods were the initiation of mapping of greenstone belts and sedimentary basins, publication of the first 1: 1 million geological and mineral maps, the introduction of motorised fieldwork transport in 1925, the discovery of new strategic minerals spurred by the war effort, and the successful hosting of the International Geological Congress field excursions in Southern Rhodesia. Another important milestone was the domestication of thin section preparation by mineralogist John Reekie thereby dispensing with the need to send specimens to England or Germany. By the end of 1929, there were four geologists at the Survey: Maufe, Lightfoot, Macgregor and Tyndale-Biscoe.

4.2 1930-1949

In 1930 two new geologists joined the Southern Rhodesia Geological Survey, and another two joined in 1933, bringing the number to eight. In 1934, Maufe retired from the Geological Survey and was replaced as director by Lightfoot. Another new geologist joined the Survey in 1936 bringing the number of geologists back to eight, but a death in 1937 brought the number down to seven. Lightfoot agitated for the allocation of new office space which was granted in 1937. The Geological Survey moved to its present offices at the corner of Simon Muzenda Street and Selous Avenue in October 1940. The purpose-built Geological Survey headquarters, named Maufe Building in recognition of the founding director, is still in use today. Due to overwhelming demand for geological services by small scale miners during this period, Lightfoot suggested the introduction of a cost recovery charge for the service, which was not implemented.

Before the outbreak of the Second World War in 1939, the mapping team had accomplished or was accomplishing mapping of gold belts in Filabusi, Antelope, Bulawayo, Mazowe Valley, and Umfuli (Mupfure) Valley in Hartley (Chegutu). In 1938 Lightfoot sent all available field staff to the Lowveld to update the 1:1 million geological map of Rhodesia. Less than a week before the declaration of the Second World War, another geologist joined the Survey, bringing the number of geologists to eight.

Field mapping came to an abrupt end in 1939 when the Second World War broke out and field mapping staff diverted their efforts to increasing production of gold and base minerals. To achieve this, it was decided to post a geologist to each mining centre: Bulawayo, Gatooma (Kadoma), and Gwelo (Gweru). This early attempt to decentralize services of the Geological Survey failed because support services (chemist, mineralogist and draughtsman) were still centralized in Salisbury with which communication systems were rudimentary. The geologists were recalled to Salisbury.

By 1940 nine staff members, including several geologists had joined the fighting forces. In 1945 all the field staff returned from their war-time occupations and resumed regional mapping. Lightfoot retired in 1946 and Macgregor took over as director. To arrest the declining gold output, it was decided to increase the number of geologists and to implement the ex-servicemen mining rehabilitation scheme. The ex-servicemen rehabilitation scheme, conceptualised during the war years, involved identification and reopening of selected old mines for interested ex-soldiers. Successful applicants were allocated mining properties, paid a salary and granted a calculated development loan for each mine they operated. The salary was dropped when a mine proved successful and potentially self-sustaining. The loan was gradually repaid and the operator became the owner. If a venture failed and the operator was considered competent, the operator had the option of getting another property. The Chief Government Mining Engineer was chairman of the scheme in a committee that included a senior member of the Geological Survey's field staff. Geologists from the Survey provided support services to the scheme, involving a lot of cross-country travelling. Apart from the main committee in Salisbury, subcommittees held monthly meetings at Bulawayo, Gweru and Kadoma chaired by local government mining engineers. The scheme had mixed successes, but on the whole it was considered worthwhile.

Two new geologists were recruited in 1946, and another three in 1947. Macgregor retired in 1948 and James Crighton Ferguson, who had joined the Survey as geologist in1930 became director for twelve years until 1960. Meanwhile, British geologist Albert Edward Phaup who had initially joined the Survey in 1930 and left in 1939, re-joined the Survey in 1947 and was sent to map the Kariba Gorge and its environs in preparation of dam work. In his pre-war stint, Phaup had completed geological mapping of the Mutare Greenstone belt between 1933 and 1935. There were a few more recruitments and resignations such that by the end of 1950 there were 10 geologists at the Survey.

The main achievements in this period were allocation of new larger office space to the Survey in 1940, the institution of the post-war ex-servicemen rehabilitation scheme, the geological groundwork in preparation of Kariba Dam construction. The early, unsuccessful attempt at service decentralization in 1939 is noteworthy.

4.3 1950-1960

An extensive diamond drilling programme in 1950 around Kwekwe, supervised by Worst led to the establishment of Riscom Steelworks (later Zisco Steel) in Redcliff, Kwekwe. In the same year the 1:1 million geological map was updated to incorporateMashonaland dolerites intruding the granitic terrain in eastern Zimbabwe. This was economically important on account of the Inyati Copper Mine and Umkondo Copper Mine, and speculative nickel potential associated with these dolerites. Other important projects undertaken in the 1950s include coal resource mapping and drilling programme in Wankie (Hwange) District and in the Middle Sabi (Save) Valley, mapping of greenstone belts (Chegutu, Mberengwa and Masvingo), mapping of mines (Cam & Motor and Bikita mine), and mapping of the Miami (Mwami) Mica Field, Sinoia (Chinhoyi) and southern Urungwe (Hurungwe) areas in the Makonde and Hurungwe districts, as well as detailed mapping of the Great Dyke.

Highlights during this period include the discovery of Sandawana emeralds in Mberengwa, the adoption of geochemical methods of mineral exploration, first trialled in the Penhalonga area and around Kwekwe, and the institution of Regional Geologists for Harare, Gweru, Kadoma and Bulawayo. The geochemical methods included collecting deep regolith samples by power auguring and analysing them, and use of spectrographic equipment for rapid identification of pegmatite minerals, including lithium ores. The instrument proved exceptionally useful during the 1960's nickel boom.Three new geologists were appointed during this period and were assigned to three different areas: Shurugwi, Mvuma and Shangani-Fort Rixon.

Ferguson retired as director of the Survey in March 1960, whereupon Francis Leslie Amm, who had joined the Survey in 1933, took over as director. During the first 50 years of the Geological Survey, 48 bulletins, 37 short reports and several Mineral Resources Series booklets were published.

4.4 1961-1969

Most of the account of the history of the Geological Survey to 1960 as summarized above, was drawn mainly from Tyndale-Biscoe (1972). The main reference for the years 1961 to 1995 is Fey (1997), supplemented by other accounts such as Broderick (2010).

In early 1962 Phaup, who had been based in Gweru since re-joining the Geological Survey in 1947, succeeded Amm as director; Amm himself had been promoted to become the Director of Mines. The fifth edition of the 1: 1million geological map of Rhodesia was published in 1962. Between April and June 1964, the Geological Survey building, then housing the Mines Department and Mining Commissioner's office, was extended and refurbished. The Survey played a key role in the organization of the 7th Congress of the Geological Society of South Africa held in Salisbury in July 1964, and a lesser role in the September 1962 Symposium on Pegmatites along with the Institution of Mining and Metallurgy.

In 1964, Northern Rhodesia (Zambia) attained independence and Southern Rhodesia became known as Rhodesia and, consequently, 'Southern' was also dropped from the Survey's name to become Rhodesia Geological Survey.

A long standing request for a salary review for geologists was heeded by the Public Services Board in 1966, leading to an influx of new relatively young geologists. The department was reconfigured and staff re-graded. The first locally trained geologist, Ian Robertson, joined the Survey in 1965. From March 1966, the re-configured Rhodesia Geological Survey consisted of Director, Deputy Director, 4 Regional Geologists, 1 Economic Geologist, 1 Mineralogist and 18field geologists. The field section was centralized from Harare but geologists could be posted to regional offices, depending on their mapping assignments.

Phaup retired as director of the Survey in March 1967 and was replaced by deputy director John Walter Wiles who had joined the Survey in 1947. Phaup re-joined the Survey as a temporary geologist in August 1967 in which capacity he edited 13 bulletins and numerous reports, and mentored Geological Survey staff. His initial contract was for one year but he worked for 10 years in this capacity until his retirement in 1978 whereupon he returned to Britain and died there in September 1990. In recognition of his contribution to the Survey and to the geology of Zimbabwe, the Rhodesia Geological Survey library was named the A. E. Phaup Library in April 1974. In 1978, Phaup was awarded an honorary Doctorate of Science by the University of Rhodesia.

4.5 1970-1979

During this period, thanks to the boost in staff numbers from 1966, at least 9 geologists were mapping in the field. The 6th edition of the 1:1 million geological map of Zimbabwe was published to coincide with the 'Granite 71' symposium held in Harare (then Salisbury) in August-September 1971. The mapping momentum was hampered by the intensifying liberation struggle which entered its decisive phase from 1972. Geologists would be called up to do service in the Rhodesian security forces while many others tendered their resignation. New British graduates who had no military commitments took up some of the vacated posts. However due to the deteriorating security situation, all rural regional mapping was suspended at the end of the 1977 field season.

The Rhodesian Branch of the Geological Society of South Africa organized the successful Metallogenesis '76 congress on mineral deposits in 1976. In the same year, director Wiles retired and was replaced by John Gerard Norman Stagman who had joined the Survey in 1946. Stagman led the effort to compile the seventh edition of the 1:1 million geological map published in 1977 and the accompanying Bulletin 80, "An outline of the Geology of Rhodesia" which was published in 1978. Another milestone during this period was reappraisal of the Achaean Geology of Zimbabwe by the Belingwe Team led by Prof. J.F Wilson (formerly on the Geological Survey staff) with Dr. Anthony Martin, Dr. John Orpen, Dr. Euan Nisbet and Dr. Mike Bickle. Their mapping of the Belingwe (Mberengwa) Greenstone Belt contributed

enormously to the understanding of Zimbabwe Archaean stratigraphy. Stagman retired as Director in June 1978 and was succeeded by his deputy, Euen Richie Morrison who had joined the Rhodesia Geological Survey in 1967. When Morrison took over, many of the 26 posts for geologists were vacant, but Stagman continued as Editor.

The liberation struggle culminated in the Lancaster House talks that paved way for Zimbabwe's independence in April 1980. The two years leading to independence were an interim period symbolized by the country's transitional name Zimbabwe Rhodesia, which was born out of a widely discredited internal settlement that excluded the larger sections of the liberation movement.

4.6 1980-1989

Upon attainment of independence in 1980, international sanctions imposed following Rhodesia's unilateral declaration of independence in 1965 were lifted. Keen investment interest in the Zimbabwean economy ensued, with foreign governments offering technical cooperation within the mining and other sectors. In mining, significant technical cooperation agreements were signed with the British, German, Canadian, Japanese, French and North Korean governments. Many of the agreements were executed in partnership with the Zimbabwe Geological Survey (ZGS). The British Geological Survey funded and executed mapping programmes in selected areas and studied structural controls of gold mineralization in Zimbabwe. The Federal German Geological Survey (BGR) reviewed several coalfields and the Lower Karoo Group in Zimbabwe between 1982 and 1984, and conducted a magnetotelluric survey in the Lower Zambezi Valley, including an interpretation on the depth to magnetic basement from aeromagnetic data generated during uranium exploration, leading to a hydrocarbon exploration agreement between the Government of Zimbabwe and Mobil Oil. In 1986-1988, the BGR undertook geological, geophysical and geochemical mapping of an area west of Guruve. The Canadian International Development Agency (CIDA) conducted aeromagnetic surveys in Zimbabwe, covering nearly 70% of the country in three phases between 1983 and 1990. Another significant contribution by BGR was the setting up of a remote sensing facility initially housed at the ZGS before it was moved to the Scientific and Industrial Research Development Centre (SIRDC).The French Geological Survey (BRGM) and the North Korean assistance supported specific mapping or mineral exploration programmes. The Japan International Co-operation Agency (JICA) has supported many exploration and training programmes to date, with many ZGS staff having visited Japan for hands-on training programmes. JICA's main projects in Zimbabwe included the Snake's Head platinum exploration on the northern part of the Great Dyke, nickel exploration near Shamva, base metal exploration in Makonde, and gold exploration in the Midlands.

Apart from the technical cooperation projects, the ZGS continued to execute its main functions in the first decade of independence. Geological mapping recommenced towards the end of 1980 under the supervision and logistical support of Tim Broderick, Chief Field Geologist. Areas mapped in-house and through aid-related projects include Filabusi (1981-1983),

Bindura (1985-1989), Norton (1985), Dorowa-Shawa (1986),Doma (1986-1987),Guruve-West (1986-1989), Matamve north of Beitbridge (1983-1984), Centenary-Mount Darwin (1981-1983); Rushinga-Nyamapanda (1983-1985); Harare (1983-1986), Bulawayo (1983-1986), Mutandahwe (1982) and Dande West (1988-1991). Regional gravity measurements resumed in 1982 after revival of the geophysical unit; exploration continued to be monitored by the Economic Geology section; Regional offices were all manned and the coal resources database continued to be maintained and mineral deposit summaries compiled/ updated. The geological conditions at numerous sites for large and small dams across the country were reported on for the Designs Branch of the Ministry of Water and Water Development and for private engineers as an ongoing service.

Despite the upgrading of the ZGS within the civil service structure, staff retention remained a problem, with the director himself (Morrison) taking early retirement in April 1989, leaving Nick Baglow as Acting Director. In the period 1980-1989, 6 geological maps, 4 bulletins, 2 short reports, 3 volumes of mineral resources series reports, 6 reports on Zimbabwe's coalfields, and annual issues of the ZGS Annals were published. The Annals continued to reflect the achievements of the Geological Survey by way of summary reports on regional mapping, economic updates, exploration reviews and miscellaneous articles.

4.7 1990-2016

Dr. John Orpen who had lectured at the University of Zimbabwe since 1980 was appointed Director of the ZGS in January 1990, inheriting an under-staffed entity. The significant salary gap between the private and public sectors was a major impediment in any efforts to attract and retain geologists, although most junior posts were filled by 1993. However, the ZGS was crippled in that its functions were under-funded within the national budgetary allocations.

Significant technical cooperation projects that were executed beyond 1990 include the re-establishment of a well-equipped geophysical unit by CIDA, the continued BGS support through funding of the position of Economic Geologist and an Editor, BGR monitoring of oil exploration by Mobil Oil in the Zambezi Valley, Australian funding of three expatriate geology positions, including that of Chief Field Geologist Peter Fey in 1992-1995.

The BGS had declined to fund further purely regional geological mapping projects as not having direct economic implications. In this context, apart from funding Economic Geologist and Editor positions, the BGS agreed to sponsor an initiative of E.R. Morrison (following a visit to Canada) of a project to review the structural controls of gold in Zimbabwe. This project, which was headed by Messrs S. D. G. Campbell and P. E. J. Pitfield and focussed on the Midlands Greenstone Belt, resulted in the publication of Bulletin 101 in 1994, which covered structural implications relating to gold across most Zimbabwe greenstone belts.

By the early-mid 1990's, there were early signs that technical cooperation project funding was drying up. When Fey and his fellow Australian geologists arrived, field mapping had

ceased with the resignation in 1991 of Baglow who then headed the field unit. The Director Dr. Orpen himself resigned in August 1993 and was replaced by his deputy, S. M. N. Ncube who initially worked in an acting capacity until 1994 after which he became substantive director for one year in 1995. Ncube was seconded to the Ministry of Mines head office in 1996 and was replaced by W. Magalela in an acting capacity before being confirmed Director in 1997. Magalela resigned in 1997 and was replaced by F. Mugumbate who was Acting Director until 2002 when T. M. Hawadi was appointed substantive Director. By 1997 there were only two on-going, but winding up, technical cooperation projects at the ZGS and the department was severely depleted in staff numbers. Traditionally, the ZGS employed only those geologists with at least a four-year Honours degree in geology. In 1997, Acting Director Magalela secured the authorization to employ geologists with three-year degrees in geology and recruited four geologists under this scheme in 1997. By 2001 three of them had attained the Honours degree through a year of further study at the University of Zimbabwe with the support of the ZGS. In an effort to resume regional geological mapping, the ZGS under Magalela recruited Drs H. Bouammar and A. AitKaci, both of Algerian extraction, as senior field geologists. They, respectively, mapped south of Mataga (Mberengwa) and north of Gokwe up until 2001, representing the last formal regional field mapping work by the ZGS to-date.

The loss of technical cooperation funding has not been made-up for in subsequent budget allocations, leaving the ZGS perennially underfunded. Thus, although the post-independence technical cooperation projects represented a major accelerator of geological work at the ZGS, this kind of funding proved to be unsustainable. The technical projects were headed by expatriates who were relatively well-remunerated courtesy of their home institutions/ governments, but the local ZGS staff relied solely on remarkably lower local salaries. During the same period, Zimbabwe was experiencing an exploration boom with a plethora of companies offering better salaries than the government. Thus, there was a mass exodus of staff to take up positions in private companies and only skeletal staff, mainly expatriates remained at the ZGS for a while to maintain essential services.

The economy of Zimbabwe further declined over the period 2000 to 2008 by a compound annual rate of 6.4% on the back of hyperinflation, financial sector instability, company closures, low capacity utilisation, among other challenges. Although in 2009 the economy stabilised as a result of dollarisation, some challenges have continued and as a result the revenue base of government shrunk, hence affecting budget allocations across all sectors of the economy. The national estimated budget allocations to the ZGS have ranged between US$300000 to US$700000 over the period 2009 to 2016 and in 2017 it is estimated at US$482000. Although the allocations have increased, their share as a percentage of the total budget has declined from 0.03% in 2009 to an estimate of 0.01% in 2017.The underfunding of the ZGS continues to undermine its ability to effectively execute its mandate.

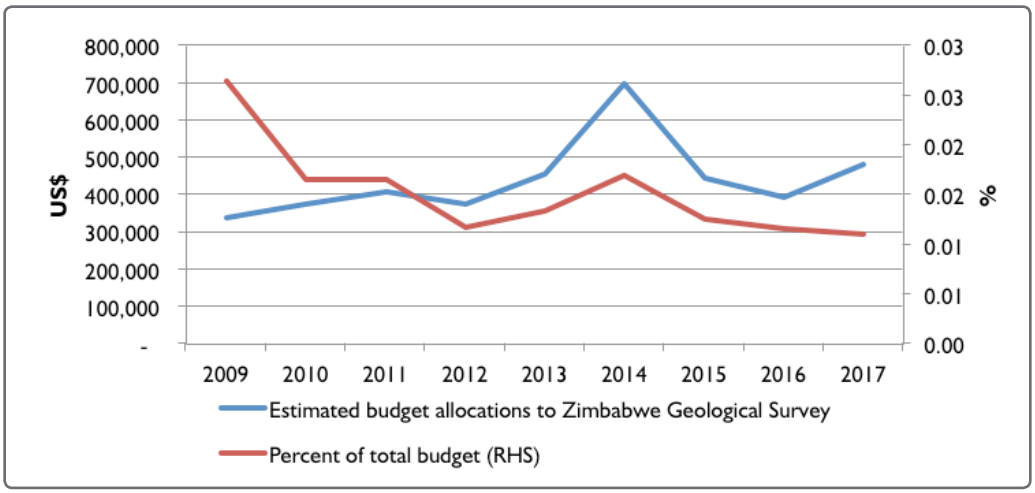


Figure 1. National budget allocations to ZGS, 2009 to 2017. Source: Government Estimates of Expenditure.

However, in 2003 the government embarked on the 'Look East Policy'. This not only drew some mining and mineral exploration investment from countries like China and Russia, but also kindled new technical cooperation initiatives. For example at the time of reporting, the ZGS was rounding up a regional geochemistry mapping programme in partnership with the Chinese Geological Survey. Similarly, Japan, through JOGMEG, has continued to offer training scholarships to ZGS staff and at the time of reporting, was partnering the ZGS to undertake a remote sensing mapping programme in Zimbabwe. Remote sensing provides rapid appraisal of the geology of an area, but should be subjected to ground control to improve reliability.

The Government Institutional Strengthening Project, being implemented in Zimbabwe with the support from the African Development Bank, includes direct support to the ZGS. This support includes capacitation of Zimbabwe Geological Survey through i) supply of cartographic, geophysical and geological equipment ii) training and iii) editing and printing of bulletins.

5. LESSONS FROM THE HISTORY OF THE ZGS

The century-plus history of the ZGS is replete with invaluable lessons that may be used to help shape the future of the ZGS. Some of these lessons are:

- **Dedication to duty and passion for geology:** The Geological Survey started off with a staff complement of only 3 geologists whose dedication to duty saw them achieve a high mapping coverage of the country with their meagre resources: the initial annual budget for the Survey was only £4000, and up to 1925 the only means of transport were donkey or mule wagons. There is need to engender the ethos of service from all staff at the ZGS.

- **Autonomy:** In the early days under the directorship of Maufe, the Geological Survey was a semi-autonomous entity answerable directly to the colonial Administration. When it was felt that Maufe had become 'a law unto himself', the Geological Survey was relegated to a department under the Secretary for Mines and Roads. Today many geological surveys have transformed to become semi-autonomous agencies, from being government departments to ease off bureaucratic hurdles and embolden decision making and implementation.

- **Decentralization:** When the Second World War broke out in 1939, field mapping stopped and economic geology work with mines was prioritized. Geologists were sent to regional mining centres but were recalled to Harare (Salisbury) when it became clear that to be effective they required a whole suite of support services: chemists, mineralogists, metallurgists, etc. Later on decentralization with all complementary staff available at a regional centre for at least some of the time, was more successful.

- **Commercialization:** Noting that rock and mineral identification for the public, prospectors and miners was taking too much of the Survey's time, then director Lightfoot entertained the idea of charging a fee for the services. The idea was however dropped citing potential complications, but was continued proudly as an important free service to prospectors and the public in general. Is commercialization of at least some of the services of a geological survey worthwhile pursuing in today's environment? Some geological Surveys earn as much as 30% of their annual budgets from research and contract work (see Section 9).

- **Exploration:** In the 1950s an exploration section was established within the Geological Survey to undertake exploration programmes, mainly a drilling programme to improve the prospectivity of areas under regolith cover, such as that around Golden Valley west of Kadoma.This kind of initiative does not constitute exploration, it is more like an

older version of Exploration Incentive Scheme of the Geological Survey of Western Australia (GSWA), or a similar scheme run by South Africa's CGS under their Mineral and Energy Resources programme. The Australian scheme involves exploration facilitation, innovative drilling promotion, provision of geophysical and geochemical data, three-dimensional mineral prospectivity modelling and strategic embedded research with industry. In particular GSWA co-funds innovative drilling in greenfields and under-explored areas to stimulate private sector resource exploration. Similarly under the scheme run by South Africa's CGS, data gathering and assessments are undertaken at national and regional scales and provided to the mineral industry. Both versions of the incentive scheme seek to provide pre-competitive geoscience information to stimulate increased private sector resource exploration, potentially leading to new mineral discoveries and greater understanding of the country's geology and resources.

In general geological surveys do not do actual exploration; they facilitate exploration. Junior mining companies utilize the precompetitive datasets to undertake grassroots exploration before giving way to major mining houses to undertake advanced exploration that may lead to discoveries.

- **Staff retention:** Although some Geological Survey staff remained in service for lengthy periods of time as a carrier path, on average the staff turnover has always been high. The Public Service Board had consistently refused to increase staff salaries until 1966. After the salary increases, the staffing situation improved and the Survey could send more staff to the field than was previously possible. According to T. Broderick (personal communication, December 2016), at $250 per month plus $2 a day in Travel & Subsistence allowances, one could live on the latter and save the salary living in a caravan. As a result, the period 1967-1978 was one of the most productive for the ZGS in terms of regional mapping progress, even though there were disturbances due to the escalating liberation struggle. During periods of thriving mining and mineral exploration, Geological Surveys can only attract and retain the best geoscience professionals by closing or at least significantly reducing the salary gap between the private and public sectors.

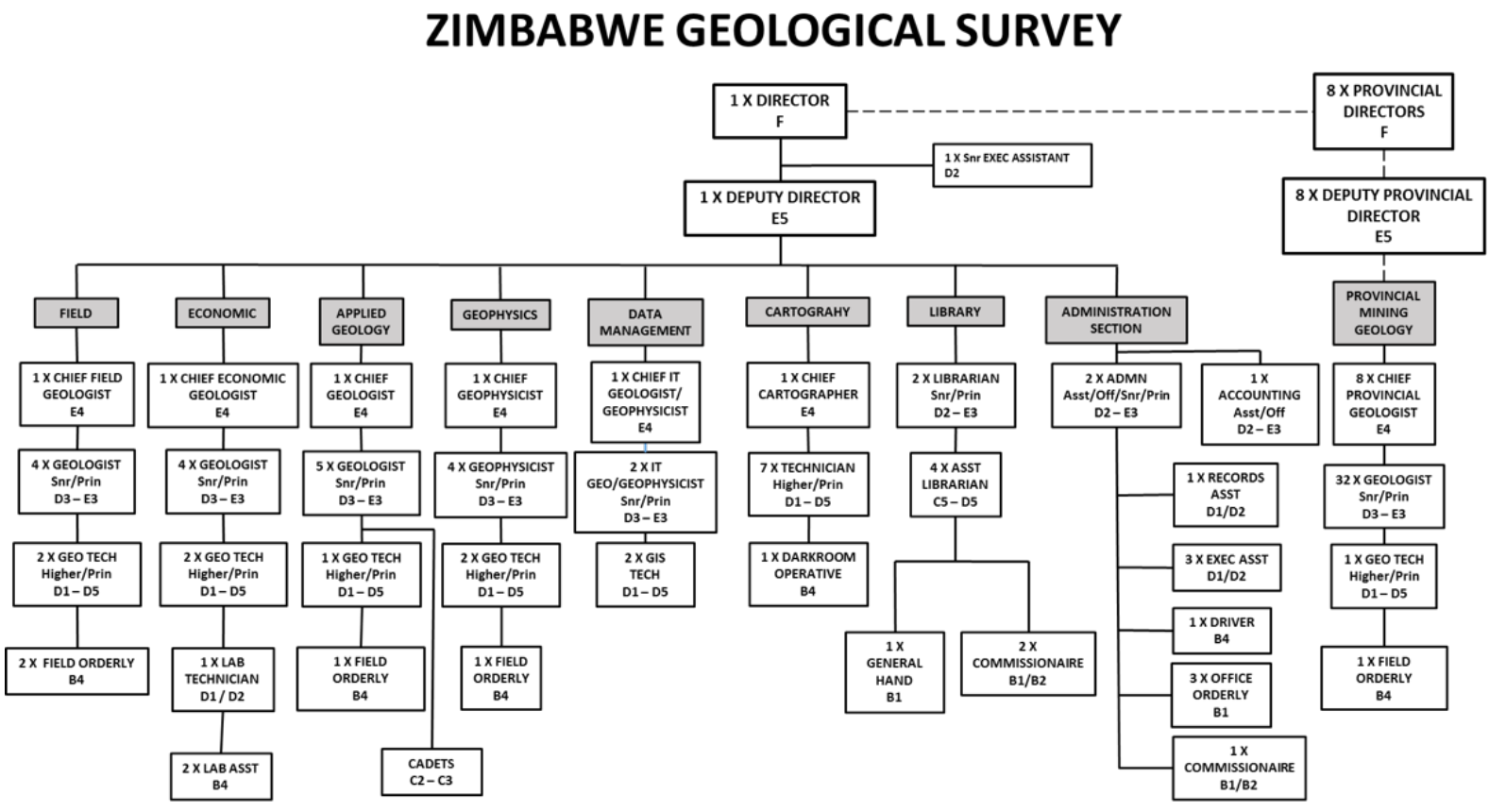


Figure 2. Proposed new structure of the Zimbabwe Geological Survey. Source: Zimbabwe Geological Survey.

6. STRUCTURE OF THE ZGS

When fully constituted by the 1970's, the then Rhodesia Geological Survey consisted of the following sections: Field Mapping, Mining/ Regional geology, Economic Geology, Cartography, Mineralogy (with slide-making and spectrographic facilities), the Library and the Geochemical Laboratory. In 1981, P.P. Zhou re-established a geophysics section at the ZGS, thus reviving regional geophysics experimentation, notably gravity survey, which ran from 1975 to 1976. Another milestone in 1981 was the setting up of a remote sensing facility within the ZGS under a technical cooperation agreement between the ZGS and the German Geological Survey (BGR). The facility was headed by A. B. Made until it was transferred to the Scientific and Industrial Research and Development Centre (SIRDC) in the early 1990s. In many Geological Surveys, such South Africa's CGS and the Geological Survey of Namibia (GSN), remote sensing is a key tool in field mapping and is therefore housed within the Geological Surveys. Departure of the remote sensing unit from the ZGS coincided with cessation of mapping and this could have diminished relevance of the remote sensing unit in the short term.

The above structural organization, less the remote sensing unit, was the one officially in place at the time of reporting, but a new structure (Figure 2) was being proposed. According to the ZGS Director, M. T. Hawadi, the new structure was meant to improve compliance with the decentralization of the Ministry of Mines and Mining Development. In the proposed structure, the Mining Geology section has been moved to the provinces and a new section, the Applied Geology section has been created at the ZGS head office. The roles of the applied Geology Section will include collation of provincial data and coordination of provincial activities, and initiating and maintaining new non-traditional Geological Survey functions such as geo-hazard mapping, environmental geology, engineering geology, geo-tourism and climate change studies.

The decentralization of the Ministry of Mines and Mining Development has led to the transfer of the Mining Geology section of the ZGS to the provinces. Previously the ZGS had Regional Geology offices in Bulawayo and Gweru, manned by two geologists at the most. These would also serve mining offices in Kadoma, Masvingo and Mutare as scheduled from time to time. In the new decentralized structure of the Ministry of Mines and Mining Development, there would be 40 geologists in the provincial offices (Figure 2) who would dually report to Provincial Directors and to the Director of the ZGS. Geology posts for geologists in the provinces are Ministry rather than ZGS posts but through establishment of the Applied Geology section, the ZGS has instituted a mechanism to share provincial information with the Ministry geologists. For the ZGS, the regional (now provincial) presence is not a new thing except that instead of the previous 5 mining districts, there are now 10 provinces, each with 5 geologists (instead of 2). The rest of the ZGS units remain centralized at head office.

7. THE ZGS IN THE EYES OF FORMER AND CURRENT EMPLOYEES

The history of the ZGS as chronicled above shows that many people of diverse backgrounds and aptitudes have been or are currently employed by the ZGS. Their experiences at the ZGS vis-à-vis their expectations during their engagement with the ZGS can usefully inform the direction that the ZGS should take towards its goal of becoming a world-class organization. Crucially, some of the past employees of the ZGS moved on to join reputable national, regional or international organizations and thus collectively have a rich story of how organizations exploit opportunities and address challenges along the road to world-class status.

Questionnaires were sent to many surviving former employees and to current employees of the ZGS (and its legal predecessors) to tap into their ideas of how the ZGS could be transformed into a more efficient, well-resourced organization. Tables 2 summarizes views of three past employees of the ZGS who had stints at the ZGS in the 1970s.

Table 2.Views of former ZGS employees on historical opportunities, successes and challenges of the ZGS.

Employee ID	**FE01**	**FE02**	**FE03**
Period at ZGS	1971-1980;1992-1995	1970-1976	1970-1980
Challenges encountered	• Shortages of professional staff • Derelict vehicle fleet	• War came with it: » Military call-ups of ZGS staff. • Emigration of staff.	• War came with it: » UDI sanctions » High Staff turnover » Disruption in mapping activity in countryside • Inadequate vehicles and field equipment.
How challenges were overcome	• Recruitment of expatriate senior staff sponsored by technical cooperation/ foreign aid programmes in 1992-1995 • Several new field vehicles were acquired by the ZGS in 1994	• Recruitment of new overseas staff	• Not resolved

Period considered as the most successful for ZGS	• 1928-1939: more geologists recruited, introduction of photogrammetry mapping technologies • 1965-1975: Improved salaries: » Attracted many geologists to the ZGS, accelerating mapping pace. » Permitted opening of Gweru and Bulawayo regional offices » Recruitment of full-time editor, permitting timeous editing.	• 1970s: recruitment of 14 new geologists.	• 1947-1977: Most geological mapping, with excellent publications (bulletins) produced during this period.
Views on decentralization of the Ministry of Mines and Mining Development	• Increases bureaucracy, not productivity • Regional offices have successfully been manned by regional geologist and secretary; with additional geologists, mining engineers and metallurgists visiting only upon request. • Drafting capability should be retained in Harare.	• A good move especially if there is a senior supervisor/ mentor in each province. • In the 1970s, field staff were left to their own devices.	• Likely to lead to duplication of positions and resources • There is need for one central office to store maps, reports, tenement records, cartographic section, etc. • Geologists and mining engineers, not metallurgists and cartographers, can work out of regional offices. • From many years of experience with mining organizations, decentralisation is expensive for no gain in productivity.
Current interaction with ZGS	• Engaged to assist with backlog in editing publications.	• No need to interface with the ZGS from Australia • Follows some developments via the ZGS newsletter.	• No official contacts with the ZGS.

Ideas on reconfiguration of the ZGS	• Offer competitive salaries. • Some senior roles may be reserved for experienced expatriates. • At present ZGS should concentrate on revamping its core roles of: » Regional geological mapping and publication » Servicing small-scale miners » Provision of geological advice and mineral identification » Maintenance of the country's mineral inventory • Additional functions to be added when funding, staffing levels and expertise permit.	• Not intimate with ZGS developments • For mining industry in general, Zimbabwe needs to create a favourable investment climate.	• One large central office • Regional offices with very few geologists and mining engineers • Main function is geological mapping – aim to produce the 1:250,000 map of Zimbabwe. • ZGS should help ensure conducive mining investment environment » Tenements granted quickly » Workable Mining Law » Knowledgeable geologists should provide assistance to small-scale miners.

Sixteen current employees of the ZGS responded to a questionnaire soliciting their views on challenges, opportunities, and successes of the ZGS and their ideas towards a world-class ZGS. Their responses are summarised in Table 3.

Table 3. Views of current ZGS employees on historical opportunities, successes and challenges of the ZGS.

Question	Responses
Main challenges facing ZGS	• Lack of project funding • Very low, pathetic salaries • Lack of equipment and vehicles • Offices poorly furnished » Poor or no desks and cabinets » Lack of air conditioners » Poor or no internet access • No on-going geological mapping • High staff turnover and skills flight • Under-utilisation of human resources
Additional functions for the ZGS	• Geostatistical mineral resources evaluation • More detailed geological mapping of Zimbabwe, e.g. 1:250,000 map of Zimbabwe • Re-establish the mineral exploration section at the ZGS • Be the country's chief geoscientific research institution • Providing short courses to small-scale miners • Providing geoscience appreciation to school students to encourage uptake of geoscience at universities • The ZGS must re-tool and resume the basic geological mapping function and remap emerging areas of importance such as the Marange Diamond Field area. No additional functions required at this stage.

Periods when ZGS was most successful	Current employees consider successes and challenges for the ZGS in the following periods: • 1910-1935: Productive formative years of the ZGS, though to an extent affected by the First World War. • 1935-1965: Activities to 1940 were disrupted by the Second World War. Thereafter there was productive geological mapping and a revamping of small-scale mining. • 1965-1980: Though hampered by the liberation struggle and UDI sanctions, this period was very productive and churned out a lot of quality publications underpinned by a boost in staff morale due to improved salary scales. • 1980-1990: The ZGS was relatively well-resourced due to funding commitments from the new government and foreign-supported technical cooperation projects. • 1997-present: One of the worst periods for the ZGS due to paucity of resources, lack of experienced staff and centralized budget control.
Views on decentralization	Positive: • Improved ZGS services access to small scale miners • Reduced workload at HQ Negative: • Decentralisation costly financially • Experienced staff taken away from HQ to provinces • Dual reporting at province and to HQ confusing • Information-scattering in provinces – geological information must be housed at ZGS HQ
What can be done to improve work of the ZGS?	• Encourage foreign direct investment (FDI) in mining • Training workshops on service delivery for all staff • ZGS should embrace modern technologies in its functions, e.g. remote sensing in mapping • ZGS should institute staff-retention schemes, including higher staff salaries • ZGS should request local budgetary powers • Revamp the internet infrastructure at the ZGS • Arrange further training for ZGS staff

8. ZGS IN THE EYES OF CLIENTS

Clients of the ZGS include members of the public, mineral prospectors, small-scale miners, large scale miners and the country's institutions, including educational institutions, and professional associations such as the Geological Society of Zimbabwe. Questionnaires were administered among members of the public/ prospectors as well as members of the Zimbabwe Geological Society. Members of the public and mineral prospectors generally seek free mineral identification and geological advice from the ZGS and therefore their assessment of the services of the ZGS can usefully inform the ZGS on how to improve its day to day service delivery to the public. Geological Society members are a specialised, well-informed clientele that is knowledgeable on geoscientific matters and can make useful suggestions on how the ZGS should operate at function and policy levels.

8.1 Members of the public and mineral prospectors

The questionnaire administered among small-scale miners sought to collect their views on what additional functions they would like the ZGS to offer, how decentralization was influencing their work, how the ZGS should respond to the decentralization of the parent Ministry, and their ideas about how the ZGS should be reconfigured. A summary of responses to these questions is captured in Table 4.

Table 4. Suggestions from members of the public on reconfiguration of the ZGS

Question	Responses
What additional functions would you like the ZGS to provide?	• Public libraries in provinces • Library borrowing facilities to public • E-library resources. • Computerize all information • Analytical instrumentation, e.g. rapid proximal XRF. • Geological and mining news magazine • Publicly available internet facilities at ZGS offices. • Electronic access to geoscientific and tenements data • Provincial mining and exploration equipment hire scheme • Regular outreach meetings/ workshops/ seminars with miners, e.g. every two months to disseminate geological updates. • Re-start regional geological mapping and mineral exploration programmes, including greenfields exploration and geophysics. • Fully equipped gemmology unit
How has the decentralization of the Ministry of Mines influenced your work?	• ZGS now less visible as provinces are under-resourced • Some areas, such as Harare have been disadvantaged as residents have to travel to provinces for ministry of mines services; not all services are available at provinces, e.g. no libraries yet. • ZGS should place copies of all HQ information at provinces

How should the ZGS respond to the decentralization of the Ministry of Mines?	• ZGS should set targets for provinces • Provinces should be autonomous and fully resourced • Publicise the decentralization and educate people on how to access geological services in newspapers and on the radio.
What are your ideas regarding the proposed reconfiguration of the ZGS?	• ZGS should be an independent fully resourced entity • ZGS should set up an exploration unit • ZGS should map and remap areas • Proactive information dissemination, including general geology and new discoveries. • Modernize/ computerize, e.g. provide online platform for data access • Carry out needs assessments among small scale miners on reconfiguration • Encourage large scale miners to assist small-scale miners • Publish outstanding bulletins and reports • Introduce latest technologies in mapping and mineral exploration.

8.2 Geological Society of Zimbabwe

Thirteen members of the Zimbabwe Geological Society responded substantially to a questionnaire seeking their views on how best the ZGS can be reconfigured to better serve the geoscientific needs of Zimbabwe and the world. Most of the Society members who responded are resident in Zimbabwe but others are based in Southern Africa or overseas. Most of the members interact with the Zimbabwe Geological Survey via different forums such as the Zimbabwe Chamber of Mines, Geological Society meetings, liaisons in specific tasks upon request, editing Geological Survey Bulletins, visits to the ZGS for specific purposes such as to purchase of publications or to use the library. Responses of the members of the Geological Society are summarized under the sub-headings below.

8.1.1 Additional functions envisaged for the ZGS

Asked what additional functions they would like introduced at the ZGS, members of the Zimbabwe Geological Society listed items which, as aptly captured by one respondent, mostly amount to asking the ZGS to re-introduce former functions, such as regional mapping, rock cutting and thin section preparation, optical mineralogy, geochemistry laboratory work, gemmology work, regular updates of mineral production statistics and provision of more efficient library services. Many respondents bemoaned that at the time the questionnaire was administered, bulletins remained unpublished more than two decades after the mapping was completed. However, the ZGS has recently moved to clear this backlog, with some members of the Geological Society having been contracted for the requisite editing. A chorus call from the respondents was to have ZGS publications available online free of charge or at minimal cost, in line with international trends. A suggestion was that before final publication, some reports and bulletins could be made available online to promote mineral exploration and investment. In terms of new functions, one respondent suggested that

the ZGS should be the natural sciences centre incorporating hydrogeological, pedological, and geomorphological mapping and capacitated to carry out spatial intelligence analyses integrating several searchable datasets. According to one respondent, the ZGS should take a leading role in guiding the Ministry of Mines and Mining Development in formulating investor friendly mining policy and legislation. Echoing this view another respondent pointed out that the ZGS should be the first port of call for mining investment and must live up to that expectation by providing ready access to basic geological information, including an up-dated 1:1million map of Zimbabwe.

8.1.2 Views on decentralization of the Ministry of Mines and Mining Development

The Ministry of Mines and Minerals Development has decentralized by establishing provincial offices headed by a Provincial Mining Director (PMD). The provincial offices are complete with geologists, mining engineers, metallurgists, draftspersons, and administrators. Geologists report to the PMD, as well as to the Zimbabwe Geological Survey head office at Maufe Building, Harare. The same dual reporting applies to engineers and metallurgists who in addition to reporting to the PMD, also report to the Chief Government Mining Engineer and Director of Metallurgy, respectively. Views were sought from members of the Zimbabwe Geological Society regarding this move which itself constitutes a significant restructuring and expansion of the ministry.

According to one respondent, decentralization could be a good move as long as there is adequate supervision and autonomy, and an investor friendly, free and fair dispensation of the duties among the decentralised provincial offices, and instantaneous central oversight. A common concern among the respondents is that decentralization has removed experienced staff from the Geological Survey head office through promotions to higher provincial posts, including directorships. A more averse view is that decentralization was a premature move as the requisite human and financial resources capacities were lacking. The move was intended to make services of the Ministry more accessible to the local mining communities within provinces but according to one respondent, the opposite could result: a less efficient inaccessible service. One respondent noted that only the mining geology service to the mining industry is what has been decentralized from the ZGS. The respondent implored that in that situation, the ZGS should remain the central data repository fed with high quality data from the provinces.

8.1.3 What should the ZGS do to remain relevant in a decentralizing parent Ministry?

A widely shared view among the respondents is that the ZGS needs to concentrate on its core business of mapping the country and step up this by embracing remote sensing and geophysical mapping technologies recognizing that the ZGS itself has not decentralized. The ZGS must remain a central data repository while the provinces should focus on administering mining titles and site visits, reports of which must be effeciently transmitted to the ZGS.

One respondent pointed out that development of robust Information Communication Technologies (ICT), underpinned by a user-friendly website, must be expedited to facilitate efficient information exchange between the ZGS and the provinces. Whereas one respondent called for a reversal of the decentralisation move, another suggested that the system can become robust and sustainable through active trial-testing. Another respondent observed that for the ZGS to survive and make important contributions to the national economy, the ZGS should come up with relevant training courses in areas such as field mapping for its largely new and inexperienced staff. The respondent noted that the Council for Geoscience of South Africa enrols its junior staff in such courses and pointed out that this could easily be adapted for Zimbabwe given the availability of experienced ex-Geological Survey geologists still in Zimbabwe who are willing to be contracted to mentor junior geologists. The respondent also noted that the ZGS could, additionally, tap into the strength of South African institutions by sending junior staff there for training.

8.1.4 Suggestions for restructuring of the ZGS

This study is about reconfiguration or restructuring of the ZGS. Most people would agree that at the time of this study, the ZGS was not operating optimally and that some sort of reorganisation was required. The ZGS itself has the vision of becoming a world-class geoscientific organization, a dream whose realisation calls for rebranding. However, most responses from members of the Zimbabwe Geological Society suggest that the ZGS must re-establish its former services and functions before any expansion or reconfiguration can be meaningfully instituted or, as one Society member put it, the ZGS 'must learn to walk again before it can fly'. Elaborating this point, Society members pointed out that the ZGS needs to secure funding to rebuild its human resources capacity (including experienced mentors), infrastructure and equipment stocks. In particular, the members pointed out that the field mapping (data collection) and data management (data analysis, archiving, and distribution) sections must be revamped and experienced people appointed to head them. A respondent noted that the ZGS should be the central geoscientific databank of the country and should introduce world-standard mapping techniques and produce new maps which are the basis of new exploration and investment.

8.1.5 Which geological surveys can be models for the ZGS to emulate?

To avoid re-inventing the wheel, this study posed a question to the experts: 'which geological survey in the world can Zimbabwe learn from the most'? The Namibia Geological Survey, the Council for Geoscience of South Africa and the British Geological Survey featured as the most preferred models for Zimbabwe. Geological Surveys of Botswana, Malawi, Australia and the USA were also mentioned but were certainly not considered as top models. The Geological Survey of Tanzania (GST) was not mentioned but its transformation into a semi-autonomous state agency may provide useful lessons for Zimbabwe. One participant indicated that the Geological Survey of Namibia is generally considered to be the SADC model for a Geological Survey.

9. GEOLOGICAL SURVEYS WORLDWIDE

The existence of a Geological Survey is not unique to Zimbabwe; most countries have Geological Surveys or differently named entities that perform Geological Survey functions. For example, the former Geological Survey of South Africa, founded in 1912, became the Council for Geoscience in 1993. One of the oldest Geological Surveys, known as the British Geological Survey since 1984, started in 1835 as the Ordinance Geological Survey. When colonial authorities in the then Southern Rhodesia established the Southern Rhodesia Geological Survey (now Zimbabwe Geological Survey) in 1910, initial suggestions were that the United States Geological Survey (USGS), which had been established in 1879, be the model for the new Survey.

Geological surveys are crucial; every country needs them. To transform the Zimbabwe Geological Survey (ZGS) into world-class organisation, there is need to analyse the resourcing, functions, legal status and service delivery of other Geological Surveys and develop a sound reconfiguration strategy within the Zimbabwean context. To that end, a literature survey, including internet research and questionnaire surveys, were conducted on selected Geological Surveys. In addition, study tours to the Council for Geoscience of South Africa and to the Geological Survey of Namibia were undertaken; this aspect is summarised separately in Section 10.

To gain more insights about Geological Surveys that were not physically visited, questionnaires were administered online to key contact personnel at several Geological Surveys probing specific issues. Ten responses, of which four were complete, were obtained. The four, obtained from the Geological Survey of Western Australia, the Geological Survey of Brazil, the Geological Survey of Finland, and the Geological Survey of the Netherlands, are summarized in Table 5.

One of the leading Geological Surveys in the world, the BGS, operates 12 well-resourced sites containing thousands of assets. The organisational structure of the British Geological Survey is shown in Figure 3 and its funding and resourcing model alluded to in Table 5 is shown graphically in Figure 4. Table 5 also captures some highlights on Geological Surveys elsewhere, including the Geological Survey of Tanzania (GST) which now operates as a semi-autonomous Executive State Agency rather than a government department. The organisational structure of the GST is shown in Figure 5. Figures 6 and 7 show the organisational structures of the Geological Survey of Namibia (GSN) and South Africa's Council for Geoscience (CGS), respectively.

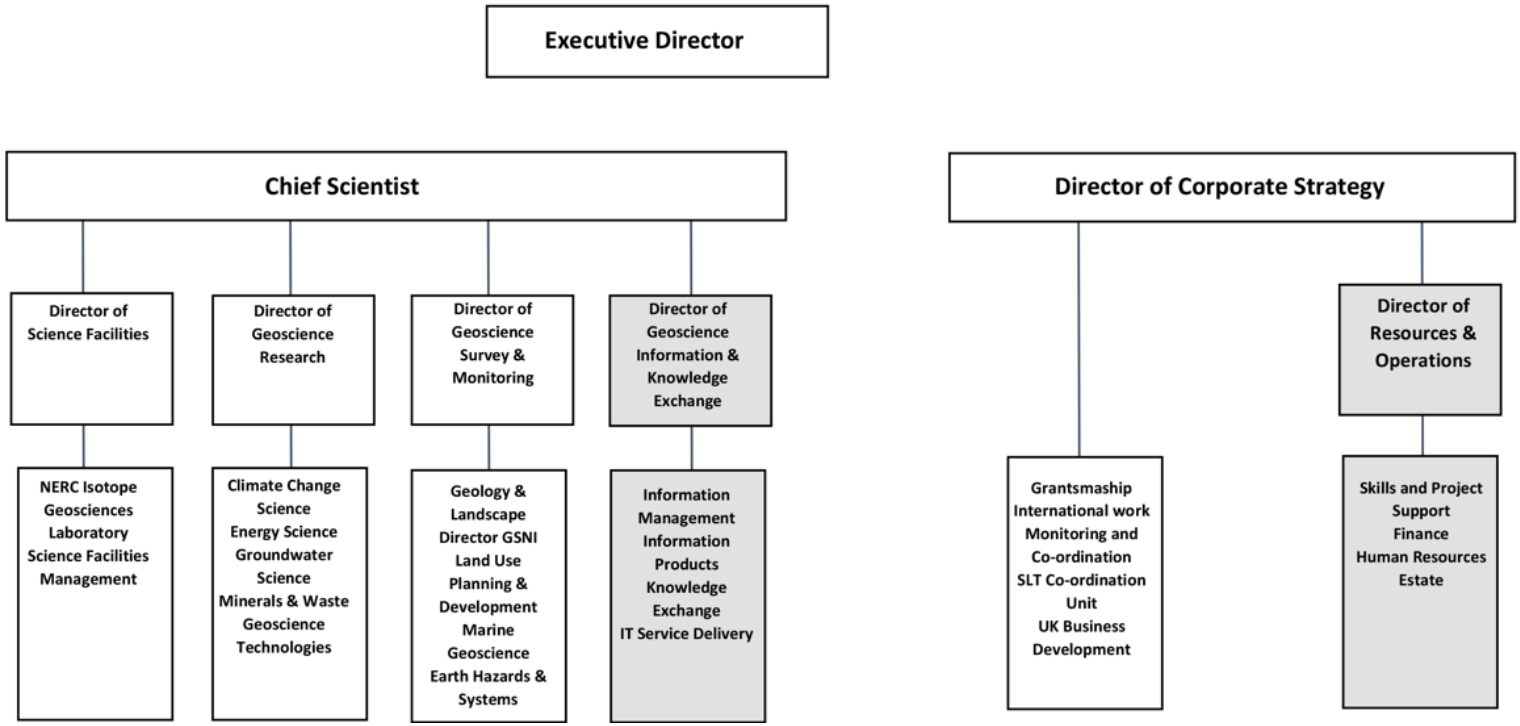


Figure 3. Organisational structure of the BGS. Source: British Geological Survey (2011)

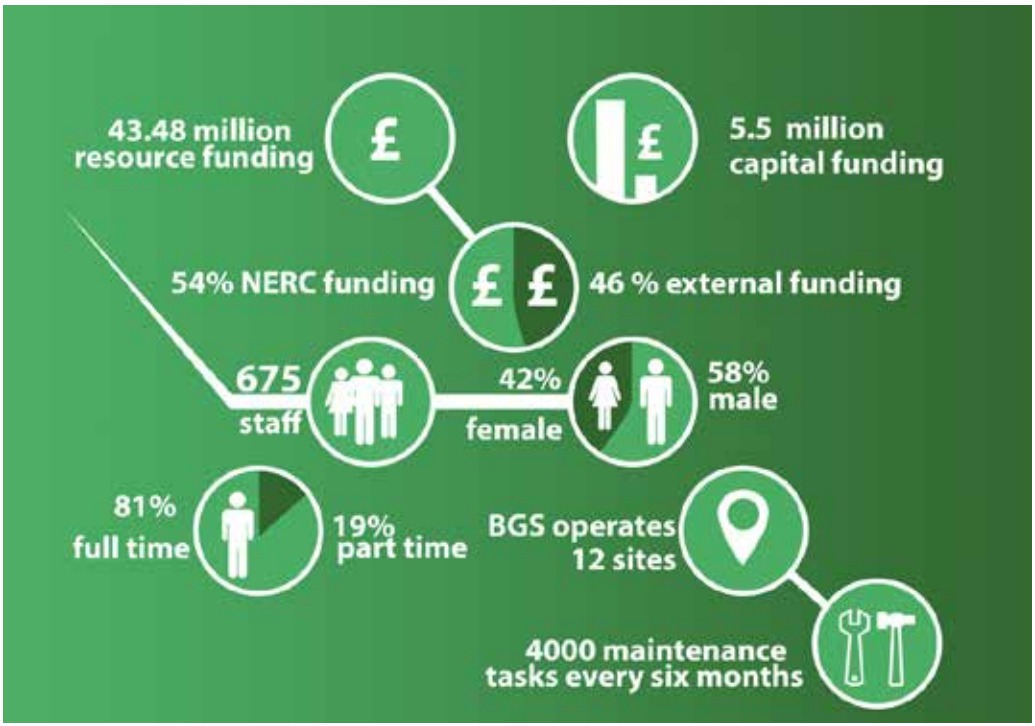


Figure 4. Funding and resourcing of the BGS for the 2014/ 2015 financial year. Source: British Geological Survey (2015).

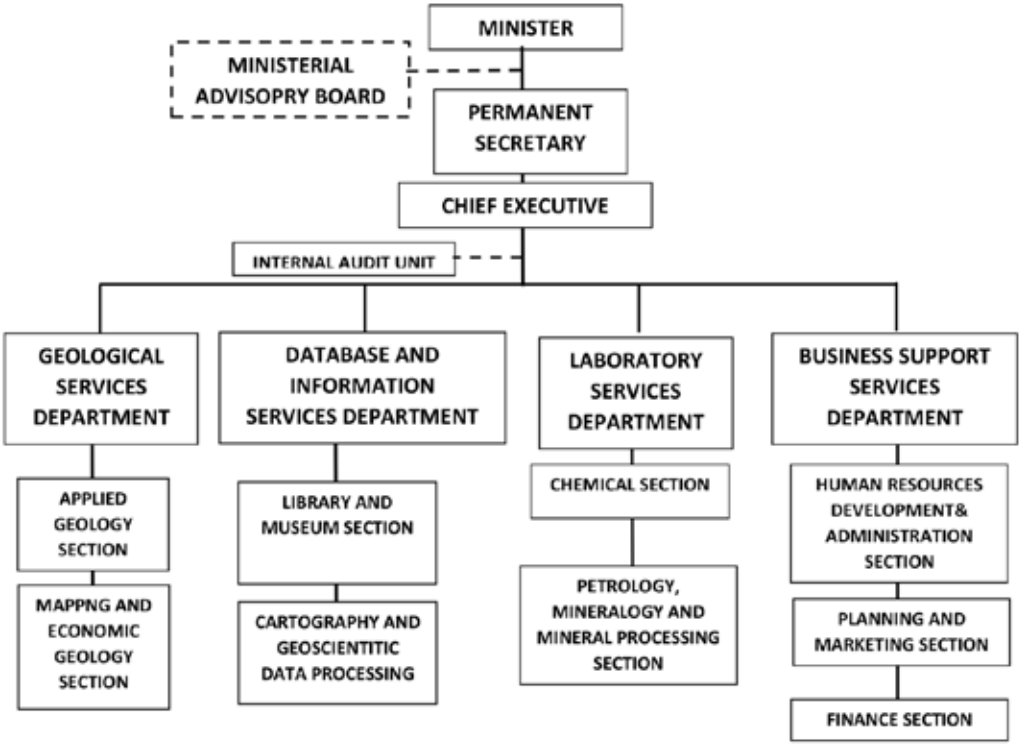


Figure 5. Organisational structure of the Geological Survey of Tanzania.
Source: http://www.gst.go.tz/add/about_organisational.html

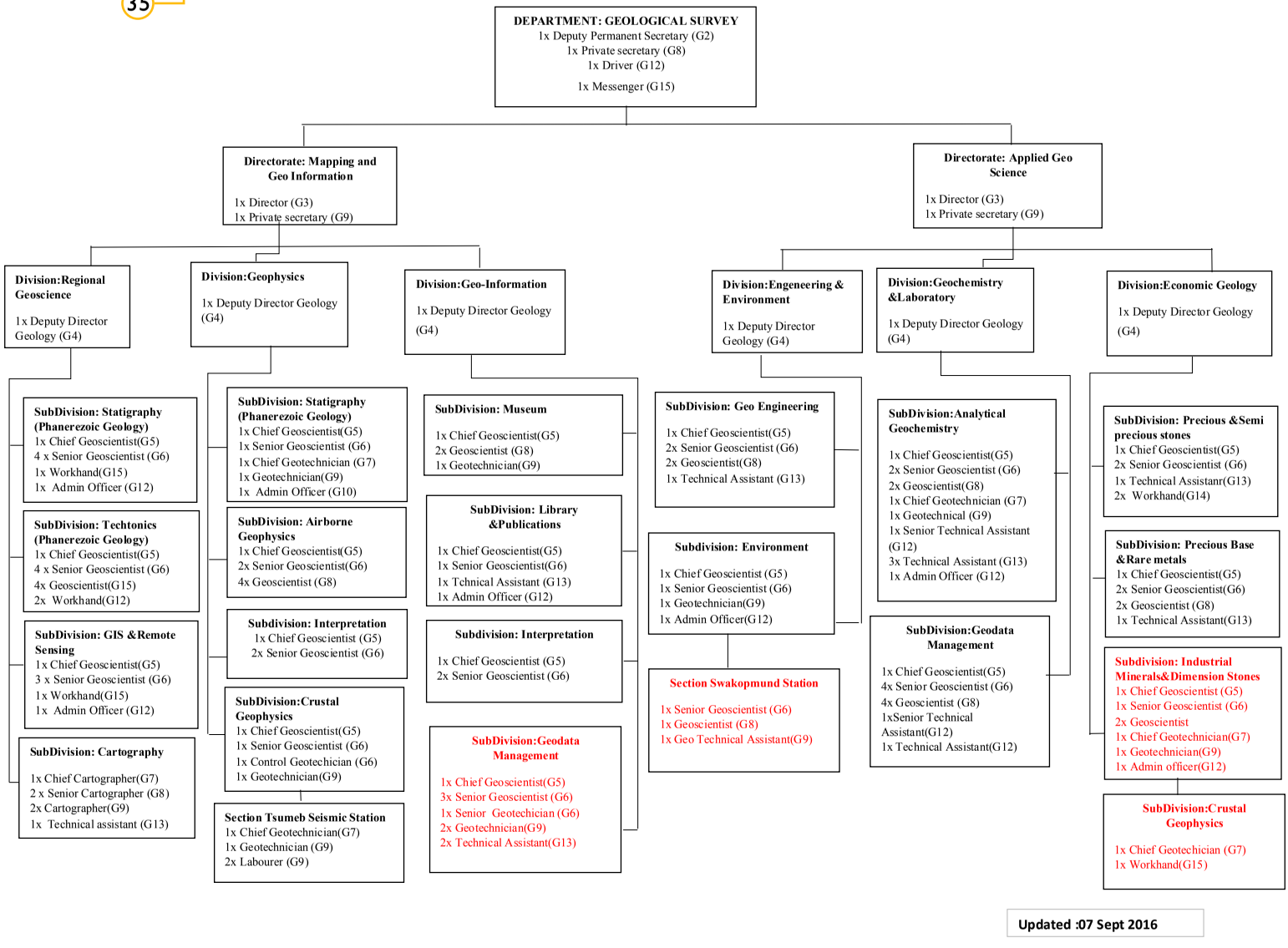


Figure 6. Organisational structure of the Geological Survey of Namibia. Source: Study tour files

Table 5. Summary of information about other Geological Surveys

Geological Survey	Legal Status	Functions	Funding Model	Key strengths	Human Resources
British Geological Survey (BGS)	• Established 1835 • Research Centre of the National Environment Research Council (NERC) • NERC, established by a Royal Charter, is supported mainly by the Department for Business, Energy & Industrial Strategy (BEIS), but its activities and funding decisions are independent of government.	• Provides knowledge of British geology • NERC public good science and research • Overseas research and development programmes	• £45M annual budget on average • Half funded from NERC • Other half from competitively tendered public and private sector research, data licensing and product sales	• Cutting edge geological research • Open release of data • One of the most productive research centres in the world, e.g. BGS publishes about 250 peer-reviewed papers per year.	• 675 staff at 12 UK sites • 58% male, 42% female • 81% full-time, 19% part-time • BGS has a 'People Matter' programme to promote personal and career development for all staff.
Geological Survey of Tanzania (GST)	• Established 1925 by British Overseas Development Authority as a government department • Re-established as an executive agency of government under Executive Agency Act No. 30 of 2007	• Generate and disseminate geoscientific data to stakeholders • Conducting environmental studies • Assessing geo-hazards	• Government budget • Consultancy services • Technical services (geochemical analyses and assays, petrology, mineralogy, geophysics, etc.) • Sale of geoscience products	• Knowledgeable pool of experts, e.g. PhD holders in structural geology and sedimentology • Solid geoscientific databases	• Headed by a CEO assisted by 4 directors • 109 staff including 30 geoscientists and 40 technicians

Geological Survey of Botswana	• Established in 1948 as the Geological Survey of Bechuanaland • A department in the Ministry of Minerals, Energy and Water Resources	• Repository of Botswana's geoscientific information • Sustainable management of Botswana's mineral and water resources • Functions executed by 5 divisions and 5 sections • Divisions: Regional Geology, Economic Geology, Geophysics, Hydrogeology, National Information Centre • Support Sections: Cartography, Drilling, Mineral Dressing, Technical Records & Library.			
Namibia Geological Survey (NGS)	• A department in the Ministry of Mines and Energy	• Research and disseminate geoscientific information on Namibia • Provide landuse advice to government • Promote investment in Namibian mining sector • Showcase earth science to Namibians • Functions carried out by 6 divisions: Regional Geoscience, • Economic Geology, Geophysics, Geochemistry & Laboratory, Geo-information, and Engineering & Environmental Geology.	• Primarily funded from Namibian treasury • Some funding contribution from foreign technical cooperation on specific projects.	• State-of-the art equipment, including geochemical analytical equipment and rock mechanics equipment.	Staff compliment of 139

Algerian Geological Survey Agency (AGSA)	• Changed name from Algerian Geological Survey to National Office of Geology in 1985. • Changed to National Office of Geological Research and Mining in 1992 (ORGM) • Under a mining law of 2001, ORGM split into the National Agency of Geology and Mining Control and the Geological Survey of Algeria • The current AGSA was established by law no. 14-05 of 2014as a department of the Ministry of Industry and Mines	• Acquisition and preservation of Algerian geoscientific information • Conducting geological infrastructure programmes • Maintaining mineral inventories databases of Algeria • Functions spread among three divisions: mapping, Infrastructure and Mineral Resources.	• Treasury budget allocations • Technical cooperation funding/ training arrangements		
Council for Geoscience (CGS) of South Africa	• Established in 1993 as the legal successor of the Geological Survey of South Africa which had been established in 1912. • One of the national science councils of South Africa.	• Public and consulting services, research and training in 4 major areas: » Geoscience mapping » Minerals development » Environment and water » Engineering geoscience and geo-hazards	• Treasury budgetary allocation (about 76%) • Commercial services (consultancies and commissioned research, royalties and fees) (about 23%) • Publications (about 1%)	• Financially viable • Structurally robust • Multiple revenue streams • Excellent facilities • Excellent expertise	• 316 staff in various offices and project areas

Table 6. Responses from key contact personnel from other Geological Surveys.

Question	GS01	GS02	GS03	GS04
Name of your Geological Survey (GS)	Geological Survey of Western Australia	Companhia de Resquisa de Recursos Minerias -CPRM	Geological Survey of Finland (GTK)	Geological Survey of the Netherlands
What entity is your GS	Government Department	Public Company	Government Agency	Embedded in a research organisation
Funding model of your GS	Government-funded		• 70% State budget • 30% Contracts	• 70% state budget for geological mapping and data management • 20% state budget for advising the Ministry of Economic Affairs • 10% mixed (R&D, consultancy)
Mandate of your GS	• Provide geological mapping data for public use • Provide advice to government	• Derived from the Federal Constitution of Brazil	• Create and maintain geoscientific information and expertise • Produce innovations for society and business.	• Derived from (1) Mining Act, (2) Environment Act, (3) BRO Act (new legislation on subsurface data and information).
Functions of your GS	• Geological mapping • Data collection • Document mineral resources • Landuse planning advice to government	• Geological and hydrogeological mapping of Brazil	• Carrying out research • Producing expert services in the sector	• Advisory role • Data and information repository
Powers of your GS	• Regulatory powers on reporting requirements		• Complain and defend on behalf of the State • Supervise the interests and rights of the State in courts of law and agencies in all matters falling within the remit of the Geological Survey.	

Divisions of your GS	• Geoscience mapping • Resources • Geoscience information	• Geological Mapping, • Airborne Geophysics, • Geochemistry, Mineral Researches, • Marine Geology, • Natural Disaster surveys • Geoprocessing Data, Data • Base Systems (geology, mineral resources, environmental studies, hydrogeology).	• Geoenergy • Engineering Geology and Land Use • Subsurface Construction and Waste Disposal • Environmental Geology • Marine Geology • Ore Geology and Mineral Economics • Mineral Resources • Industrial Minerals • Mineral Processing and Materials Research • Peat Resources • Groundwater • Applied Geophysics • Industrial Environments and Recycling • Regional Geodata and Interpretation • Corporate Geodata Management • Digital Products and Services	• DINO (data management) • Geo-modelling (3D geological mapping) • Advisory Group for Economic Affairs
Three challenges facing your GS	• Funding • Finding suitably qualified staff • Web data delivery	• Only 1/3 Brazil mapped at 1:250,000 • Need to finish mapping of Brazil • Capacity building for 3D modelling	• Mineral Economics • Clean Technologies and Landuse • Digitalisation	• Preparing law on subsurface information • Funding diversification • Growth
Envisaged additional functions	• Developing 3D modelling capability	• Understanding geodynamics of South American plate • Understanding South Atlantic Ocean and its mineral prospectivity • 3D database development	• Supporting mining sector • Growing needs of society in environmental problems	• Advisory role for groundwater management • Urban geology • Producing 4D products (subsidence, groundwater flow, etc.)
Area to focus on	• Web data delivery	• Complete 1:100K mapping of Brazil • Capacity building of staff for 3D data processing and modelling.	• Easily accessible geodatabases for public use • Staff with high expertise in geosciences	• Systematic QC of 3D model portfolio; • Professionalization of IT activities; • Maintaining a sufficient level of R&D investments

10. STUDY TOURS

As part of this study, visits were undertaken to two selected institutions undertaking Geological Survey work in Southern Africa, namely the Council for Geoscience of South Africa and the Namibia Geological Survey. The visits are summarised in sections 10.1 and 10.2, respectively.

10.1 Study tour to the Council for Geoscience, South Africa

A Zimbabwean team consisting of the ZEPARU Director, ZEPARU Consultant, ZGS Director and Director, Mining Promotions in the Ministry of Mines and Mining Development spent two days on a study tour of the Council for Geosciences in October 2016. The tour consisted of presentations from the CGS, a tour of CGS facilities (library, laboratories, museum, core yard, seismology section, and the minerals and energy section) and discussions and deliberations. Of particular interest to the study team were the following issues:

- Transformation of the CGS from a government department to a scientific council
- Funding models and revenue streams for the CGS
- Mandate of the CGS
- Resources and facilities and of the CGS

The ensuing presentations, observations and discussions were insightful and can profoundly contribute to the proposed reconfiguration of the Zimbabwe Geological Survey.

10.1.1 Geological Survey to CGS transformation

The Geological Survey of South Africa, a government department established in 1912, was succeeded by the Council for Geoscience, one of the National Science Councils of South Africa, via the Geoscience Act (Act 100 of 1993) which was amended as the Geoscience Act (No. 16 of 2010). Such transformation has facilitated broadening of the CGS mandate to incorporate non-traditional functions of Geological Surveys, and has permitted the CGS to create multiple revenue streams including commercial contract work in and outside South Africa. The CGS is run by a Board of Directors appointed by the Minister and comprising public and private sector representatives, and the Chief Executive Officer of the CGS. The organizational structure of the CGS, which is a typical corporate structure, is shown in Figure 7.

10.1.2 Funding model for the CGS

The CGS is funded by the South African Government (80%), commercial contracts/ commissioned research (20%). The Department of Mineral Resources contributes half the government funding and the other half comes from the Department of Science and Technology. For salary commitments, the CGS receives a separate grant from the government. Currently, the contracts/ research component is made up of work for government departments, such as Economics and Energy departments, engineering geology

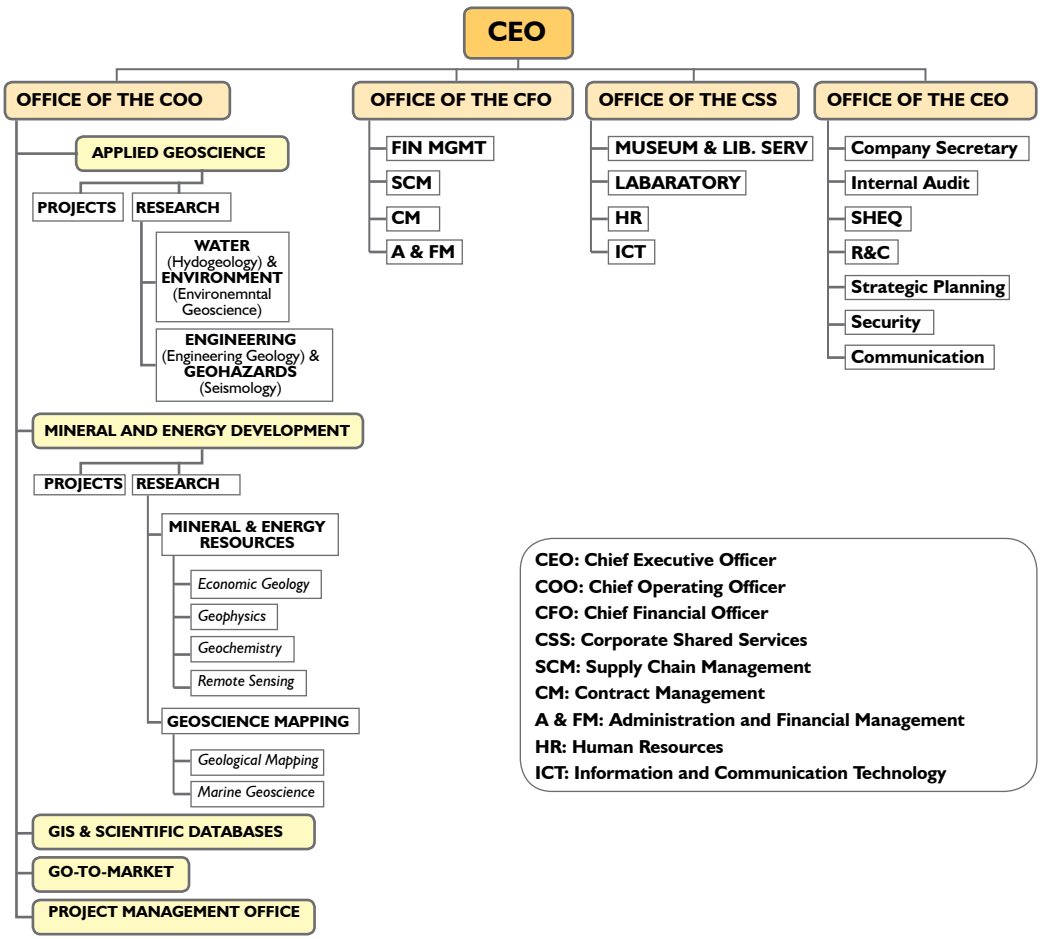
work for municipalities, mineral resources and mapping projects in countries such as Malawi, Namibia, Burkina Faso, Mozambique and Cameroon.

10.1.3 Mandate of the CGS

The CGS principally derives its mandate from the Geoscience Act (Act No. 16 of 2010) according to which the CGS has the mandate to (Council for Geoscience 2015):

- Undertake the systematic onshore and offshore geoscientific mapping of South Africa
- Carry out basic geoscience research into the nature and origin of rocks
- Collect and curate of all geoscience data and act as a National Geoscience Repository
- Render geoscience knowledge, services and advice to the State
- Manage national geoscience facilities on behalf of the country
- Render commercial geoscience services and products to national and international clients

Figure 7.Organisational structure of South Africa's CGS.



To effectively deliver on the above mandate, the CGS has divided its activities into four 'business thrusts', namely: Geoscience Mapping, Engineering Geoscience & Geohazards, Environment & Water and Mineral & Energy Resources. The first and last thrusts encompass what can be considered traditional Geological Survey functions while the middle two encompass non-traditional Geological Survey functions. Geological maps are useful in mineral exploration, town planning and management, environmental work, hydrogeology, and environmental geology. The function of the Engineering Geoscience and Geohazards thrust is to monitor, assess and conduct research on natural hazards to assist policy makers and the public in formulating hazard preparedness and response, and formulating recommendations on the suitability of sites for human settlement and infrastructure development. The Environment & Water thrust develops solutions for problems of soil, water and surface pollution, and of the preservation of sensitive environments. The Mineral & Energy thrust assesses the economic viability of mineral and petroleum deposits to provide pre-competitive geoscience information to facilitate mineral and petroleum exploration and exploitation in South Africa.

10.1.4 Resources and facilities of the CGS

The CGS has 420 employees spread in five provinces: Kwazulu-Natal, Western Cape, Eastern Cape, Limpopo and the Pretoria head office. Among the 420 employees are highly skilled geoscience professionals and technicians with diverse expertise spanning all the geoscience disciplines. Apart from this human resource endowment, the CGS has excellent facilities and assets, including well equipped laboratories (geochemistry, geophysics, seismology, petrology, mineralogy, materials & engineering, and data management), near-shore survey vessels, geophysical aircraft, core yards, drill rigs, museums and well-resourced libraries.

The CGS values its human capital and is dedicated to training and development of its staff, ensuring that the CGS is abreast with modern trends in expert areas. Apart from continuous training and development, the CGS offers scholarships to successful school leavers to pursue geosciences at universities, and to first degree holders to pursue further studies with no obligation to work for the CGS afterwards. Another particularly interesting training platform is the CGS Field School which strives to equip early career geoscientists with the field mapping skills, microscopy, 4X4 driving to put them on sound footing at the launch of their careers. In Zimbabwe, where not much geological mapping expertise remains at the ZGS, such training is critically required. Other CGS training programmes include internships and mentorship programmes.

10.2 Study tour of the Geological Survey of Namibia (GSN)

In December 2016 a Zimbabwean delegation consisting of the ZEPARU Director and ZEPARU consultant visited the Geological Survey of Namibia which is considered one of the best in Africa and also considered in some circles as a good model for Geological Surveys of the SADC region. Even with this status of being a model institution, the GSN was in the process of implementing structural re-organisation (Figure 6) which had been approved by the Namibian Government a few months earlier. Through the reorganization the GSN was

upgraded to a department from being one of five directorates in the Ministry of Mines and Energy. The other four directorates were: Administration & Finance, Mines, Energy and Diamond Affairs.

In the new structure (Figure 6) the Geological Survey Department has two directorates: Mapping & Geoinformation, and Applied Geoscience, with a total establishment of 159 posts.

Objectives of the visit were to learn:
- About the functions and mandate of the GSN
- How the GSN has managed to be among the best geoscience institutions in Africa
- What structural or other changes, if any, the GSN considers necessary for the GSN to perform even better
- About the funding model for the GSN
- How the GSN executes collaborative research and how effective these have been

The GSN arranged tours to their facilities (laboratories, library, museum, core yard, offices), made presentations and explained their functions, opportunities, successes and challenges.

10.2.1 Functions of the GSN

The key broad functions of the GSN are:
- Research and disseminate geoscientific information on Namibia
- Provide landuse advice to government
- Promote investment in Namibian mining sector
- Showcase earth science to Namibians

To effectively undertake these functions, the Mapping and Applied Geoscience Directorates of the GSN are each broken into Divisions which are in turn split into Subdivisions (Figure 6). Geophysics, Regional Geoscience and Geoinformation are the three Divisions of the Mapping and Geoinformation Directorate. Within the Applied Geoscience Directorate are subdivisions Engineering & Environment, Geochemistry & Laboratory, and Economic Geology.

10.2.2 Funding model and legal status of the GSN

The GSN is a government department under the Ministry of Mines and Energy, drawing its primary mandate from the Minerals (Prospecting and Mining) Act (No. 33 of 1992). The Act does not spell out the functions of the GSN and it does not even mention the name Geological Survey of Namibia. At the time of the visit to the GSN, a process was under way to introduce a comprehensive GSN Act to properly spell out the mandate, legal status, functions and powers of the GSN. The GSN is primarily funded by the Namibian government though Treasury, and secondarily from foreign technical cooperation projects via specific project budgets. State-of-the-art facilities and publications at the GSN indicate that the institution is well funded and resourced. However, it was indicated during the tour that

Treasury allocations for the GSN budget are not always adequate. At the time of the visit, a significant cut of up to 60% was being implemented owing to depressed performance of the national economy ostensibly partly due to low mineral prices. Thus, although the Namibian government may be doing its best, this creeping inadequacy suggests that sole reliance on treasury may be problematic for the sustainability and growth of a Geological Survey and that new revenue streams may need to be explored. Several GSN staff were of the opinion that a semi-autonomous status, which would enable the GSN to create new revenue streams, would be preferable. At the time of the visit, the GSN was in consultation with the Office of the Prime Minister for guidance on possible statuses for the GSN namely the status quo (government department), becoming a parastatal or becoming an agency. By establishing a new structure (Figure 6) the GSN had started institutional reconfiguration which expanded the GSN functions and which required additional funding. The demonstrated need for additional funding contributes to the justification for semi-autonomous status.

10.2.3 Resources and facilities of the GSN

The GSN has 139 employees and its main offices are in Windhoek. The GSN has plans for decentralization; currently regional offices are at Tsumeb and Swakopmund. The Windhoek offices are well-maintained and the laboratories are well equipped. Instrumentation includes X-ray diffraction machines, bench top XRF machines, optical polarizing microscopes, gemmological instruments and geophysics equipment. The core yard houses mineral exploration rock and soil samples, as well as samples derived from water drilling operations. The facility has filled up and plans are underway for its expansion. Field vehicles and equipment are currently adequately available.

10.2.4 Technical cooperation and capacity-building programmes

The Regional Geoscience Division (Figure 6) of the GSN charged with regional geological mapping is currently very active and being capacitated through cooperation with South Africa's CGS and South African universities. Experienced South African mappers train young GSN field geologists in field mapping thereby transferring skills to the GSN. Individually the young geoscientists benefit from the experience and knowledge of geological mapping and from earning MSc. or PhD from South African universities through their mapping projects. This in turn ensures that the geological mapping is of high standards. Through this programme, the GSN aims to be self-sufficient again following erosion of more experienced personnel from the institution over the years through retirement. The CGS benefits from the contracts to undertake this kind of work which contributes to their contracts revenue stream.

The GSN has also had several technical cooperation projects with geoscience institutions such as the German Institute of Geosciences and Natural Resources (BGR), the British Geological Survey (BGS), the French Geological Survey (BGRM) and the Swedish Geological Survey. Specific projects under these arrangements have been a significant supplement to the funding of the CSN. Currently, a GSN-BGR Raw Materials for Namibia's Industrial Development project is running and is aimed at:

- Capacity building
- Industrial minerals value chains and beneficiation
- Supporting small-scale industrial minerals mining
- Strategic environmental management

10.3 Summary of the CGS and GSN study tours

The visits to South Africa's CGS and Namibia's GSN, two of Africa's top geoscience institutions, provided invaluable insights into the opportunities and challenges of Geological Surveys. Although both can be said to be very successful compared to their counterparts elsewhere in Africa, they are currently run under different legal statuses. The CGS is 80% funded by the government and raises the rest from contracts and commissioned research. On the other hand, the GSN is 100% government-funded and although it raises significant revenue from its operations (laboratory facilities, customized maps, publication sales, engineering geology work, etc.), the GSN surrenders all revenues generated to Treasury. The GSN is undertaking far-reaching reforms, having recently been upgraded from a Directorate to a Department with two Directorates, signalling a significant expansion in functions and Importantly, a new Act of Parliament is being enacted specifically for the GSN so that its functions, mandate and powers are properly defined and redefined. In addition consultations between the GSN and Namibia's Office of the Prime Minister are on-going as to what status the GSN should aspire to attain. Discussions with GSN personnel suggest that the GSN will tread carefully to avoid pitfalls that may have been encountered in CGS's transformation from a government department. On the whole, however, the GSN realizes that it may not be sustainable in the long run to rely entirely on government funding. It will be interesting to many Geological Surveys to see how the GSN treads this path.

11. PROPOSED RECONFIGURATION OF THE ZGS

11.1 ZGS VISION AND STRATEGY

The mission of the ZGS is to generate, archive and disseminate geological data for Zimbabwe's economic and infrastructural development. Although currently constrained by inadequate funding, the ZGS has the vision of being a world-class geological information services centre by 2020. Achieving the world-class status is a noble goal, but may not be realistically achieved by 2020. However, it is hoped that by 2020 real progress will have been made towards laying the foundation for eventually achieving the world-class status at some later date. The present research, seeks to contribute to formulation of strategies for reconfiguring the ZGS and better position the ZGS to achieve its vision of being a world-class geological information services centre.

11.2 LEGAL STATUS, MANDATE AND POWERS

Between 1910 and 1918, Southern Rhodesia Geological Survey operated as a semi-autonomous agency, its director reporting directly to the colonial administrator. In 1918, the Minister of Roads and Mines expressed discomfort with the semi-autonomous status of the Geological Survey and moved to rein in the Geological Survey by enlisting it as one of the departments under his ministry. Since then the Geological Survey has been a department of the ministry responsible for mines, currently the Ministry of Mines and Mining Development. The Zimbabwe Geological Survey (ZGS) principally derives its mandate from the Mines and Minerals Act (Chapter 21:05) but that mandate is poorly defined compared to that of other Geological Surveys, such as South Africa's Council for Geoscience (see Section 10.1) or the Geological Survey of Tanzania (GST) which now operates as an Executive State Agency. The only functions and powers explicitly conferred upon the ZGS within the Mines and Minerals Act (Chapter 21:05) relate to the right of ZGS officials to unobstructed entry upon any land for the purposes of prospecting, surveying or pegging. The current Act does not even explicitly specify what entity ZGS is, namely a department within the ministry responsible for mines. Such specification is necessary because some Geological Surveys, such as the Geological Survey of Tanzania or the Geological Survey of Algeria have transformed into state agencies. An example of a state agency in Zimbabwe is the Environmental Management Agency (EMA) which is clearly defined within the Environmental Management Act (Chapter 20:27) as a corporate body capable of suing and being sued in its own right, and for which constitution, functions and powers are detailed within the Act. In similar vein, the Minerals Marketing Corporation of Zimbabwe (MMCZ) is '… a body corporate and shall, in the name of the Minerals Marketing Corporation of Zimbabwe, be capable of suing and being sued and, subject to the provisions of this (MMCZ) Act, of performing all such acts as bodies corporate may by law perform' (Minerals and Marketing Corporation of Zimbabwe Act (Chapter 21:04).

Autonomous or semi-autonomous state agencies have or should have the advantage of reduced bureaucratic procedures compared to government departments. Thus, the

Geological Survey of Tanzania (GST) is one of the '… semi-autonomous Executive Agencies within the ambit of Government Ministries for the purpose of providing public services in selected areas in a more efficient and effective manner…' (Executive Agencies Act 1997). According to the Executive Agencies Act, a Permanent Secretary shall be responsible for the strategic management of an Executive Agency under his or her ministry and shall uphold the Agency's autonomy in the day-to-day management of its affairs.

Other advantages of assuming the status of an Agency, as gathered during the study tour to South Africa's CGS, itself defined at law as a 'juristic person', are the flexibility to earn additional funding through contracts and commissioned research, the leeway to work for any government department or ministry and the latitude to work anywhere on Earth.

The ZGS is likely to be in a better position to create additional sustainable revenue streams that may significantly complement government funding if it transforms into a State Agency. Similar transformation is or has happened in several Geological Surveys, including those of South Africa, Tanzania, Algeria, Britain, New Zealand, and the Netherlands among others. Management at the ZGS has strongly expressed the desire for similar transformation. However, questionnaire respondents outside the ZGS appeared to be more concerned about resourcing and functioning of the ZGS. In the current state of where the operations of ZGS are paralysed due to lack of resources, the issue of the legal status of the ZGS may not appear to be of immediate concern to those outside the ZGS. However, their quest for more and better services may in part be addressed if the ZGS morphs into a more efficient, legally empowered and well-resourced State Agency with clearly defined functions. By positioning itself as such, the ZGS can become an indispensable institution that is critical for the development of the mining sector and the development of Zimbabwe in general. Such an Agency can work with the government and its development partners, the private sector, local authorities, training institutions and others in resource mobilisation for sustainable national development.

11.3 Functions: expand or rebuild traditional functions?

Many Geological Surveys worldwide, including South Africa's Council for Geoscience, the British Geological Survey, and Geological Survey of Finland have since moved beyond the traditional functions of geological mapping and mineral resources inventories to incorporate areas such as engineering geology, hydrogeology, environmental management, geo-hazards mapping and climate change. Respondents in this study indicated that while expansion of functions of the ZGS is desirable for its long term sustainability, the ZGS must initially concentrate on re-establishing its former basic functions, particularly regional geological mapping which will act as an anchor for any expansion programmes. Regional geological mapping is such a core function of a Geological Survey that it is interlinked with all other functions such as cartography, petrology and mineralogy, geochemistry, geophysics, mineral exploration and mineral resources inventories. Some areas in Zimbabwe were last mapped more than 50 years ago and some of the maps need updating to encompass evolving

thinking. The 1:1 million geological map of Zimbabwe, a very important mining investment decision tool, had its last major update in 1977 and new geological knowledge acquired since then is compiled but is yet to be captured on that map. The next move would be to produce a larger-scale map for the country such as the 1: 250,000 map, in keeping with trends in other jurisdictions. Other countries are aiming for even greater mapping detail. For example, the Geological Survey of Namibia, in collaboration with South Africa's CGS, has initiated a 1:50,000 geological mapping programme. Thus, if the ZGS transforms into a State Agency, it should aim to retain and revamp former basic functions and modernise by a phased incorporation of the non-traditional functions of a Geological Survey.

In preparation for a future with expanded activities and in order to remain relevant in a decentralizing Ministry of Mines and Mining Development, the ZGS is establishing a new section known as Applied Geology (Figure 2). According to the current thinking at the ZGS, Applied Geology is meant to encompass all non-traditional functions of Geological Surveys and coordinate workflows between the ZGS head office and mining geologists posted at provincial centres. The non-traditional functions include hydrogeology, engineering geology, environmental geology and medical geology and geo-tourism. Tasks involving some of the non-traditional functions can be potentially offered as services to clients at reasonable non-commercial costs thereby contributing to the ZGS revenue streams, cross-subsidising public good functions such as mineral determinations and grassroots geological evaluations. At the time of writing, a concept paper on geo-tourism was being compiled at the ZGS and it is hoped that the concept will take off the ground.

11.4 Funding model: what non-treasury supplementary sources could be explored?

The ZGS is currently funded by the government through treasury budgetary allocations. A capacitated and resourced Geological Survey can significantly supplement government funding through private and public sector consultancies, contracts, technical services, commissioned research and product sales. An emerging trend is that Geological Surveys can be funded 70% by government and as much as 30% through consultancies, commissioned research and provision of technical services and product sales. This70:30 ratio has been achieved by Geological Surveys of Britain, the Netherlands and Finland; South Africa's CGS is at 80:20.The Geological Survey of Tanzania, a state agency, is largely government-funded but this is significantly supplemented from consultancies and sale of products and technical services.

A Geological Survey can only sustainably fund its activities from consultancies and commissioned research when it has attained a good reputation, which in turn can only be earned by a well-resourced, well-run and capacitated entity. The ZGS needs to re-tool and re-establish its former basic functions and demonstrate capacity to undertake work for private and public sectors to be able to attract funding from contracts and commissioned research. However, as stated above gradual and prioritized expansion of functions can potentially contribute significantly to revenue generation.

11.5 Human and material resources

Historically, the ZGS (and its predecessors) has struggled to attract and retain experienced and appropriately trained personnel. Interviewed former Survey geologists indicated that relatively low remuneration was a major reason for leaving the Survey to join private practice. In the 1966 when the salary scales for geologists were significantly raised, there was a spike in staff recruitment which contributed to the peak in regional mapping between 1966 and 1977. As long as the ZGS is a government department, the salary scales will generally mirror those across government departments and salary increases across the board will depend on performance of the national economy. At present the ZGS is unable to attract the most experienced and most talented personnel and has to resort to designing internal training programmes for personnel. A state Agency with better conditions of service is more likely to attract and retain appropriately trained and experienced personnel in a carrier path.

Already a number of ZGS employees with diplomas from the Zimbabwe School of Mines are enrolling with universities to upgrade their qualifications to degree level. Another exciting step taken by the government is the on-going setting-up of the Pan African Minerals University (PAMUST) that will enrol postgraduate students within the minerals sector.

While this academic advancement of ZGS personnel is useful, a suggestion by experienced former ZGS geologists to train younger ZGS geologists in field mapping is probably even more pertinent for the resuscitation of the primary regional mapping role of the ZGS. The ZGS should utilize this window of opportunity to work out modalities to re-engage these experienced and knowledgeable geologists to bequeath to the younger generation skills required to re-interpret the local and regional geology of Zimbabwe which is necessary for the discovery of new styles of hidden mineralization. In the past, retired geologists have been successfully engaged by the Survey on special contracts on the basis of their skills and experience. Examples include former director Phaup who re-joined the ZGS as Editor and mentor between 1967 and 1978, and former Director J.G. Stagman who continued as Editor upon retirement in 1978. At the time of writing this report, former ZGS field geologists Peter Fey, Tim Broderick and Bornwell Mupaya were editing ZGS bulletins which had not been published decades after completion of the mapping. A training programme in field mapping could be developed along the same lines as the Field School of the Council for Geoscience' (CGS's). The CGS Field School started in 2005 as a two-year programme for interns in preparation of their careers with the CGS. The new compressed one-month version of the training includes field mapping, a road trip across South African stratigraphy, and lecture series on GIS and advanced geological mapping. During the study tour, the CGS indicated that it was assisting may African Geological Surveys, including those of Namibia, Malawi, Botswana, Cameroon, Burkina Faso and Mozambique with capacity-building in geological mapping, and would consider assisting Zimbabwe if requested to do so. Similarly, staff at the Geological Survey of Namibia expressed readiness to work with the ZGS if approached.

12. RECOMMENDATIONS

The following recommendations are proffered in considering the future of the ZGS:

1. Define the legal status, mandate and functions of the ZGS clearly: As indicated above, the Mines and Minerals Act (Chapter 21:05 of 1996) from which the ZGS supposedly draws its mandate is vague about what entity the ZGS is and what functions the ZGS should perform (see Table 1). The legal status, mandate and functions of the ZGS must be clearly spelt out as they are for South Africa's CGS, Zimbabwe's Environmental Management Agency or the Minerals Marketing Corporation of Zimbabwe. Currently the ZGS is a government department but started off in 1910 as what can be called today a State Agency. Are there merits of transforming the ZGS into a State Agency in the same way South Africa's Council for Geoscience or Tanzania's Geological Survey have transformed? Although such transformation did not appear to be an immediate concern to most stakeholders judging from their questionnaire responses, this question needs to be seriously considered because it has implications for the development and financial sustainability of the ZGS.

- The on-going amendment of the Mines and Minerals Act provides a window of opportunity to reconsider the legal status of the ZGS, which will form the basis for its transformation. If a decision is made to pursue the transformation of the ZGS into a State Agency, then a completely new piece of legislation may be required which primarily defines the mandate of the ZGS, with the Mines and Minerals Act only secondarily defining such mandate. In that case there may be no need to crowd the Mines and Minerals Act with statutes of the proposed Agency. In Namibia, where the mandate, functions and powers of the GSN are similarly not comprehensively defined, a new Act for the GSN (or its successor) was being crafted at the time of the study tour.

2. Re-establish traditional functions: Traditional Geological Survey functions include the collection (principally geological mapping), storage and distribution of geological information. Currently, the ZGS cannot perform most of its functions, although its stated goal is to become a world-class organization by 2020. Therefore, before the ZGS can become world-class, there is need to ensure that it is capable of carrying out the basic functions of a Geological Survey, after which the ZGS can venture into new geoscience areas. To re-establish former functions requires substantial human, material and financial resources. Recently, the African Development Bank (ADB) assisted the ZGS with procurement of critical equipment requirements to restart operations. In terms of staffing, current ZGS geologists do not have adequate field mapping experience but, fortuitously, there are some experienced mappers who have worked with the ZGS before who expressed willingness to provide training to the ZGS staff. The ZGS is implored to explore this possibility, which may immediately result in a hive of mapping activity in Zimbabwe. The training can borrow aspects from the Field School run by South Africa's CGS after which the trainees are allocated mapping project areas under

the supervision of the trainers. During study tours, the CGS and the Geological Survey of Namibia expressed willingness to assist the ZGS with fieldwork capacity building, an avenue which the ZGS should explore.

3. World-class Geological Surveys today would be well-resourced and would have expanded their functions into non-traditional areas such as engineering geology, environmental geology, medical geology, geo-hazards mapping and climate change studies, among others. Some of these Geological Surveys are such big research and consultancy engines with sought-after expertise and services that a significant part of their funding comes from commissioned research and consultancy. Examples cited earlier include the British Geological Survey, the Geological Survey of Finland, the Geological Survey of the Netherlands and South Africa's CGS. As much as 30% of the annual budget of these organisations comes from consultancy and research. The ZGS presently does not have the same research and consultancy capacity, but can make a start by re-establishing its former reputation in geological mapping and mine evaluations. Growing from these pillars of strength, the ZGS would then eventually establish the non-traditional Geological Survey functions. At that point it may be possible to attract funding from contracts and research. South Africa's CGS is currently capacitating other countries such as Malawi, Tanzania, Namibia, Angola, Gabon and Ghana in geoscience mapping. In addition, the CGS is assisting Geological Surveys of Botswana, Mozambique and Mauritania with capacity building and institutional reform. Zimbabwe can partner the CGS in both institutional reform (reconfiguration) and capacity building in geoscience mapping.

4. Although Zimbabwe's Ministry of Mines and Mining Development is currently decentralizing, the ZGS has remained centralized in Harare. However, some of the more experienced ZGS staff have been transferred to the new provincial offices leaving less experienced staff at base. Thus, although the ZGS has been involuntarily drawn into the decentralisation of the parent Ministry, the ZGS should strategically respond to the decentralisation to remain relevant. As suggested above these less experienced staff left at the ZGS headquarters should undergo tailored training programmes. The ZGS must maintain an effective communication line with provincial offices of the Ministry to collate effectively all information generated at the provincial level. The proposed establishment of the Applied Geology Section to coordinate workflows between the ZGS and provincial geology offices and to spearhead the non-traditional Geological Survey functions appears to be an important strategy for the survival and effectiveness of the ZGS in the changing times.

5. Reconsider the proposed new organisational structure of the ZGS: There is need to reconsider some aspects of the proposed new organisational structure of the ZGS shown in Figure 2:
   - Provincial Mining Geology: Clarification is required on whether the provincial geology unit belongs to the ZGS or to the parent Ministry and how the ZGS headquarters and

the provincial offices can work as seamlessly as possible, one possible bridge being the proposed Applied Geology Section. Whatever the case maybe, it appears the total staff complement at provincial level is too large.

- Applied Geology: Specialist areas, such as Engineering Geology, Geo-tourism, Geochemistry, Hydrogeology and Environmental Geology, etc. can helpfully be itemised on the proposed structure of the ZGS. Hydrogeology is presently under the Groundwater Branch of the Zimbabwe National Water Authority. Similarly, Seismology which normally falls under Geophysics and is an important unit at both the CGS and NGS, is overseen in Zimbabwe by the Goertz Observatory in Bulawayo.
- Geochemistry Laboratory: The ZGS should consider whether or not to re-establish this unit which was disbanded in the 1990s. One option is to outsource the services from other government or government-related institutions such as the Department of Metallurgy or from the Institute of Mining Research (IMR).
- Economic Geology: Provision for mineralogist should be considered within this Section.
- Field Mapping Section: This is a priority area given that about 40% of the country has never been mapped, and that there is need to remap some areas at larger scale or to accommodate new geological knowledge. Thus, this Section appears understaffed with only 5 geologists and 2 technicians. In comparison, the GSN Regional Geoscience Division has 19 Geoscientists (similar to previous ZGS structure which had provision of 18 field geologists), 2 administrators, 4 'workhands', and a cartography subdivision manned by 5 cartographers and 1 technical assistant. One Field Orderly in the proposed new ZGS structure is inadequate; a mapping geologist requires a field assistant and a camp guard, who are normally temporary seasonal staff.
- Cartography: A deputy Chief Cartographer may be required.
- Library: The library appears bloated on the new structure given that, in comparison, it is much smaller than that of South Africa's CGS or that of the Geological Survey of Namibia (GSN). The GSN library has a staff establishment of 4 whereas the ZGS proposes an establishment of 8 for its library. With electronic data management, including digital dissemination, the ZGS library can do with less staff numbers.
- Museum: The museum is not included on the organogram in Figure 2, yet it has a very important educational role. Within the GSN, the museum is a subdivision of the Geo-Information Division, which also has the Library and Data Management sub-divisions.
- Editor/ Mentor: There is need to provide for the position of in-house Editor/ mentor in the new proposed structure of the ZGS.
- Drivers: The new ZGS structure should include positions for drivers.

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