Belize National Spatial Data Infrastructure

Supporting Sustainable and Resilient National Development

Programme Design

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GPC Group
A Global Network of Information Professionals

Belize National Spatial Data Infrastructure

PROGRAMME DESIGN

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EXECUTIVE SUMMARY

This report provides a comprehensive general design for the Belize National Spatial Data Infrastructure (BNSDI) programme. This design is based on a thorough analysis of the existing situation in the past and current utilization of geographic information system (GIS) technology across the Government of Belize and selected representative non-government stakeholders and a projection of future potential uses. Also assessed were the related factors that will impact the form, function and utilization of a common BNSDI utility in government, including both technical (computing infrastructure, data, application software, skilled technical staff capacity) as well as institutional (policies, procedures, inter-institutional arrangements) matters.

The full BNSDI is a broad programme that ultimately can have far-reaching and transformative impact on government and society in Belize, but will not be implemented overnight. Rather this will involve a phased, incremental development program to be addressed in a subsequent BNSDI Implementation Plan. The current programme design is intended to provide a comprehensive reference framework that will provide structure and context to the planning and implementation processes.

This report covers several key components that need to be addressed for the program to function effectively, including:

BNSDI Policy. This includes the formulation of the policy for the establishment of the BNSDI as a permanent function in Government. This has been developed, in reference to and extending the initial "Belize National Spatial Data Infrastructure (NSDI) Policy" which was approved at a meeting of the Government of Belize Cabinet held 21st August, 2012, Cabinet-Confidential Memorandum No. 40 of 2012.

Institutional Framework. A Governance Structure for the BNSDI Programme, the Coordination Center and the various stakeholder representation bodies that will be responsible for shaping and directing the Programme is provided.

Coordination Centre. The BNSDI Coordination Centre will be responsible for carrying out a variety of activities that will be necessary for the BNSDI programme and infrastructure to perform effectively as described in this report. The purpose of the Coordination Centre is to facilitate, coordinate and support the BNSDI initiative on a permanent basis, and to provide geographic analysis and decision support to the executive leadership when required. Although housed within the Ministry of Natural Resources, Spatial Data Department, it will be important that the BNSDI Coordination Centre functions under the direction of the Executive Committee to support both the initiation and operation stages of BNSDI development.

Data Framework. This section outlines the framework for the development, documentation, management and dissemination of fundamental geospatial data sets (FGDS) information needed by the community.

Computing Infrastructure. This section provides the general specifications for the hardware, software and web portal components needed for the Coordination Center to carry out its work and support the BNSDI stakeholder community.

Annexes. An extensive set of annexes are provided, including:

Charters, Templates and Standard Operating Procedures. A series of Annexes outline the various charters, templates and standards operating procedures that are needed to structure and guide the BSNDI operations.

Standards. A series of selected international standards that have some relevance to the BNSDI are provided for reference.

This BNSDI Programme Design, once finalized, is to be followed with the development of a more detailed Implementation Plan that will spell out the specific tracks and activities that will be required to carry out the next phase of BNSDI development.

Definitions and Acronyms

APAMO		Association of Protected Areas Management Organizations
BACONGO		Belize Association of Conservation NGOs
BAD		Belize Archives Department
BAHA		Belize Agricultural Health Authority
BAS		Belize Audubon Society
BBIS		Belize Biodiversity Information System
BCB		Banana Control Board
BCC		Belize City Council
BCCI		Belize Chamber of Commerce and Industry
BCS		Belize Country Strategy for Adaptation of the Sugar Industry
BEL		Belize Electric Company Limited
Bmp CITCO		Belmopan City Council
BNMP		Belize National Map Programme
BNSDI		Belize National Spatial Data Infrastructure
BERDS		Biodiversity and Environmental Resource Data System of Belize
BEST		Belize Enterprise for Sustainable Technology
BLPA		Belize Livestock Producers Association
BNCC		Belize NSDI Coordination Center. Function or unit proposed to provide the facilitation, coordination, promotion and support that is needed to build and operate an NSDI
BNE		Belize Natural Energy Ltd.
BNSDI		Belize National Spatial Data Infrastructure
BRDP		Belize Rural Development Programme
BSI		Belize Sugar Industry
BTB		Belize Tourism Board
BWSL		Belize Water Service Limited
CARDI		The Caribbean Agricultural Research and Development Institute (CARDI) was established in 1975 to serve the agricultural research and development needs of the member states of the Caribbean Community (CARICOM).
CATHALAC		Water Center for the Humid Tropics of Latin America and the Caribbean (in Spanish ¨CATHALAC¨- Centro del Agua del Trópico Húmedo para America Latina y el Caribe) is an autonomous international organization dedicated to promote sustainable development through applied research and development, education, and technology transfer in the areas of integrated watershed management, climate change, environmental modeling and analysis, and risk management in Latin America and the Caribbean
CARICOM		Caribbean Community
CBA		Central Building Authority
CBD		Convention on Biological Diversity
CBO		Community Based Organization
CCB		Citrus Company of Belize
CCCCC (5C's)		Caribbean Community Climate Change Center
CDB		Caribbean Development Bank
CEO		Chief Executive Officer / Chief Environmental Officer
CFR		Chiquibul Forest Reserve
CGA		Citrus Grower's Association
CH4		Methane
CIARMP		Community Initiated Agricultural Resources Management Project
CITES		Convention on International Trade in Endangered Species of Wild Fauna and Flora
CNP		Chiquibul National Park
CO		Carbon Monoxide
CO2		Carbon Dioxide
CPA		Country Poverty Assessment
CPACC		Caribbean Planning for Adaptation to Climate Change

CRIP		Climate Resilient Infrastructure Project.
CZMAI		Coastal Zone Management Authority and Institute
DfID		Department for International Development (formerly ODA)
EIA		Environmental Impact Assessment
Enterprise GIS		Enterprise GIS refers to a geographic information system that is effectively integrated as a fundamental component of an organization's information infrastructure, business processes and customer services.
EPA		Environmental Protection Act.
ERI		Environmental Research Institute of the University of Belize
ESTAP		Environmental and Social Technical Assistance Project
EU		European Commission / Union
FAO		The Food and Agriculture Organization of the United Nations leads international efforts to defeat hunger. Serving both developed and developing countries, FAO acts as a neutral forum where all nations meet as equals to negotiate agreements and debate policy. FAO is also a source of knowledge and information. We help developing countries and countries in transition modernize and improve agriculture, forestry and fisheries practices and ensure good nutrition for all. Since our founding in 1945, we have focused special attention on developing rural areas, home to 70 percent of the world's poor and hungry people.
FCD		Friends for Conservation and Development
FD		Forest Department
FGDC		Federal Geographic Data Committee (USA)
FGDS		Fundamental Geospatial Data Set. This is any data theme or topic that is needed in common across a stakeholder community.
FIRMS		Fire Information for Resource Management System
FPMP		Forest Planning and Management Project
GBIF		Global Biodiversity Information Facility
GDP		Gross Domestic Product
GEF		Global Environment Facility.
GeoNode		GeoNode is an open-source, web-based application and platform for developing geospatial information systems (GIS) and for deploying spatial data infrastructures (SDI)
GEO		Group on Earth Observations
GEO		Global Environment Outlook
GeoMaturity		A set of performance standards for the measurement and assessment of the optimization of GIS technology within an organization, sector and NSDI community
GHG		Green House Gas
GIS		Geographic Information System. A Geographic Information System is a computer system designed to allow users to collect, manage, and analyze large volumes of spatially referenced and associated attribute data. The major components of a GIS are: a user interface system; data base management capabilities; data base creation/data entry capacity; spatial data manipulation and analysis packages; and display/product generation functions.
GoB		Government of Belize
GPA		Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities (UNEP)
GPS		Global Positioning System
HDI		Human Development Index
HIV/AIDS		Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
Hydromet		Belize National Meteorological Center
IABIN		Inter-American Biodiversity Information Network
ICRAN		International Coral Reef Action Network
ICT		Information and Communication Technologies
IDB		Inter-American Development Bank
IICA		The Inter-American Institute for Cooperation on Agriculture (IICA) is a specialized agency of the inter-American system, and its purposes are to encourage and support

		the efforts of its Member States to foster agricultural development and rural well-being in their territories.
IP		Internet Protocol
IPCC		Intergovernmental Panel on Climate Change
ISO		International Organization of Standardization
ISP		Internet Service Provider
IT		Information Technology
IUCN		International Union for Conservation of Nature
IUU		Illegal, Unreported and Unregulated
IWRM		Integrated Water Resource Management
KB		Kilobyte
KCB		The Ke'kchi Council of Belize
LIC		Land Information Centre
LLES		Limited Level Environmental Study.
MAR		Mesoamerican Reef
MARPOL		International Convention for the Prevention of Pollution from Ships
MBRS		Mesoamerican Barrier Reef System
MDG		Millennium Development Goals
MEA		Millennium Ecosystem Assessment
Metadata		Standardized catalog of information about each geospatial data set
MFED		Ministry of Finance and Economic Development
MFFSD		Ministry of Forestry, Fisheries and Sustainable Development
MLGRD		Ministry of Local Government and Rural Development
MNRA		Ministry of Natural Resources and Agriculture
MoESTPU		Min of Energy, Science & Technology, and Public Utilities
MoFED		Ministry of Finance and Economic Development
MoH		Ministry of Health
MoWT		Ministry of Works and Transport
MPAs		Marine Protected Areas
MPRFR		Mountain Pine Ridge Forest Reserve
NASA		The National Aeronautics and Space Administration (NASA) is the agency of the United States government that is responsible for the nation's civilian space program and for aeronautics and aerospace research
NAVCO		National Association of Village Councils Organization
NBII		National Biological Information Infrastructure (USA)
NBSAP		National Biodiversity Strategy and Action Plan
NCB		National Coordinating Body
NCCC		National Climate Change Committee was established to advise government on issues regarding climate change
NCRIP		National Climate Resilient Investment Plan
NEAC		National Environmental Appraisal Committee. The Committee was established to review development projects in the context of the national environment.
NEAP		National Environmental Action Plan
NEMO		National Emergency Management Organization
NFAB		National Fisheries Advisory Board established to provide guidance on fisheries commodities extraction strategies and policies
NFP		National Focal Point
NGO		Non-Governmental Organization
NICH		National Institute for Culture and History
NMS		National Meteorological Service
Node		A facility that is connected to other facilities over the Internet for the purpose of publishing and sharing data
NPAC		National Protected Areas Committee. This Committee was established to advise the government of Belize on issues concerning the national protected area system
NREPS		Natural Resource and Environmental Sub- committee was established to increase the national understanding and acceptance of the linkages between natural resource and environmental protection and socio-economic development
NSDI		National Spatial Data Infrastructure. An institutional and technical framework for

		coordinating and sharing geospatial information across a stakeholder community.
OAS		Organization of American States
ODA		Overseas Development Administration
OIRSA		The International Regional Organization for Plant and Animal Health (OIRSA) is a technical organization established to provide administrative and technical support to the Ministries or Secretariats of Agriculture from its member countries, to protect and develop their agricultural resources in order to achieve a healthy production to satisfy population's demands and provide well-being. OIRSA's assistance is focused on its member countries' projects and plans for plant and animal health, food safety and facilitation towards agricultural commerce
PACT		Protected Areas Conservation Trust
PAHO -		Pan-American Health Organisation
PCPU		Policy Coordination and Planning Unit
PEU		Programme Execution Unit
PFB		Programme for Belize
PUC		Public Utilities Commission
QuickStart		An activity that is an accelerated portion of a longer term initiative, intended to result in near-term, visible and compelling results.
RAMSAR		Convention on Wetlands of International Importance Especially as Waterfowl Habitat
REDD		Reduction of Emissions from Deforestation and Degradation
SERVIR		Regional Visualization and Monitoring System
SIB		Statistics Institute of Belize
SICB		Sugar Industry Control Board
SIF		Social Investment Fund
SIRDI		Sugar Industry Research and Development Institute
SISE		San Ignacio/ Santa Elena Town Council
SPAGs		Spawning Aggregation Sites
Spatial Data Clearinghouse		Common repository of geospatial information, often composed of data provided by multiple custodians
SIG		Special Interest Group. A permanent multi-stakeholder body that is established to provide communication, coordination and support around a particular common interest or practice.
Stakeholder		Any organization or person that will be involved in the development and/or use of the Belize NSDI
SCADA		System Control and Data Acquisition
SWMA		Solid Waste Management Agency
SWOT		Strengths, Weaknesses, Opportunities and Threats
TBSL		Total Business Solutions Ltd.
TNC		The Nature Conservancy
TOR		Terms of Reference
UB		University of Belize
UN		United Nations
UNCBD		United Nations Convention on Biological Diversity
UNCCD		United Nations Convention to Combat Desertification
UNDP		United Nations Development Project
UNEP		United Nations Environment Program
UNESCO		United Nations Educational, Scientific and Cultural Organization
UNFCCC		United Nations Framework Convention on Climate Change
USAID		United States Agency for International Development
WB		World Bank
WCMC		World Conservation Monitoring Centre
WCS		Wildlife Conservation Society
WMO		World Meteorological Organisation (UN)
Working Group		A temporary body, normally consisting of representative members from multiple concerned organizations, assigned to address a particular subject over a certain period of time

WRI		World Resource Institute
WWF		World Wildlife Fund
XML –		eXtensible Markup Language
CINTEC		Council for Information Technology (CINTEC)
DMC		Disaster Management Centre
FGDS		Fundamental Geospatial Data Sets (FGDS).
Geomaturity		Geomaturity is a measure of the level of technical and institutional development in regards to the use of GIS technology in an organization.
Geoportal		Web-based portal for discovering, accessing and viewing GIS data services
Geospatial Data		"Geospatial data" means information that identifies the geographic location and characteristics of natural or constructed features and boundaries on the earth. This information may be derived from, among other things, remote sensing, mapping, and surveying technologies. Statistical data may be included in this definition at the discretion of the collecting agency.
GIS		Geographic Information System
GPS		Global Positioning System
GSDI		Global Spatial Data Infrastructure
ICT		Information and Communication Technologies
Coordination Centre		Information and Communications Technology Authority
IP		Internet Protocol
IT		Information Technology
ISO		International Standards Organisation
ISO/TC		International Standards Organisation/Technical Committee
ISP		Internet Service Provider
LGN		Lanka Government Network
National Geospatial Data Clearinghouse		The "National Geospatial Data Clearinghouse" means a distributed network of geospatial data producers, managers, and users linked electronically
NMP		National Map Portal
NSDI		National Spatial Data Infrastructure. An institutional and technical framework for coordinating and sharing geospatial information across a stakeholder community.
OECD		Organisation for Economic Cooperation and Development
OGC		Open Geospatial Consortium
PDF		Portable Document Format
RDBMS		Relational Data Base Management System
RTI		Right To Information
SDD		Spatial Data Dictionary
SDE		Spatial Data Engine
SDI		Spatial Data Infrastructure
BNSDI		Belize National Spatial Data Infrastructure" (BNSDI) means the technology, policies, standards, and human resources necessary to acquire, process, store, distribute, and improve utilization of geospatial data
SME		Subject Matter Expert
SOA		Service Oriented Architecture
TOR		Terms of Reference
UN		United Nations
VGI		Volunteered Geographic Information
WofG		Whole of Government
WFS		Web Feature Service
WMS		Web Map Service
XML –		eXtensible Markup Language

1 INTRODUCTION

1.1 Background

This BNSDI Programme Design is one component of a structured work program for the planning, design, and implementation of the BNSDI. The position of this report relative to the entire work program is illustrated in the Figure below.

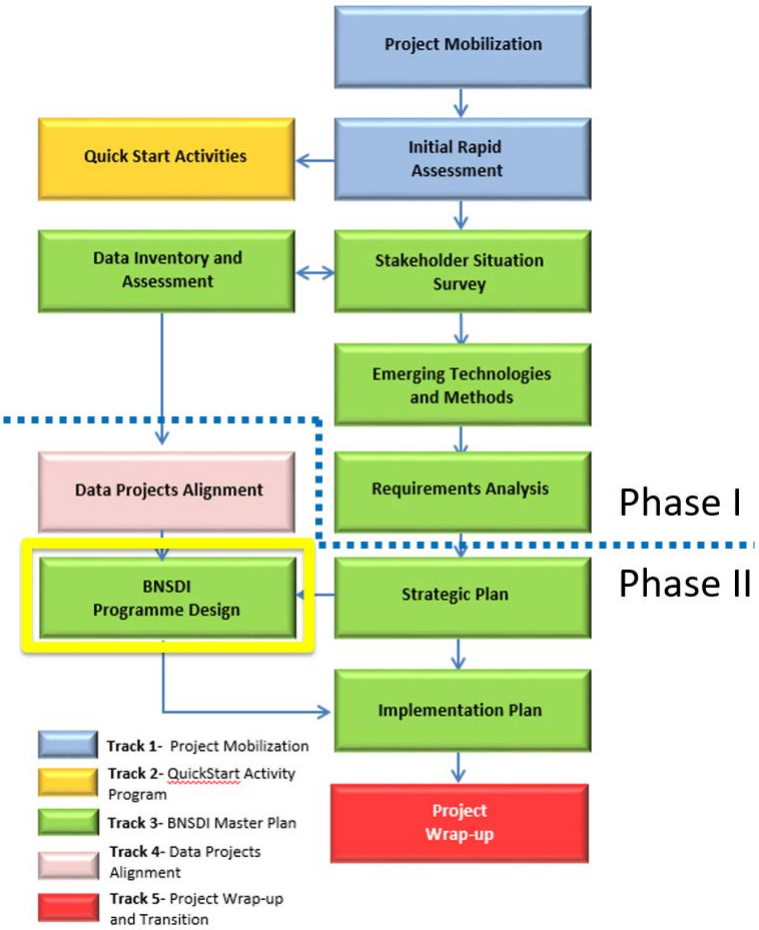


Figure 1 – Work Program Illustration

The synthesis of requirements outlined in this report draws upon previous five contributing activities spanning the two phases of the project, including:

PHASE I

BNSDI Stakeholder Situation Update Survey. The BNSDI Stakeholder Survey involved over 60 units of government and other sectors and identified over 370 major functional areas that are or could benefit from GIS and the BNSDI. The study also outlined over 1700 specific applications of GIS and the BNSDI that

would directly benefit and streamline those functional areas identified, as well as other information and findings.

Data Inventory and Assessment. The Data Inventory and Assessment provides a listing of the extensive range of geospatial data resources that were identified in the conduct of the BNSDI Stakeholder Situation Update Survey activity. This document provides a summary of the information available for over 35 data themes that are further broken down into over 140 specific geospatial data topics and then grouped to nearly 100 fundamental geospatial datasets (FGDS) that are needed in common among the BNSDI stakeholder community.

e-Merging Technologies and Methods. This report outlines a wide range of emerging technologies and methods that have implications for the form and function of the BNSDI in the future. This report outlines a broad range of technologies, applications and enabling policies and methods, from new advanced space platforms for remote sensing, to unmanned aerial vehicle (UAV) survey techniques, to the many uses of social media and crowd sourcing, to the policies and incentives needed to catalyze innovations within the Country, among many other areas. The results of that analysis have been incorporated to this report where appropriate.

Requirements Analysis. This Requirements Analysis report provides a comprehensive overview of the elements that the Belize National Spatial Data Infrastructure (BNSDI) will need to address for it to become a fully functioning, permanent fixture in the Government of Belize. This covers the full range of program requirements that can be classified roughly into business, technical and institutional frameworks and their interdependencies. Information collected and compiled in the previous Stakeholder Situation Update Survey, Data Inventory and Assessment and e-Merging Technology Reports has informed the current report. International best practices in national efforts of a similar scope have been used as a frame of reference that has been extended and adapted to reflect the specific context in Belize.

PHASE II

Strategic Plan. This BNSDI+ Strategic Plan outlines the vision, defining principles and priorities for the initiative. As described in this Strategic Plan, BNSDI+ is to comprise a central programme coordination unit, an interconnected network of interoperable entity nodes, geoportal, data repository and the standards, policies and procedures that together provide the enabling environment to support the coordinated development and sharing of commonly needed geographic information across the Belize stakeholder community.

1.2 Purpose of this document

The BNSDI is intended to provide a fundamental, permanent infrastructure of commonly needed, accurate and up-to-date geospatial data shared in a systematic and secure manner across the stakeholder community. International experience in this field suggests that for any national SDI to be effective there must a supporting framework of technical infrastructure (data, computing infrastructure, applications, trained technical staff), institutional enabling environment (policies, regulations, inter-institutional agreements) and aligned governance (representative bodies, integrated service flows, monitoring and adaptive management and innovation). This report considers the international experience, adapts this to a form that is tailored to the Belize situation. It also goes beyond the traditional "supply side" focused approach to add "demand side" coordination and support functions to ensure that this important asset is optimized to most effectively support climate resilience planning and development investment, more streamlined and coordinated government operations, better services to the public. This programme design provides a broad reference framework for all the required elements that will ultimately need to be addressed.

Once finalized, this document will provide the reference framework for the development, in the next task, of a phased implementation plan for how this programme can be realized through an incremental and staged development process that considers priorities, resource limitations, and other constraints and opportunities.

1.3 Organization of this document

This document is organized into the following sections:

> ***Section 1: Introduction***. This Introductory section outlines the background and purpose of the BNSDI program, the methodology being followed, and other general reference information.
>
> ***Section 2: Institutional Framework***. A Governance Structure for the BNSDI Programme, the Coordination Center and the various stakeholder representation bodies that will be responsible for shaping and directing the Programme is provided.
>
> ***Section 3 – Coordination Centre***. The BNSDI Coordination Centre will be responsible for carrying out a variety of activities that will be necessary for the BNSDI programme and infrastructure to perform effectively as described in this report. The purpose of the Coordination Centre is to facilitate, coordinate and support the BNSDI initiative on a permanent basis, and to provide geographic analysis and decision support to the executive leadership when required. Although housed within the Ministry of Natural Resources, Spatial Data Department, it will be important that the BNSDI Coordination Centre functions

under the direction of the Executive Committee to support both the initiation and operation stages of BNSDI development.

Section 4– Data Framework. This section outlines the framework for the development, documentation, management and dissemination of fundamental geospatial data sets (FGDS) information needed by the community.

Section 5 – Computing Infrastructure. This section provides the general specifications for the hardware, software and web portal components needed for the Coordination Center to carry out its work and support the BNSDI stakeholder community.

Section 6 – Financing. The BNSDI represents a common infrastructure that requires an approach to financing the initial facility, creation or upgrading of commonly needed baseline data and ongoing operations and maintenance support. This section provides an overview of these topics and potential financing mechanisms.

Annexes. An extensive set of annexes are provided, including:

- Charters, Templates and Standard Operating Procedures. A series of Annexes outline the various charters, templates and standards operating procedures that are needed to structure and guide the BSNDI operations.
- Standards. A series of selected international standards that have some relevance to the BNSDI are provided for reference.

2 INSTITUTIONAL FRAMEWORK

This section outlines the institutional framework for the BNSDI, inclusive of a conceptual governance structure for the BNSDI Programme and the various stakeholder representation bodies that will be responsible for shaping and directing the Programme. This structure is defined in alignment with the BNSDI Policy outlined in Section 2.

This section is followed by others that describe the structure and operations of the Coordination Centre, an office that will provide secretariat support to the BNSDI Executive Committee and will be responsible for the day-to-day facilitation, promotion and support of the BNSDI initiative. While this Centre will ostensibly under the strategic direction of the Executive Committee, it will be housed and administered within the Ministry of Natural Resources (MNR), Spatial Data Department (SDD).

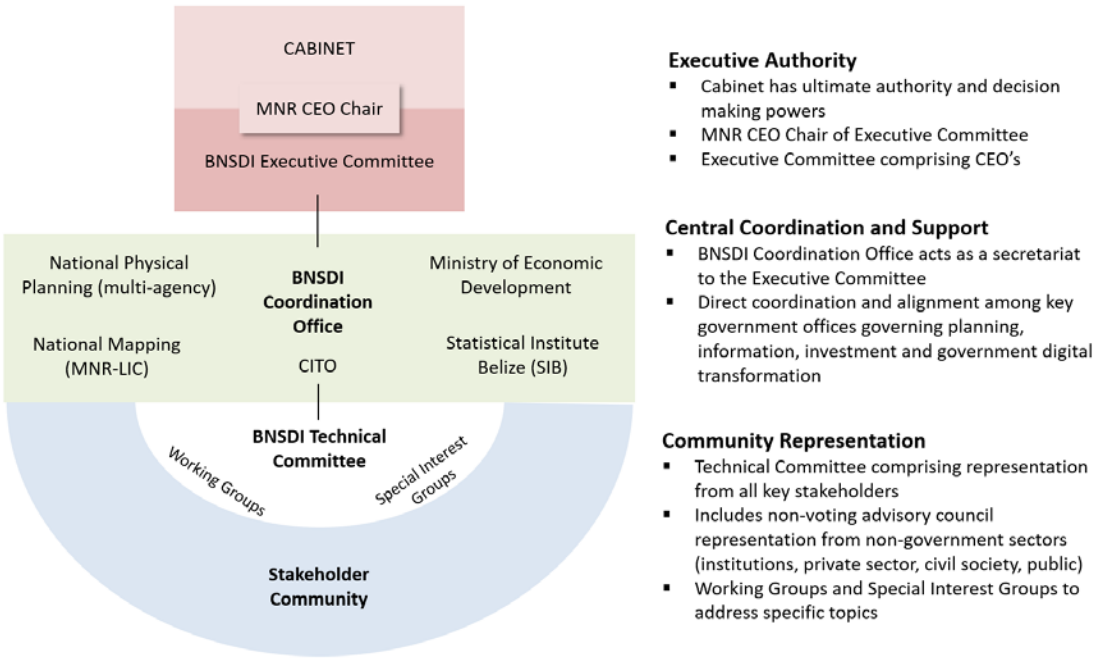
2.1 Conceptual Governance Structure

Per the proposed Policy Framework, the BNSDI Programme is to be governed by an Executive Committee chaired by the CEO of the MNR and comprising high level representation from all the key stakeholder organizations. The day to day operations, coordination and support of the BNSDI is to be carried out by a BNSDI Coordination Centre that will serve as the secretariat to, supporting and under the direction of, the Executive Committee. Beyond data sharing, the BNSDI is being structured to very directly support effective national sustainable development, investment, streamlined and transparent government operations, and the strengthening of capacity and innovation across institutions of higher learning, civil society and the private sector. As such, the BNSDI is to be developed and operated in such a manner to provide a "Smart Development Infrastructure (SDI+)" supporting the development and advancement of the Country. The Coordination Centre will play an important role in facilitating coordination and data sharing across the stakeholder community, but will also have an important role to support the analysis and alignment of sustainable development planning and investment across government.

A Technical Committee comprising representatives from all the key participating organizations will provide will serve in an advisory capacity to address and provide the Executive Committee and Coordination Centre advice concerning specific issues that are of interest across the stakeholder community. This function will be further supported through the formation and activities of Working Groups and Special Interest Groups that will be activated to focus on particular specific subjects identified by the Technical Committee.

The conceptual governance structure for the BNSDI is represented in the diagram below.

Figure 2 - Conceptual Governance Structure for BNSDI



The sections following provide an elaboration of the specific roles and responsibilities of each of the major functional groups involved in the BNSDI. These are based on the functions described in the draft policy which are further elaborated to provide a more complete picture of the specific activities to be carried out by each group.

2.2 BNSDI Executive Committee

The BNSDI Executive Committee is the executive body with responsibility to provide guidance and direction to the Programme on behalf of the whole of government. The Executive Committee will have ultimate decision-making authority over the priorities, policies and activities of the BNSDI, within the mandate and jurisdiction of the Programme. The specific topics and activities to be carried out by the Executive Committee.

- Executive Stakeholder Representation and Oversight;
- Represent the interests and executive perspective of participating stakeholder organizations;
- Jointly assess and make recommendations to Cabinet regarding relevant policies and regulations;
- Provide executive championship in support of the BNSDI program;

- Overseeing coordination of geospatial investment management;
- Voting on the adoption of BNSDI standards and decisions;
- Promoting agency compliance with BNSDI standards and responsibilities;
- Dedicating agency resources to fulfill the responsibilities of effective spatial data collection, production, and stewardship;
- Ensuring the communication of key national geospatial activities within the agency and with the greater BNSDI stakeholder community;
- Appointing an agency technical representative and alternate to serve on the Technical Committee of the BNSDI;
- Appointing representatives to lead or serve on working groups;
- Promoting the benefits of coordinating and partnering among government agencies in the development of the BNSDI within the member's agency;
- Serving as a champion for the use, value, and benefits of geospatial information in decision making and in the business of government;
- Collaborating with the member's agency IT and/or GIS manager to ensure that the agency leverages its cumulative geospatial information investments to benefit agency-wide business processes and services.

2.3 BNSDI Technical Committee

Technical stakeholder representation in the BNSDI is to be provided through a Technical Committee. The Technical Committee is to comprise representative members from each of the organizations actively participating in the BNSDI. Members will be responsible for representing the interests and priorities of their respective organizations in a consultative process that will provide input and advice to the Coordination Centre for day to day matters. It will also provide recommendations to the Executive Committee for matters that are of a technical policy matter and involve the interests of multiple organizations.

- Support BNSDI executive committee members in the formation and analysis of pertinent policy matters for those aspects that are of a technical nature;
- Support the BNSDI in identifying and carrying out cross-agency coordination;
- Lead the coordination of technical issues across the BNSDI community;
- Work closely with the BNSDI to develop and promote common standards and interoperability guidelines, including participation in Topical Working Groups when needed;
- Participate in evaluating cross-agency business processes and applications where spatial information is concerned;
- Participate in the development and promotion of common quality assurance and quality control specifications, methods and tools;
- Participate in the development and adoption of framework data standards and specifications;

- Participate in BNSDI data clearinghouse development and operations performance monitoring and provide feedback regarding potential improvements to the BNSDI executive committee on a regular basis.

2.3.1 Working Groups

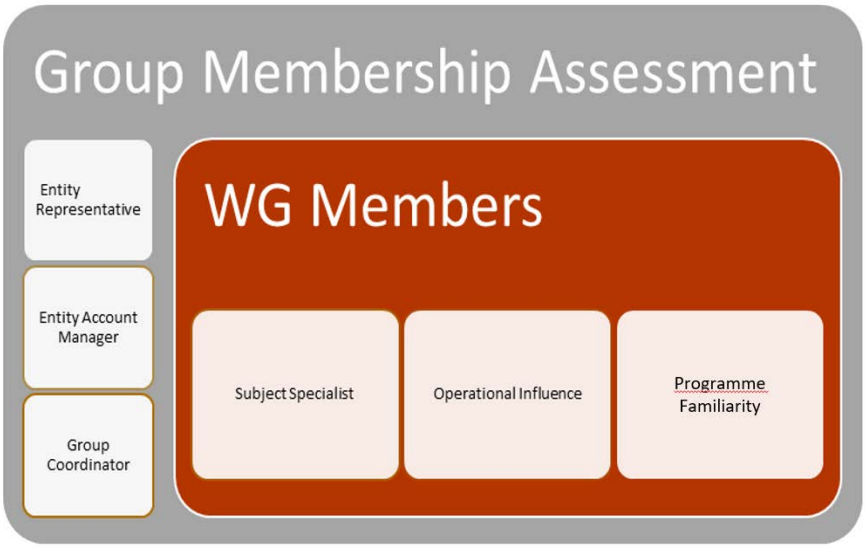
The Working Groups are teams comprised of representatives from BNSDI member entities who share a common interest in the issue under address. Each Group focuses on issues that pertain to coordination and the standards associated with the topical area or geospatial data theme (FGDS) such as; data collection, maintenance, access, exchange, and applications using those data.

A Working Group may be initiated for several reasons for example; in response to the needs of a newly engaged entity; a new project track, the development of a new application/e-service; or in response to a specific topic of interest brought to light by the Community through an SIG.

The Working Groups function from defined objectives and a working Charter; they are intended for cross-sector collaboration for the delivery of agreed outcomes within a specified timeframe.

WG Member Selection. Working Groups are formulated to address specific issue in a specified timeframe. The Working Group members are expected to be; subject-matter specialists, able to easily converse with other entity representatives on all subject related issues; from a level within their organizations where they are able to influence, or deliver operational initiatives; and, are knowledgeable regarding the BNSDI Program and it's implementation.

Figure 3 - Working Group Conceptual Structure



WG Responsibilities. The Group responsibilities include, but are not limited to, the following;

- Assist in the development and adoption of common standards of content, format, and accuracy for Working Group-specific data for use by stakeholder agencies and to encourage use by other agencies and organizations, to increase its interoperability and enhance its potential for multiple uses.
- Focus on issues that pertain to coordination and standards associated with a geospatial data theme (FGDS) with regard to data collection, access, exchange, and applications using those data or other areas of interest by the community.
- Participation in the development and evaluation of metadata definitions and standards used by United Nations and other international organizations (ie. International Standards Organisation Technical Committee TC211) and recommendations for their inclusion in the Belize Metadata Content Standard as appropriate.
- Participation in the revision or extension of the BNSDI Metadata Data Standards to more accurately describe its scope.
- Assist the development and adoption of common standards of content, format and accuracy for Metadata for use by all BNSDI members, encourage standards implementation by non-BNSDI organizations and support interoperability to enhance data's potential for re-use.
- Facilitate collection and compilation of information for Working Group-specific data activities.
- Facilitate the economic and efficient application of Working Group-specific data through the sharing of experiences involving applications.
- Participate in the development and evaluation of data definitions and standards used by international organizations and standards bodies, and make recommendations for their inclusion in Working Group-specific data as appropriate. Facilitate the collection and compilation of information for entities activities including training opportunities supported by BNSDI members and other supporters of the BNSDI .

WG Coordination. Each Working Group shall be chaired by an individual approved by the Group, and agreed by the BNSDI Executive and/or Stakeholder Committees or Coordination Centre as appropriate.

Where multiple representatives volunteer for the Group Lead (Chair) position, or for instances where there is no volunteer, Coordination Centre management will make an assignment, either from the member entities or from the Coordination Centre staff.

Meetings shall be held at the call of the Group Lead, and shall be held at least biannually. Where a Working Group has a defined timeframe, a calendar of meetings may be pre-determined; the Group Lead reserves the right to call for a special session of the Working Group at any time.

All decisions shall be on the basis of consensus agreement. Where an agreement is not reached, the issue will be promptly referred to the Coordination Centre for resolution in consultation with the Executive Committee as necessary.

The Group Lead shall consult with Coordination Centre to determine the need for further coordination prior to implementing Group decisions that impact any other Groups.

The Group will employ those tools that are best suited to meeting its responsibilities, such as Group meetings, nation-wide user forums, user surveys and analyses, workshops, and research initiatives, or the initiation of a sub-Working Group for focus on a particular outcome/output.

Follow-up Mechanism. The Group Lead will give notification and an agenda will be distributed to Group members and the Coordination Centre Group Coordinator 10 working days in advance of the meeting.

The Group Lead is responsible for organizing the provision of a draft report of Group meetings (Minutes of Meeting - MoM), including recommendations and action items, to all Group members and BNSDI Group Coordinator for review prior to approval.

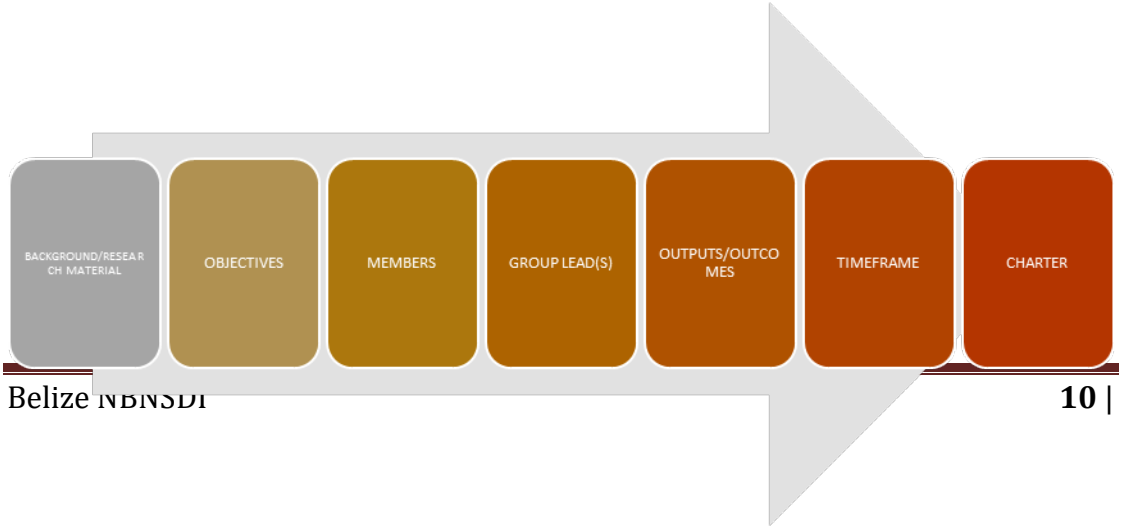
On approval, the Group Lead shall provide the final report of Group meetings to all members, BNSDI Coordinator, and Coordination Centre Management.

The BNSDI Group Coordinators may take responsibility for the Group administration tasks at the request of the Group, and subject to approval by BNSDI management.

Sub-Working Groups. The sub-Working Group is formed from selected members of the Group to focus on a particular topic/issue/deliverable defined by the Working Group. The sub-Working Group will have a limited timeframe for completion and provide regular reports to the Group on its progress.

Once the outcomes/outputs have been achieved, the sub-Working Group will be dissolved. Another sub-Working Group can be initiated by the Working Group at any time.

WG Documents. Each Group functions under a Charter; this is the Group's mandate which outlines its scope or purpose, the members and Group Lead, and its guidelines or objectives. The Working Group Charters are also required to define each Group's intended outputs and outcomes, as well as a timeframe and roadmap for delivery. The accompanying diagram illustrates the elements which combine to produce the Group



Charter.

The Charter is a "living" document which is maintained throughout the lifecycle of the Group to reflect its current status. It is updated on, for example; a change in scope or re-definition of Group objectives; on the joining of a new entity or change in entity representative; change in defined outcomes or timeframe.

Each Working Group is also required to submit an Implementation Plan/Roadmap for achieving the agreed outputs/outcomes, and an operations plan which outlines the plan for each new operating period for Coordination Centre review and concurrence. An operating plan should be submitted for every new operating period (e.g. annually) for the life cycle of the Working Group.

On delivery of the outputs, each Working Group should also produce a Final Report. This is a final document which documents the Groups' achievements, challenges and any other issues faced during its life cycle.

Coordination Centre Responsibilities Relative To Working Groups. The team's responsibilities include, but are not limited to, the following:

- Facilitating the initiation of a new Working Groups, including the preparation of the framework papers, i.e., the Charter, in collaboration with the Coordination Centre team.
- Identifying the Group members, in collaboration with the Entity Account Manager and Entity BNSDI Representatives.
- Coordination of the initial meeting, and assistance for any meetings of special junctures, e.g. workshops, etc.
- Promoting consensus with the participants on the Group's Charter, Action Plan, and Group Lead.
- Monitoring and reporting on Group performance through the Group Dashboards.
- Report on any difficulties or risks to BNSDI management
- Review requirement for sub-Working Group, and facilitate initiation.
- Follow up on all actions items with, or in coordination with the Group Lead(s).
- Communicating the update status of projects discussed in the WG and 'Standards development' in relation to the Project / Class / Theme/ Topic to the DP team (*refer to the Data Projects SOP for more details*)
- Transfer of any the gathered (formal / informal means) intelligence and knowledge on all projects that may have spatial components or relate to ICT/e-gov initiatives for assessment by the Data Projects team.

2.3.2 Special Interest Groups

Are permanent sub-bodies of the BNSDI Community; they serve as a forum for cross disciplinary, sector-orientated collaboration on those aspects of BNSDI and related matters that are most relevant within their community of practice.

Special Interest Groups (SIG) consist of representatives from BNSDI member entities and subject-matter experts around geospatial data themes or persistent topical areas such as, Public Safety and Security and the Environment. The Group is a forum for discussion and action on the strategic issues related to the implementation of the BNSDI initiative, for example; policy recommendations, use of standards and specifications and roll out, business guidelines, and issues pertaining to privacy and security. At any time, an SIG may request the formulation of a Working Group(s) in order to tackle specific topics of interest from the SIG's scope or topical area.

It is considered that the purpose of the SIGs will continue and develop, providing a 'think-tank' for all governance related issues; expanding in representation to all government and key external agencies, committed to the continued development of the Country.

SIG Member Selection. Special Interest Groups are an association of individuals or organizations formally organized, on the basis of one or more shared concerns, to attempt to influence public policy in its favour. They provide a channel for special expertise to be made available to decision-makers, and for particular concerns to be brought to their attention.

Entities may be represented in one or several Groups. On the initiation of a new Group, the Group Coordinators liaise with the Entity Account Manager and the Entity Representative to select the most suitable representative(s) for the Group(s). The diagram below highlights some of the key criteria for SIG member selection.

Figure 4 - SIG Conceptual Structure

It is expected that SIG members are from a level within their organization where they; influence or delivery policy recommendations; authorize operational strategy initiatives; have an overview of the e-government strategy and understanding of its impact and influence on society.

SIG Responsibilities. The Group responsibilities include, but are not limited to, the following;

- Act as a forum to discuss best practices by Government organisations on a national, regional and municipal level.
- Consider the growing trend, traction and importance of the subject sustainability and its related activities in Belize.
- Define the different needs by various stakeholders for geospatial data.
- Confer on the best mechanism for collaboration in the future to avoid redundancy while meeting the common needs of the different members in the BNSDI Community.
- Establish a forum for sharing information and news.
- Address areas of policy, regulatory, and institutional practice that will have an impact on the BNSDI .
- Facilitate access to resources such as, the web-based Geoportal.
- Identify areas that can be instigated and facilitated by the SIG members.
- Propose the development of tools and methods to stay up-to-date on entity related projects and/or activities (for example, the development and maintenance of a dedicated channel on the BNSDI Portal).
- Contribute toward the development and execution of key events outreach and communication.
- Facilitate the development and coordination of agency activities.
- Promote the publication of digital spatial data.
- Assist Coordination Centre to establish and publish standards, specifications and strategic priorities.
- Promote entity responsibility in complying with BNSDI standards and thus institutionalizing BNSDI standards, in consensus with the entities and help cross-agency coordination in data sharing and information exchange.
- Promote nation-wide use of defined and published spatial data transfer standards.
- Support development of the Belize Spatial Data Infrastructure through facilitation of partnerships and definition of data framework standards.
- Identify ways in which data from any source may be included in the Belize Spatial Data Infrastructure.

SIG Coordination. Each Group shall be chaired by an individual approved by the Group and agreed by the BNSDI Executive and/or Stakeholder Group or Coordination Centre as appropriate.

Where multiple representatives volunteer for the Group Lead (Chair) position, or for instances where there is no volunteer, Coordination Centre management will make an assignment, either from the member entities or from the Coordination Centre staff.

Meetings shall be held at the call of the Group Lead, and shall be held at least biannually.

All decisions shall be on the basis of consensus agreement. Where an agreement is not reached, the issue will be promptly referred to the Coordination Centre for resolution.

The Group Lead will coordinate the Group's activities with other BNSDI Groups by participating in BNSDI meetings.

The Group will employ those tools that are best suited to meeting its responsibilities, such as Group meetings, nation-wide user forums, user surveys and analyses, workshops, and research initiatives.

Follow-up Mechanism. Normally, the Group Lead will give notification and an agenda will be distributed to Group members and the Group Coordinator, 10 working days in advance of the meeting.

The Group Lead is responsible for organizing the provision of a draft report of Group meetings (MoMs), including recommendations and action items, to all Group members and BNSDI Group Coordinator for review prior to approval.

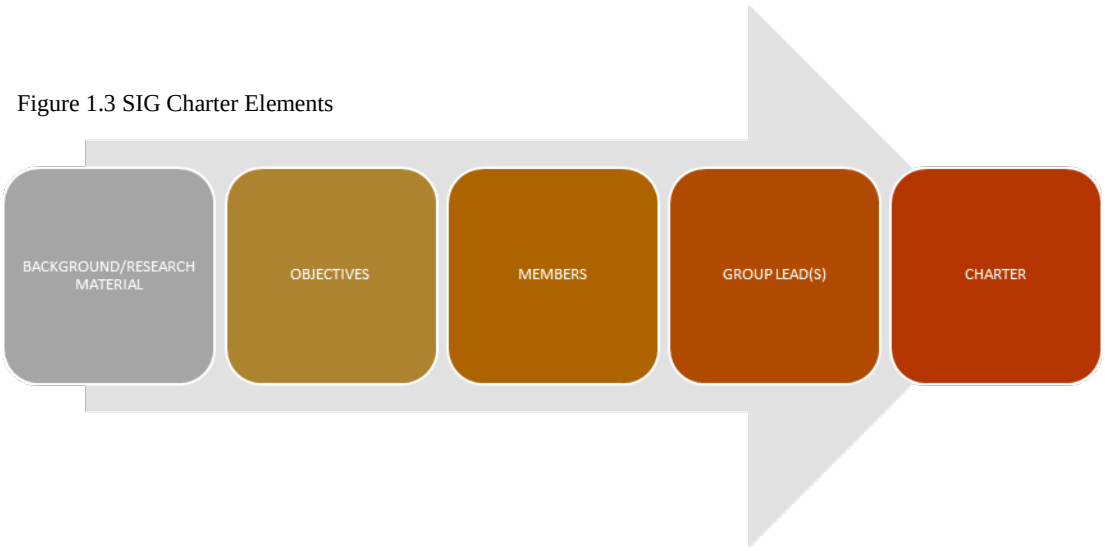
On approval, the Group Lead shall provide the final report of Group meetings to all members, Groups Coordinators, Coordination Centre management, if required, the BNSDI Technical Committee.

The BNSDI Group Coordinators may take responsibility for the Group administration tasks at the request of the Group, and subject to approval by Coordination Centre management.

SIG Documents. Each Community Organization Group is initiated for a specific purpose. A Special Interest Groups general purpose is, for continued cross-sector collaboration to influence policy and provide guidance for decision-makers on a spatially related topic

Each Group is required to produce a Charter; this is the Group's mandate which outlines its scope or purpose, the members and Group Lead, and its operational guidelines or objectives. The Charter is a "living" which is updated throughout the lifecycle of the Group.

Figure 1.3 SIG Charter Elements



Coordination Centre Team Responsibilities. The Group Coordinator's responsibilities include, but are not limited to, the following:

- Facilitating the initiation of a new Special Interest Groups, including the preparation of the framework papers, i.e., the Charter.
- Identifying the Group members in collaboration with the Entity Account Manager and Entity BNSDI Representatives.
- Setting the agenda for, and organising the initial meeting, and assistance for any meetings of special junctures, e.g. workshops, etc.
- Promoting consensus with the participants on the Group's Charter and Group Lead.
- Monitoring and reporting on Group performance through the SIG Dashboard.
- Follow up on all actions items with, or in coordination with the Group Lead(s).
- Review the requirement for new Working Group, and facilitate initiation process.
- Communicating the status of 'Standards development' in relation to the Project / Class / Theme/ Topic to the DP team to monitor the progress of standards development related to each project.
- Transfer of any the gathered (formal / informal means) intelligence and knowledge on all projects that may have spatial components or relate to ICT/e-gov initiatives for assessment by the Data Projects team.

2.3.3 Non-Government Stakeholders

Beyond the strengthening of government operations, the BNSDI is intended to support a broader constituency of stakeholders to include the private sector, regional and international agencies, non-government organizations, educational and research institutions, and the public. It is intended that these stakeholder sectors be kept informed of developments and resources available through the BNSDI and that these will be made proactively available within the parameters of security and related government policies.

It will be important that the BNSDI consider and respond to the needs of the non-government stakeholder community as much as practical. It is proposed therefore that a Non-Government Advisory Committee comprising representatives of that community be included within the BNSDI governance framework

3 BNSDI COORDINATION CENTRE

A BNSDI Coordination Centre facility is to be developed that will provide the overall orchestration, facilitation, promotion and support to the BNSDI programme. This Coordination Centre will effectively act as the secretariat to the BNSDI Executive Committee, however for practical reasons it will be physically situated within the Ministry of Natural Resources (MNR) Spatial Data Division (SDD), alongside the Land Information Centre (LIC) and Information Technology (IT) groups. It will be absolutely critical that the BNSDI Coordination Centre team be able to function

outside of MNR operations prerogatives and priorities to maintain the confidence and trust of the stakeholder community that it will always serve its interests.

3.1 Organization and Staffing

The Coordination Centre operations are to be supported through a lean functional organizational structure that is described below. The Coordination Centre function acting under the direction of the BNSDI Executive Committee will be established to support the effort through both initiation and operation stages of BNSDI development. The purpose of the Coordination Centre is to facilitate, coordinate and support the BNSDI initiative on a permanent basis, and to provide geographic analysis and decision support to the executive leadership when required. This section outlines the form and staffing of the Coordination Centre, with operations described in a section following.

3.1.1 Structure

The Coordination Centre as envisioned would include specialized staff and physical infrastructure needed to promote, coordinate, facilitate, and support the spatial component of the BNSDI. This office would report directly to the BNSDI Executive Committee and act at its direction. General functions of the Coordination Centre within the context of the broader BNSDI initiative are summarized below (additional operational details are provided in the next Section of this report):

- Work with Steering Committees and stakeholders to assess and develop BNSDI policy for consideration and final decision making by the Executive Committee;
- Develop common standards and guidelines in consultation with the Technical Committee;
- Assist Executive and Technical committees in cross-agency coordination, business process reconciliation, and related matters;
- Provide the Belize leadership with “honest broker” decision-support analysis of various financial, technical, and other issues;
- Promote and develop strategic public/private/institutional partnerships;
- Develop, manage and operate main spatial data clearinghouse node;
- Coordinate data security and setting of data publisher and user rights, in collaboration with the Executive Committee, and other government authorities as dictated in policy and law;
- Promote and support the development of value-add services by the private and institutional sectors;
- Promote and support, in collaboration with CITO, the expansion of spatial components of online e-Government services;

- Promote adoption and enforcement of quality assurance and quality control measures in all application service development and framework spatial data acquisition efforts;
- Participate in the development and adoption of common framework data standards, in partnership with custodian agencies and in consultation with stakeholder agencies;
- Monitor framework data acquisition projects and maintenance activities, including the maintenance of metadata by custodian agencies;
- Participate in framework data configuration management, in partnership with custodian agencies and in consultation with affected stakeholders;
- Administer acquisition and licensing of data for which there is no other logical custodian;
- Provide general oversight for FGDS data development and maintenance in the BNSDI Community;
- Develop and implement Coordination Centre staff training and professional development;
- Promote and support common training program needs throughout the stakeholder community;
- Provide helpdesk support services to the BNSDI Community in regards to BNSDI matters;
- Operate a service bureau function in order to support the BNSDI Community in the provision of BNSDI related services;
- Provide periodical reporting and monitoring to the Executive Committee and ensure that the BNSDI member agencies and working groups report the same based on the set forth service level agreements;
- Develop and maintain BNSDI program performance monitoring and management;
- Develop and coordinate Program business development with the Executive Committee.
- Formalize, institutionalize, and extend BNSDI activities among existing stakeholders (BNSDI community)
- Expand the BNSDI community
- Increase awareness among interested groups (academia, private sector, public) via media;
- Extend and increase appreciation for BNSDI value among policy makers;
- Collect and package information/data for results reporting and media placement

The basic conceptual structure and major functions of the Coordination Centre is illustrated in Figure 6. Figure 7 illustrates the connectivity between the Coordination Centre and the BNSDI stakeholders.

Figure 5 – ***BNSDI Coordination Centre Major Functions***

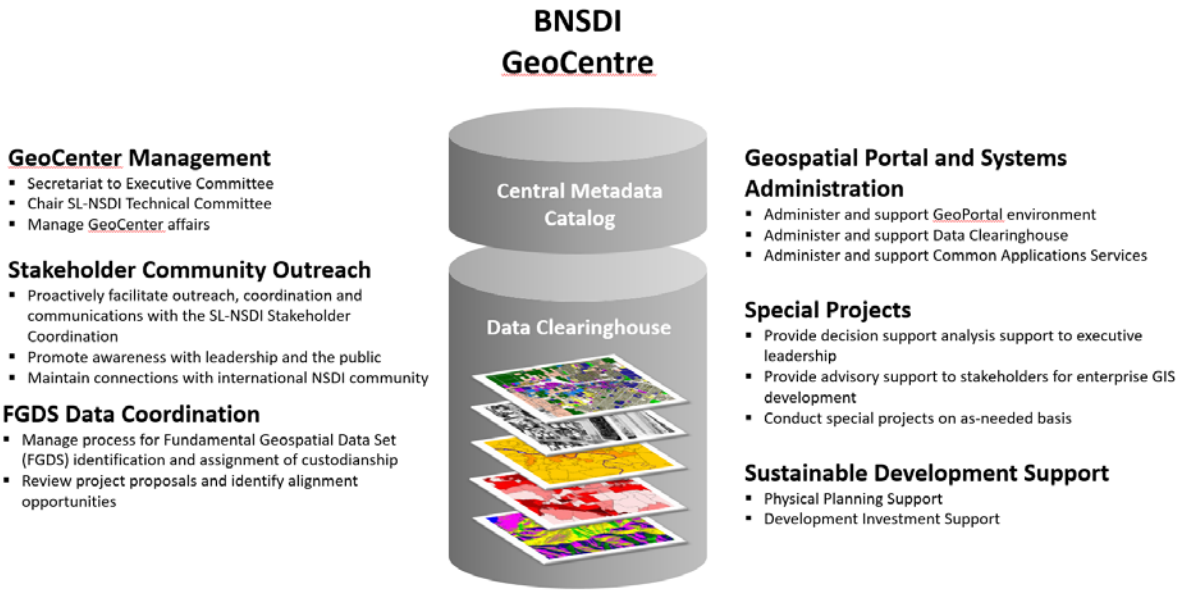
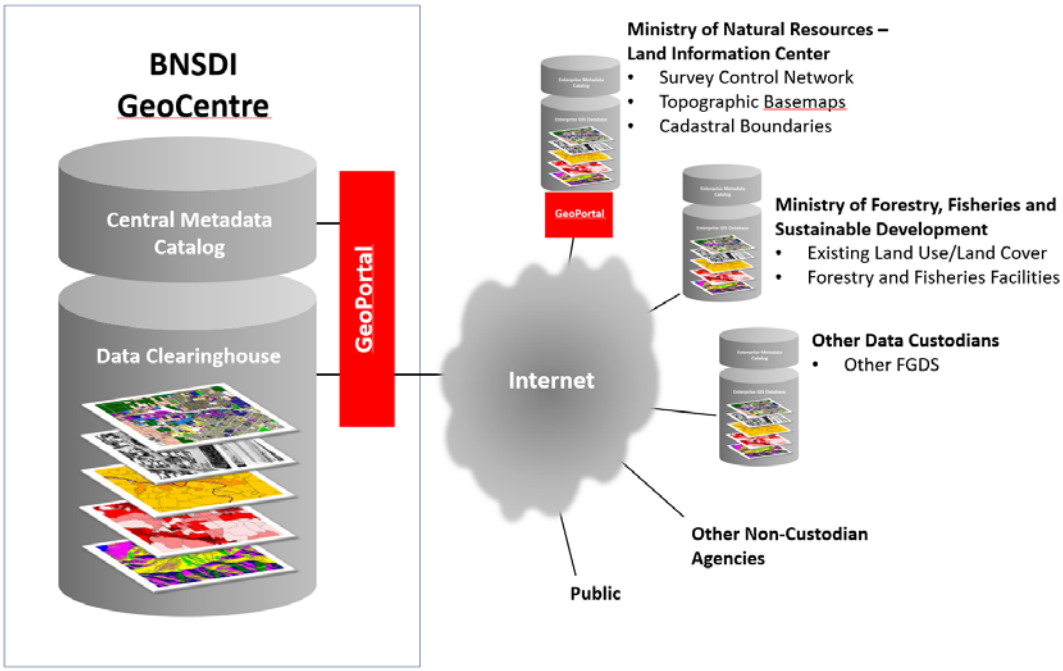
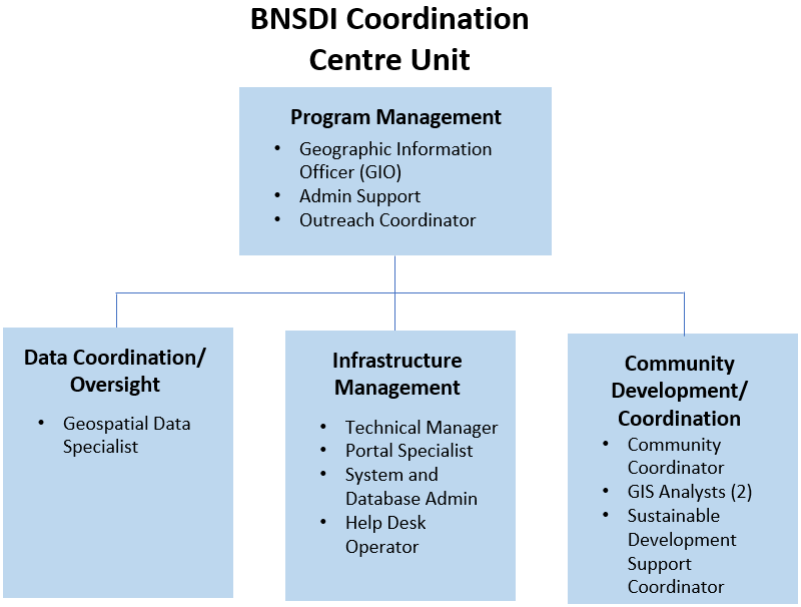


Figure 6 – ***BNSDI Stakeholder Types and Connectivity to Coordination Centre Resources***



The functions of the Coordination Centre are to be carried out by a number of interdependent teams. The basic configuration of these teams and the staff roles that comprise them are illustrated in the Figure below. Each of these staff roles are described in the next sub-section. The full operational range of activities to be carried out by each team are described in the section following.

Figure 7 – ***Coordination Centre Functional Organizational Structure***



3.1.2 Staffing

The Coordination Centre will facilitate, coordinate, and support the development of the BNSDI, manage and operate a central Geospatial Data Clearinghouse, and provide limited special project and technical consulting services to others in the stakeholder community on an as-needed basis. Staffing of the Coordination Centre will need to be sufficient to carry out all the primary functions described in the next chapter in an efficient and timely manner.

The following summarizes the primary staff roles that are required:

Geographic Information Officer (GIO). The GIO will be a person with primary responsibility as executive director for overseeing and coordinating the BNSDI implementation and ongoing operations of the Coordination Centre. This person will also participate in carrying technical tasks within the overall work program, and will be the primary liaison to the Executive Committee and Technical Committee members. The GIO shall be able to mobilize, where needed by the BNSDI Community, the necessary resources for the provision of occasional advisory services to support stakeholder organizations in building their own internal enterprise GIS capacity.

Secretary and General Administrative. The Coordination Centre will require at least one secretary, as well as general administrative staff in human resources and legal areas. These functions will work closely with the GIO, but will also provide general logistical and secretarial support throughout the office. This role may be a shared resource with the LIC.

Outreach Coordinator. This person will coordinate with others on the BNSDI Coordination Centre team and Technical Committee to oversee engagement with new stakeholders and identify key opportunities for publicizing, both nationally and internationally, the progress and development of the BNSDI Program and its resulting outputs to the BNSDI geospatial portal. In addition, the Outreach Coordinator will work with the Technical Committee to prioritize the development of those products that will showcase the BNSDI initiative and leverage external relationships and publicity. The Outreach Coordinator will oversee the development of a training and capacity building program for the Coordination Centre and coordinate the development of normalized training activities in the BNSDI Community.

Community Coordinator. The Community Coordinator will report to the GIO. This role acts in the position of a generalist consultant with a wide experience in a multi-sector environment. He/She has strong planning and analytical skills, business and management experience and well-rounded GIS background and experience and can support any activities that may fall under the Community development and coordination function. The Community Coordinator may be assigned by the GIO the management of special projects or specific oversight responsibilities within the BNSDI Program development.

Technical Manager. The Technical Manager will be a person who has technical expertise in all aspects of geospatial analysis including GIS, remote sensing, spatial analysis, programming and cartographic production. This person will report to the GIO and be responsible for coordinating among the GIS analysts to delegate and assess progress on management of Clearinghouse data, refinement of Portal interface enhancements, and other issues. This person will also be responsible for the technical management of Coordination Centre projects and operations, technical resource allocations and technical staff assignments to projects and activities. It will also include oversight of the technical content aspects of the BNSDI Geospatial Portal and associated metadata, data and application services, as well as the development and management of any associated application services;

Geospatial Data Specialist. The Geospatial Data Specialist position will be responsible for the oversight and facilitation of all issues relating to the establishment and operation of all fundamental geospatial data sets (FGDS). This includes participation in all FGDS Working Groups, data content standard development, data modeling, establishment of related service level agreements (SLA's), and follow-up to ensure that terms and conditions of all FGDS SLA's are complied with on an ongoing basis. It may be possible to start with one analyst in this role, but experience suggests that as the number and type of stakeholders increases it may be necessary to add another resource in this role;

Systems and Database Administrator. The System Administrator will work under the general direction of the Technical Manager and will be responsible to ensure that the computing infrastructure and geospatial databases and applications are kept in running condition and administered in a systematic and effective manner;

Geospatial Portal Specialist. The Geospatial Portal Specialist is responsible for the detailed design, development and maintenance of the BNSDI Geospatial Portal. The Geospatial Portal shall ensure the development and operation are compatible with international good practice and the IT standards adopted by CITO and the eGovernment programme. This Specialist will also oversee the development and maintenance of any common application services to be offered by the BNSDI. Alternatively it may be possible to train the Systems and Database Administrator or Technical Manager in the basics of Geospatial Portal management and to secure specialized services as needed on a retainer or equivalent basis;

GIS Analyst. At least two analysts will be required initially to provide basic technical and analytical support to the participating stakeholder agencies. These staff will work under the general direction of the Technical Manager. Analysts may have specialization in particular areas of system and database design, spatial analytical procedures, cartographic design and programming. In addition, the Analysts should have the capability to produce high-quality analytical procedures and outputs necessary to demonstrate the effectiveness of the BNSDI program and meet the objectives of the participating stakeholder agencies. The number of analysts may be increased later depending on the level of demand for such support from the leadership and user community;

Sustainable Development Support Coordinator. A key function of the Coordination Centre in line with the concept of "Smart Development Infrastructure (SDI+) concept will be to directly coordinate with and support all the physical planning and development investment activities going on within the Country. A Sustainable Development Support Coordinator will liase with the specific stakeholder entities that are involved in these activities to ensure that the BNSDI resources are aligned and utilized in the most effective manner to support integrated sustainable development and investment;

Help Desk Operator. At least one permanent staff should be allocated to operate and maintain a help desk function for the BNSDI. It is expected that the level of traffic in this area will increase significantly as more organizations start to utilize the BNSDI infrastructure on a more regular basis. Eventually, it is expected that this will be a full-time occupation to receive, log, analyze and

respond to requests for information or support, or to route such requests to the appropriate person or entity.

3.2 Operations

The Coordination Centre will be responsible for carrying out a variety of activities that will be necessary for the BNSDI programme and infrastructure to perform effectively. The major operational areas to be addressed include the following and as described in more detail in the sub-sections following.

- Program Central Coordination
- Community Development and Support
- FGDS Data Development
- Infrastructure Development and Operations
- Special Projects and Decision Support

3.2.1 Program Management

The BNSDI Coordination Centre will act to facilitate, coordinate, and support the development of the BNSDI, manage and operate a central Geospatial Data Clearinghouse, and provide limited technical services to the stakeholder community on an as-needed basis. Primary functions related to the overall coordination of the Programme include the following:

- Provide overall oversight and coordination of the BNSDI implementation plan;
- Oversee and interact with major FGDS data development projects to ensure compliance with BNSDI principles and community interests;
- Support executive representation functions;
- Chair technical representation, participate and support regular meetings and other functions;
- Maintain BNSDI Portal with information about the BNSDI initiative;
- Maintain Geospatial Portal and associated services;
- Manage and operate a central geospatial data clearinghouse. Data stored in this clearinghouse will primarily include those FGDS that are needed in common across the community, but whose custodian agency is not yet prepared to host and provide that information from their own distributed BNSDI node;
- Manage and operate an BNSDI “help desk” to receive, log and route requests for information and support to the appropriate place;
- Maintain a library of common reference resources in both digital and physical form on behalf of the rest of the BNSDI community, and make those resources available to others;

- Oversee topically focused coordination and joint development functions, and participate directly in Working Group activities where relevant;
- Prepare policies and policy refinements for recommendation to the Executive representation;
- Provide special technical support to BNSDI community. A limited technical consulting and support capability will be maintained to allow the BNSDI Coordination Centre to assist other organizations on an as-needed basis. Any such services that are beyond the normal operating functions of the BNSDI Coordination Centre common services will be charged to the receiving organization;
- Administer and manage the BNSDI Coordination Centre facility and staff.

The GIO will be responsible for coordinating the overall management of the BNSDI Programme, with support from other senior Coordination Centre staff.

3.2.1.1 Coordination Centre General Administration

Like with any unit of government, there are certain general and administrative activities that are required to ensure the operation can run smoothly. The General Administration and Program Management support for the Coordination Centre consists of the following:

- Secretarial Support
- Accounting
- Staff recruitment
- Training and Capacity Building
- General Administration

Staff Recruitment. The draft job descriptions for each of the positions that have been identified for the Coordination Centre are described in Annex C. These positions will be filled as qualified candidates are recruited. As with any recruitment program, the job descriptions may need to be adjusted during the hiring process to reflect any shuffling of roles and responsibilities depending upon the skill sets of the selected candidates. Position descriptions have been structured in a form suitable to support the recruitment process. The following positions are included:

1. Geographic Information Officer (GIO)
2. Secretary
3. Outreach Coordinator
4. Technical Manager
5. PM/ GIS Consultant
6. Geospatial Data Specialist
7. Systems and Database Administrator
8. Geospatial Portal Specialist
9. GIS Analyst(s)

10. Help Desk Operator

In addition, Annex D contains reference information related to hiring and retention of employees in a BNSDI development environment.

Training & Capacity Building. The training & capacity building activity will establish a framework for coordinated capacity building of the BNSDI community and will develop and implement training programs for the Coordination Centre staff as described in Annex E. In addition, Annex F contains staff self-evaluation forms for additional reference.

Coordination Centre Facility Development. The Coordination Centre will have high visibility and interaction with various levels of the Belize government, private sector and international organizations. Therefore, the Coordination Centre should be established such that it showcases the BNSDI initiative in an appealing manner to all visitors and provides a dynamic working space for Coordination Centre staff, one that is evident to incoming visitors. Similarly, the functionality of the Coordination Centre should be established such that staff can adequately perform the work required in a creative, collaborative and inspiring environment, while also being able to interact effectively with others visiting from external organizations or within the greater BNSDI community.

Establishment of the Coordination Centre will require a permanent facility to house the group, and a variety of equipment, furniture and supporting infrastructure (computing infrastructure addressed elsewhere). This will need to be re-assessed and finalized during the final design and implementation of the initial Coordination Centre. This activity addresses the steps that will be required to plan, design and implement the Coordination Centre facility and associated infrastructure as described in Annex G, outside of the computing infrastructure which is addressed elsewhere.

Strategic Plan Update. The BNSDI Strategic Plan shall be updated towards the end of the first implementation phase of the BNSDI Program. The update will reflect a synthesis of community development requirements, community coordination and support requirements as well as BNSDI operational requirements of the BNSDI Geospatial portal. The updated strategic plan will set the direction for the next implementation stage.

General Administration. The General Administration activity consists of the following that are described in Annex H:

- General administrative support
- Financial Management Support
- Supplies/ General Services
- Monitoring & Reporting
- Office Administration

3.2.1.2 BNSDI Policy and Regulatory Oversight

The Coordination Centre shall support the development and formulation of the policy and regulatory environment that support the BNSDI Program development. It shall allocate the necessary resources required to support the adoption and management of the proposed BNSDI policy and legal frameworks as described under separate cover in the BNSDI Implementation Plan.

3.2.1.3 Communications and Outreach

The Coordination Centre shall be equipped to support the following outreach and communication activities:

- Maintain website content
- Oversee website development i.e. structure and content
- Promote and process new BNSDI membership
- Administer BNSDI newsletter
- Administer media outreach, promotion and communications
- Participate in the expansion of the BNSDI community
- Increase awareness among interested groups (academia, private sector, public) via media
- Extend and increase appreciation for BNSDI value among policy makers
- Collect and package information/data for results reporting and media placement

3.2.2 Community Development, Coordination & Support

The Community Development & Coordination Support function shall include the following functions:

- Community Development
- Community Coordination and Support
- Ad hoc Support and Special Projects

3.2.2.1 Community Development

The BNSDI Community Development is a continuous activity that will evolve over time. During the inception phase of the BNSDI Programme a broad community of potential stakeholder organizations have been engaged in the current study and associated Requirements Analysis to understand the situation and needs across the community. The number of organizations that will be ready and able to actively participate in the initial implementation of the Programme will be necessarily more limited based on several variables including their FGDS data custodianship role, their stewardship role as users and beneficiaries of the program, their status and readiness

for building their enterprise capacity and the role of GIS in spatially enabling their core businesses. The process of substantive engagement with additional entities beyond the first phase is expected to continue during program implementation in what can be entitled as a second wave of community development. The latter will consist of new users' assessment, new stakeholders' surveys, new requirements additions and integration in the program implementation and coordination strategy. The main components of this activity are the following:

Stakeholder Survey. A stakeholder survey will be conducted for the new agencies that join the BNSDI community.

Data Inventory & Assessment. A detailed data inventory & assessment will be implemented to identify the data sources maintained by each new organization that have a potential of becoming reference data for the BNSDI community in the future.

Requirements Analysis. The Coordination Centre will assess the BNSDI requirements based on the valuable information that was obtained from the stakeholder survey, and data inventory and assessment.

Implementation Strategy. Based on the outcome of the requirements analysis and the possible outcome scenarios, an implementation strategy shall be developed which may consist of several activities to fully engage new organizations with the BNSDI programme.

3.2.2.2 Community Coordination & Support

Once the BNSDI GeoPortal is operational and agencies start using it, then the community will eventually move to the next stage of coordination. To do so, it will require the support of the Coordination Centre that will dispatch the necessary resources in order identify the common community developments and translate them into BNSDI development requirements.

In parallel, the Coordination Centre will be required to ensure coordination among sector and agency projects that may ensue. Some of the requirements may involve, for example, strengthening of the communication infrastructure to meet the growing needs of the BNSDI community. Some may necessitate the scoping and coordination of community applications that serve the community across the board. In some cases, the developments may be focused to common applications that may serve the needs of few agencies or sectors such as the development of a common document and multi-media management system. In other cases, specialized applications may be developed in order to cater for domain-specific needs of sectors and/or agencies such as utility and project coordination or planning support. The scope of this activity will be limited to the preparation and scoping of similar requirements as outlined above when they arise and to the supervision of implementation as a way of support provisioning for programs and/ or projects. The activity main components are the following:

BNSDI community coordination framework. The Coordination Centre has, according to its mandate, an oversight role on the implementation initiatives that are executed by the member agencies and that may have an impact on the BNSDI community. In addition to its oversight function, the Coordination Centre shall be requested by the community to coordinate the development of implementation projects that have a cross-agency impact. This activity component shall ensure that a coordination framework is introduced that is governed by standard operating procedures and is integrated with the Coordination Centre routine configuration management. Also, it shall ensure the allocation of the necessary resources in order to support the coordination activity including the development of initial design specification and the packaging of technical specifications for tendering solicitation.

BNSDI community support framework. The Coordination Centre shall provide specific support to the member agencies in the execution of the common community coordination projects. The support framework may include program management support such as project management organization structure and review of major project components.

Where the situation arises, certain activities may need to be managed in the context of projects with defined mandate and properly allocated resources and time frame. In this case, the Coordination Centre participation may be direct or indirect as described below:

BNSDI Projects Development. The BNSDI projects development are projects that are initiated and managed by the BNSDI Community, with some level of coordination and/or support from the Coordination Centre. The project (s) may be managed under the leadership of one of the special interest working groups or by an agency representative. For more details on BNSDI Projects Development, please refer to Annex I.

Coordination Centre Projects Management. In certain cases, certain projects may be managed directly by the Coordination Centre based on the request and/or needs of the BNSDI Community. This activity describes how the projects are internally managed within the Coordination Centre and coordinated with the BNSDI stakeholders as necessary. For more details on BNSDI Projects Development, please refer to Annex I.

3.2.2.3 Adhoc Support & Special Projects

It can be expected as part of the Coordination Centre operations that the ad hoc technical support for information and special project requests may be required by

management and VIPs that are not considered in the rest of the program described above. Past experience suggests that it is better to plan for accommodating some level of ad hoc activities rather than pull production staff from their planned activities. This will both reduce the impacts to planned activities as well as ensure that the Coordination Centre is prepared to effectively and immediately support requests from VIP's and others that are likely to arise during the system implementation process. This activity would involve establishing a small team of analysts who in addition to supporting other parts of Coordination Centre operations will also be allocated a certain amount of time to support the inevitable special requests and special projects that will arise on an ad hoc basis.

3.2.3 FGDS Data Development & Coordination

FGDS data development, coordination and oversight activity includes the following:

- Service Level Management including Master Service Level Agreements (MSLAs)
- FGDS Data Identification and Development
- Major Data Projects Alignment Coordination
- Data Standards Development

3.2.3.1 Service Level Management

Several Level Management (SLM) may be based on international standards and best practices such as ITIL which has achieved recognition worldwide. SLM forms the basis for Service Level Agreements (SLAs) and ensures quality services for the organization. To be effective, a service level agreement must incorporate two sets of elements: service elements and management elements.

Service elements: The service elements clarify services by communicating such things as:

- The services provided (and perhaps certain services not provided, if customers might reasonably assume the availability of such services)
- Conditions of service availability
- Service standards, such as the timeframes within which services will be provided
- The responsibilities of both parties
- Cost vs. service tradeoffs
- Escalation procedures

Management elements: The management elements focus on such things as:

- How service effectiveness will be tracked

- How information about service effectiveness will be reported and addressed
- How service-related disagreements will be resolved
- How the parties will review and revise the agreement

The process of planning, establishing, and implementing an agreement is typically a significant process of information-gathering, analyzing, documenting, presenting, educating, negotiating, and consensus-building in direct collaboration with the involved stakeholder organization.

A table of contents for a standard SLA is described in Annex J. It defines, among other things, the scope of work for the standard services and their conditions for availability in addition to support services and responsibilities based on the agreed upon agreement. It includes also measures of performance, tracking and reporting and deals with legal issues pertaining to security, intellectual property and legal compliance.

A SLA that is not managed dies upon implementation. Once an SLA becomes operational, the SLA Manager's responsibilities may include (but not be limited to):

- Serve as the point of contact for problems or concerns related to the SLA itself and the delivery of services described in the SLA;
- Maintain ongoing contact with the other party's SLA Manager;
- Serve as the primary point of contact in the escalation process;
- Coordinate and implement modifications to service delivery and to the SLA;
- Periodically assess the effectiveness of mechanisms selected for service tracking and reporting;
- Plan and coordinate service reviews;
- Facilitate or participate in conflict resolution processes regarding service effectiveness;
- Regularly assess and report on how the two parties can further strengthen their working relationship;
- Delegate responsibilities to, or seek the assistance of, colleagues, subordinates or members of the other party's staff to address issues that may arise under the agreement;
- Plan training designed to foster a heightened service attitude, create an enhanced awareness of the elements of high-quality customer service, and provide skills in service delivery.

A draft Master Service Level Agreement that is proposed by the BNSDI project team to be adopted as a reference template while developing the future agreements between the Coordination Centre and the BNSDI member agencies. The Master Service Level Agreement (MSLA) shall be supplemented by an Addendum SLA that reflects the specific conditions and agreements with the individual custodian or steward

government entity. Please refer to Annex J where the MSLA template is described for reference.

3.2.3.2 Data Access & Security Management

Data access, sharing and reuse policy is a live activity that will need to be updated periodically by the Coordination Centre in light of the evolution of BNSDI program. As part of the foundation phase development of the BNSDI Program, the BNSDI project team will be responsible to develop a detailed data security classification for each standardized FGDS that will reside in the BNSDI Geospatial Portal. Access levels will be established as articulated in the Policy Framework document under separate cover. The type of access to be determined based upon a qualitative indicator of data sensitivity that has been developed by Coordination Centre. Where required, a benefit and risk assessment will be developed to provide the basis for an informed decision about the consequence of disclosing or not the information to a category of users whenever this is in question.

3.2.3.3 FGDS Data Identification & Development

As described in the Data Inventory & Assessment (DIA) document, the BNSDI project team has identified the Fundamental Geographic Data Sets (FGDS) that is of common interest and use by the BNSDI Community. The data was categorized into class, theme and topic and was characterized by scale and associated with unique custodians for each scale. The Coordination Centre shall continue to promote and facilitate the process of FGDS data identification, development and further refinement in the future taking into consideration that new stakeholders and additional fundamental data may be added in the future to the pool in collaboration with the Technical Committee and the special interest Working Groups.

3.2.3.4 Major Data Projects Alignment Coordination

As part of the BNSDI implementation program, the BNSDI project team will need to conduct an assessment of the major on-going GIS data projects and propose an alignment strategy in order to coordinate the development of those projects and the outcome data in a way that is normalized across the board based on common standards and practices. The Coordination Centre shall continue this exercise in the future for both existing and new projects as they arise.

3.2.3.5 Data Standards Development

The Coordination Centre will facilitate and support data standards development through participation in special interest Working Groups. The data standards development activities may materialize into community development projects as described under the community coordination and support section.

3.2.4 Infrastructure Development & Operations

The Infrastructure Development and Maintenance activity consists of the following:

- Development and Maintenance of Portal/ Data Clearinghouse
- Availability, Performance and Security Management
- Release Management
- Helpdesk Management
- Configuration and Change Management Support
- Technology Standards Development

3.2.4.1 Development & Maintenance of GeoPortal/ Data Clearinghouse

The computers, core software, peripherals, data networks, security, service delivery, management and other components comprise the essential computing infrastructure for the BNSDI. Some of these components are dedicated exclusively to BNSDI functions including those that are housed in the Coordination Centre offices, while others are primarily used for other agency purposes, but provide access to BNSDI resources or otherwise indirectly support BNSDI functioning. The BNSDI computing infrastructure can be characterized as including the following major components listed below, primarily operating from within the Coordination Centre Lanka Government Cloud computing environment:

BNSDI Web Portal. An BNSDI Portal website is to be developed to serve as the central point of contact for information about the BNSDI initiative, involved stakeholders, new information resources, and access to the Geospatial Portal. This Portal is intended to be an initial common resource and service to the BNSDI community, and will be updated and refined on a continuous basis. In the future, this should be expanded to include full Portal technology.

GeoPortal. An BNSDI GeoPortal is to be implemented to provide the community with a common metadata catalog and map services for viewing and using available geospatial data. During the BNSDI foundation program, this Portal will be used solely for accessing and viewing foundation data. In a later stage, the Portal functionality will be expanded to include advanced map services, including an advanced security layer and provision for data uploading

and downloading. Other specialized application services may be added in the future.

Distributed Entity Nodes. It is expected that some other government entities will wish to host their own BNSDI node. Such nodes will allow agencies that have the technical and human capacity to administer their own facility that will interoperate with the central Geospatial Portal across a distributed network. Through this mechanism, BNSDI users will be able to search for data through the central metadata catalog, and then view and use the information from a single interface irrespective of where the data is physically residing.

Geospatial Data Clearinghouse. A central data clearinghouse will be used to publish information on behalf of agencies that have not yet developed their own geospatial portal node. This Clearinghouse will be managed and supported by the Coordination Centre. Updates to the Clearinghouse database will be made by custodians based on community needs and the nature of each topical layer.

BNSDI Coordination Centre. A physical facility will need to be developed to support the operations of the Coordination Centre. This will include office space and specialized work and equipment spaces that are required for carrying out the work of the Coordination Centre.

National Communications Network. The CITO has implemented a comprehensive telecommunications infrastructure across government for Belize. This provides effective connectivity among most of the BNSDI stakeholder entities, and thereby increases the ability to access and share distributed information through a real-time network.

Coordination Centre Information Management System Architecture. The effective operation of the Coordination Centre computing infrastructure as a common service facility for the benefit of the BNSDI community will require a technology framework of three interrelated "reference layers" designed to facilitate seamless data and information flow both within and across all layers. The framework is supported by a management framework to facilitate reliable service delivery and support as well as a security standard to ensure information confidentiality, integrity and availability. Two main goals of the framework are information sharing with public outreach and improved effectiveness of IT investments. The highest level is the Client layer whereby different client types are used to access the Coordination Centre's applications. The Core Information Management Technology Layer which will integrate and interconnect the various components of the data-processing infrastructure: databases, platforms, and applications. The bottom layer, Computing Infrastructure, is based on physical technology devices that enable the IT infrastructure to guarantee an efficient, available, and secure environment.

The Coordination Centre will host an important node in the BNSDI network, inclusive of the national data clearinghouse. Thus it will be important for the Coordination Centre to proactively manage its IT infrastructure and that business continuity is effectively supported by the selected computing environment to ensure the greatest value from the information technology resources and services and to secure the computing and network environment against threats or disruptions in service. The management framework will need to include four "transcending layers" inclusive of Service Delivery, Service Support, Infrastructure Management and Security. These all have interrelationships and provide functional support to the "reference layers" of the technology framework to provide service management, network and system monitoring, business process monitoring and integrated security management methodologies, capabilities and products that will allow the Coordination Centre infrastructure to operate efficiently and reliably.

3.2.4.2 Availability, Performance & Security Management

BNSDI system performance is critical for a successful system operation and utilization by the end users. The performance management function focuses on the design, development and deployment of performance management tools that support the monitoring and control of system performance according to pre-set metrics and performance benchmarks. It includes, but is not limited to, the following:

- Communication infrastructure monitoring tools
- Spatial information infrastructure Performance Management tools (database, network, applications)

Performance management monitoring tools maintain information related to adequate functioning and performance of the system based on pre-defined benchmarks. This may include metrics measurements, alarms and signals, status reporting, etc. The above information, which may be handled by a suite of software/ functional solutions that monitor applications and network tip-to-tip performance may be maintained in disparate applications that are hosted on the BNSDI data center platform, the network administration environment and possibly the stakeholder agencies platforms or nodes.

A dashboard interface may be developed as well that assembles all the metrics, signals and alarms as well as reporting requirements in one GUI environment where federated data is aggregated from disparate performance management systems.

Availability Management is the practice of identifying levels of IT Service availability for use in Service Level Reviews with Customers. All areas of a service must be measurable and defined within the Service Level Agreement (SLA).

To measure service availability the following areas are typically included in the SLA:

- Agreement statistics – such as what is included within the agreed service
- Availability – agreed service times, response times, etc.
- Service/Help Desk Calls – number of incidents raised, response times, resolution times
- Contingency – agreed contingency details, location of documentation, contingency site, 3rd party involvement, etc.
- Capacity – performance timings for online transactions, report production, number of users, etc.
- Costing Details – charges for the service, and any penalties should service levels not be met

Availability is usually calculated based on a model involving the Availability Ratio and techniques such as Fault Tree Analysis, and includes the following elements:

- Serviceability – where a service is provided by a 3rd party organization, this is the expected availability of a component
- Reliability – the time for which a component can be expected to perform under specific conditions without failure
- Recoverability – the time it should take to restore a component back to its operational state after a failure
- Maintainability – the ease with which a component can be maintained, which can be both remedial or preventative
- Resilience – the ability to withstand failure
- Security – the ability of components to withstand breaches of security[1]

Security can most commonly be defined as, "the management, operational, and technical safeguards and protections designed, developed and instituted for information systems and supporting computing and network infrastructure(s) intended to protect their confidentiality, integrity, and availability." Once implemented, security and its associated controls must be assessed to determine the extent to which it has been implemented correctly, is operating as intended, and is producing the desired results with respect to meeting the security requirements for the organization.

Security best practices generally indicate that a comprehensive security program, when correctly and successfully conceived, designed and implemented, will have three major components – Management, Operational and Technical.

- Management refers to the safeguards or countermeasures that focus on the management of risk and the management of information system security.

[1] ***Availability Management and IT Security*** - IT Security is an integral part of Availability Management, this being the primary focus of ensuring IT infrastructure continues to be available for the provision of IT Services. Some of the above elements are really the outcome of performing a risk analysis to identify any resilience measures to be put in place, identifying just how reliable elements are and how many problems have been caused as a result of system failure. The risk analysis also recommends controls to improve availability of IT infrastructure such as development standards, testing, physical security, and the right skills in the right place at the right time, etc.

- Operational refers to the safeguards or countermeasures that primarily are implemented and executed by people (as opposed to systems).
- Technical refers to the safeguards or countermeasures that are primarily implemented and executed through tools, platforms, frameworks and mechanisms contained in hardware, software and network components.

The security related software tools may include the following:

- Firewall software (including the network firewalls and application)
- Internet security software
- Routers and switches security encryption and configuration software
- Security Zones and their associated software
- Network Traffic Encryption
- TCP/IP Filtering
- Internet Protocol Security (IPSec)

3.2.4.3 Release Management

As a general rule, the Coordination Centre is not in the software development business, and will give preference to COTs or well supported OpenSource solutions where these can adequately meet Coordination Centre needs. However, there are needs that cannot be met with COTS technology and that need to be developed in-house to meet the BNSDI special needs. In these cases the Coordination Centre will undertake to carefully maintain and manage internally developed software to protect the investment and to optimize the benefits of the system, including establishing a software release policy by which such management will occur.

The purpose of a software release policy is to provide standards and procedures to control software developed by Coordination Centre. This will improve the documentation, maintainability, and accountability of Coordination Centre-developed software, and will decrease ad hoc and poorly planned/ implemented changes to software. All software documentation is retained in Coordination Centre's Content Management System.

Before software designed and developed by the Coordination Centre is released, it will be thoroughly tested, demonstrated to the requestor, and documented. The user will be trained. The responsible Coordination Centre custodian will assign a release number and date that will appear when the software is run and that will be noted on all copies of documentation to support the software. The custodian will assign an initial release number and date to identify the software. Initial release numbers will end in zero. Software development at the Coordination Centre will be treated as a project and will be handled in accordance with the Project Management guidelines discussed in this document. When a request for services is made that involves software development, an initial requirements analysis will be conducted. From that, a

timeline for the initial software development will be developed and forwarded to the requestor. Every effort will be made to meet the schedules outlined in the initial time line, however, if the time line changes, the requestor will be informed.

The Coordination Centre will also determine whether the software is Critical or Non-Critical, which will determine how often new releases will be made. The testing, demonstration to the user, documentation, and training must be satisfactory to the Technical Manager before software is released.

Software Reviews. After the baseline release, the software will be made available for use by the requestor and any other approved users. If changes are required once the software has been released, the requestor may generate a Project Request Form to have the software changed. Software changes will not be made immediately, but will be held by the leader of the Group that designed the software to be incorporated in the next release of the software. Software systems maintained by Coordination Centre will be reviewed every six months if the software is determined to be "Critical," or every twelve months, if the software is determined to be "Non-Critical."

Critical Software Release. Critical software is software that is determined by the GIO and the users, to be mission essential and requiring frequent updates. The Technical Manager will conduct a semi-annual review of all critical software and determine whether there have been requests to modify the software. If there are requests for changes, the Technical Manager will assign a Project Manager, and will review the scope of the changes with the Project Manager. The Project Manager will conduct a requirements analysis and develop a time line, following the procedures in the Project Management Section of this document. When the Technical Manager releases the software, the Coordination Centre staff will assign an appropriate release number and date and will record the release in the history file for that piece of software. The release number reflects changes in functionality, technology, and performance.

Non-Critical Releases. Non-Critical releases are handled in a similar manner to Critical software, except that releases are made annually. A similar Project Management approach will be taken. If documentation requires only minor upgrade, page changes can be released. The Coordination Centre staff will assign an appropriate release number and date and will record the release in the history file for that piece of software.

History of Releases. The Coordination Centre will retain a history of each piece of software that is formally released. Included in the history will be the initial release number, date, and a list of documentation prepared for the release, training conducted prior to the release, Project Manager, and releasing authority,

at a minimum. For releases subsequent to the original release, a brief summary of changes will be included in the history.

3.2.4.4 Help Desk Management

Perhaps the most important function in an IT service support organization is the Service Desk (i.e., Help Desk, Call Center). The primary goal of the IT Service Desk is to provide a single point of contact for customers and users and to facilitate the restoration of normal service with minimal business impact. Specifically designed to optimize communications regarding incoming requests, the Service Desk tool should ensure efficient and expeditious handling of customer interactions. The tools should provision for categorizing, routing, tracking, of all requests. It should provide published and open APIs that offer broad integration capabilities including integration with Network and Systems Management products. The BNSDI will require that Service Desk personnel have familiarity with GIS and BNSDI specifications, or can route such issues to the Coordination Centre Help Desk.

A limited technical consulting and support capability will be maintained to allow the Coordination Centre to assist other organizations on an as-needed basis. Any such services that are beyond the normal operating functions of the Coordination Centre will be charged to the receiving organization. Specific activities may include:

- Staff a help desk to handle technical support calls and the needs of walk-in clients
- Host a user knowledge base on the BNSDI website. The knowledge base would allow users to post and respond to technical support questions, exchange knowledge and find links to other types of support;
- Monitor technical support questions in order to identify common support related needs

3.2.4.5 Configuration & Change Management Support

The primary goal of the ITIL Configuration Management process is to achieve, through the implementation of Asset Management, a single integrated configuration management database for all configuration items. The application seamlessly supports Incident Management, Problem Management, Change Management, and Service Level Management processes. Configuration Management function is very critical for a successful and smooth operation and maintenance of the BNSDI Program. It deals with the entire process of change and configuration management related to the BNSDI system components i.e. data, applications, hardware, staff capacity building and procedures. It includes, but is not limited to, the following:

- System development automation procedures
- System maintenance automation procedures

- Logging and tracking BNSDI Enhancement Requirements
- BNSDI System Administration
- Helpdesk
- Other requirements

The Coordination Centre will design and develop a configuration management strategy and internal support capacity, systems and tools that will be needed to support and manage the BNSDI Program operation. A configuration management plan should be prepared to ensure that the Coordination Centre staff that will be in charge of the system operation and maintenance will have all the necessary tools and procedures to support their activities. This configuration management plan should be in line with the existing configuration management policies adopted by the Coordination Centre. The objective is to define a configuration management process to manage the system routine operation activities:

- Change Management
- Quality Assurance/Quality Control
- Version Control
- Release Management

In order to support the above endeavor, the Coordination Centre shall procure, customize and deploy a complete configuration management system. For more detail on the Configuration Management process, please refer to Annex K.

Change Management delivers a best-practice process to systematically manage the response to a change request in accordance with the ITIL framework. A Change Management application tracks a change from the moment it is proposed, through the implementation in the live environment, to the evaluation of the end result. The out-of-box Change Management capabilities facilitate the gathering of changes from all identified stakeholders into a change repository. It includes planning changes based on priority, impact, or urgency. Change Management considers business and technical impact, impact on other services, the effect of not implementing the change, as well as resources required. It includes use of a back-out plan and a robust approval server that manages the request through a complex approval process. It automatically assigns tasks needed to complete the change. If problems arise during implementation, automatic escalations and notifications are performed. Repeated changes can be completed consistently with change templates. Reports are used to evaluate changes for desired effect, on time, on budget. The use of a Change Board and an integrated software application is essential to maintain a proper balance of the need for change with the potential negative impact on other elements of the IT infrastructure. Change Management is an indispensable tool used by the Change Advisory Board as specified by ITIL.

3.2.4.6 Technology Standards Development

The Technology standards development includes the following:

Software procedures & standards. Software procedures and standards includes a description of any specific software standards and procedures related to open source, web enabled services, Service Oriented Architecture (SOA), Middleware, commercial off-the-shelf products, etc. The proposed developments are the following:

- The Coordination Centre shall ensure that the BNSDI platform be built on open standards and interoperable and flexible software platforms
- The Coordination Centre shall assess the current progress in the technology development lifecycle and ensure that the information technology architecture and infrastructure are built on solid grounds. For example, questions should be dealt with such as do we adopt a service oriented architecture (SOA) and web services and do we plan for the deployment of middleware in the early stage of system development (i.e. in the BNSDI Strengthening phase) or not? And on what basis?
- It is recommended, especially during the early stages of system deployment, to rely on commercial off-the-shelf products (COTS) and refrain to go into customization to the extent possible. This will alleviate system operation and maintenance burden on the system administrators. Even though some of those requirements are policy related, some of them necessitate continuous monitoring and adoption of standards that define the framework for technology innovation and development

Computing Infrastructure procedures & standards. Computing infrastructure procedures and standards include, but are not limited to, procedures and standards related to computing infrastructure i.e. application, data and development servers, disaster recovery servers, workstations and peripherals. Developments in computing infrastructure may include the following:

- Keep abreast of computing infrastructure developments and setup a cutoff date for incorporation of latest specifications during the procurement processes
- Ensure that the proposed computing infrastructure is modular and expandable based on IT good practices and standards
- Ensure that hardware support services such as maintenance and warranty are in line with the IT strategy, and the adopted procedures and standards

3.2.5 Sustainable Development Planning and Investment Support

Where the BNSDI is intended to go beyond the focus of traditional NSDI on "supply-side" data sharing is in aligning the programme in a more integrated and proactive manner with national policy making, planning and development investment. This approach to next-generation NSDI, or "Smart Development Infrastructure (SDI+)" will ensure that the investment in geospatial technology and data can be more fully leveraged to maximum advantage and positive impact to Belize society. The following outlines those channels and linkages that will require further exploration and institutional alignment during the early stages of BNSDI development.

3.2.5.1 Physical Development Planning

There are many other organizations involved in various aspects of land planning, management and administration dealing with land tenure, utilities and infrastructure, environmental resource management, biodiversity conservation, tourism development and others that are carried out by multiple agencies at several levels. The effective coordination of all these initiatives to ensure synergy and sustainability represents a significant challenge. The BNSDI can play a significant role in ensuring more coordinated and integrated development planning and execution at multiple levels. This includes ensuring access to the appropriate data and analytical tools, providing a common basis for tracking planning areas, taking a proactive role in supporting the identification and assessment of development integration and alignment activities and in ensuring that plan information is widely accessible across the involved stakeholder organizations.

3.2.5.2 Development Investment Support

At present there are many development investments planned or ongoing across the Country, but no "common operating picture" that would indicate where these projects are occurring, how they may relate to one another in time and space, nor what the cumulative effects on the environment or communities where they are taking place may be. Projects may be designed and developed by individual agencies in different sectors with little or no visibility to each other's planned activities, thus missing opportunities for coordination and in some cases creating conflicted conditions (e.g. newly paved road dug up again for a pipeline expansion project). The planning, design and construction of such projects often involves the use of geospatial technology, but without a mechanism for coordination, many projects may develop data that already exists or multiple projects may create the same data redundantly. Lack of data can result in ill-planned projects or extended timeframes for data collection to support required studies. The BNSDI Coordination Centre office can provide a critical role in supporting the development investment process through multiple stages, including but not limited to:

- Common data coordination and access;

- Development investment analysis and development of prospective indicative pipeline of viable investment projects
- Project feasibility assessment analysis;
- Project design support with GIS data and analysis;
- Project construction management and tracking support;
- Project transition to operations and maintenance;
- Project monitoring and evaluation;
- Development investment GIS based common operating picture;

3.2.5.3 Sustainable Development Monitoring and Evaluation

The U.N. Sustainable Development Goals (SDG's) can provide a valuable metric around which to monitor and assess the achievement of the Country's development aspirations over time. The BNSDI will contain much of the data to understand the current status of SDG achievement and the geographic expression of these values across the country, thus providing the basis for place and community-based interventions that are not supported by national statistical reporting. BNSDI data and geostatistical analysis and visualization tools can be used to create executive dashboards that can provide government leadership with a near real-time "pulse" of issues across the country and measures of progress around which informed and evidence-based policy and decision-making can be conducted.

4 DATA FRAMEWORK

The elements of the Data Framework have been defined in the Phase I "Data Inventory and Assessment" and "BNSDI Requirements Analysis" reports. Those reports identify the full range of Fundamental Geospatial Data Sets (FGDS) that are needed by the community, and the suggested custodians for maintaining each layer. This information is to be used as the starting point for prioritizing groups of layers for the staged development of final standards and security classifications, service level agreements (SLA's), development of baseline layers, data publishing and initiation of routine updating procedures. Highlights from those documents are summarized here for reference to the other components of the Programme Design.

4.1 National Spatial Data Framework

A set of data classes and themes based on international NSDI experience has been adapted to fit the needs of the BNSDI. The six (6) basic classes of geospatial information are Basemap, Areas, Environmental, Transportation, and Utilities. These comprise over 50 themes, representing over 200 data topics. In consideration of the business requirements, these are then consolidated to approximately 100 FGDS that represent clusters of related topics to be addressed programmatically in the BNSDI program design and implementation plan.

Each class is summarized below, along with a listing of its related themes. Further details, including the listing of specific data topics within each theme are described under separate cover in the Data Inventory and Analysis Report.

> ***Basemap***. Information in this class provides the spatial frame of reference for all other geographic data. These include horizontal and vertical geodetic control, topographic and bathymetric contours, spot elevations, planimetric features (such as landmarks), coordinate grids, and similar information. The Basemap class includes the following data themes:
>
> - Survey Control
> - Places (Gazetteer)
> - Elevation
> - Imagery
> - Remotely Sensed Data
> - Planimetric Features
> - Structures
> - Scanned Basemaps
> - Grids and Indexes

Areas. This class refers to subdivisions of land or water areas according to some jurisdictional or other purpose. Areas, such as administrative areas, can follow topographic features, or be used to delineate socioeconomic or management zones. Areas delineate jurisdictional areas, land ownership, statistical reporting and management zones and are used for a variety of planning, administrative and other purposes. The Areas class includes the following data themes:

- Activity Areas
- Cadastral
- Planning Areas
- Political/Administrative
- Service Areas
- Special Management Areas
- Statistical Areas

Environment. Environmental data typically include features of the natural environment such as hydrology, vegetation, soils, geology, archaeological sites, sensitive flora or fauna locations, and other information concerning the natural and cultural environment. There is a great deal of interest within certain organizations involved with rational physical planning, resource management and environmental protection, to enhance the development of more extensive environmental databases. The Environment class includes the following data themes:

- Air & Climate
- Waste
- Cultural Resources
- Land and Aquatic Use/Cover
- Biodiversity
- Surficial Hydrology
- Subsurface Hydrology
- Soils
- Geology
- Seismology
- Geomorphology
- Marine Abiotic

Utilities. The definition of utilities in the present context addresses the various types of asset-intensive and capital-intensive infrastructure services such as electricity, water, sewage, gas, and telecommunications. The Utilities class includes the following data themes:

- Electrical Facilities
- Potable Water Facilities
- Sanitary Sewer Facilities
- Stormwater Sewer Facilities

- Telecommunication Facilities
- Waste Management Facilities

Transportation. This class include roadways, highways, rail lines, bridges, airports and any other information related to transportation networks and facilities. This information can be used in a variety of spatial analyses and for general reference. For example, the street network can be used to route delivery trucks, school buses, public transport vehicles, emergency medical or police response, and other routing applications. It can also be used for allocation applications, by correlating the street network with other information, such as population adjacent to the streets to be served by public transportation, and other factors. The Transportation class includes the following data themes:

- Air Transportation
- Water Transportation
- Land Transportation

All of the data themes listed above have been addressed at one level or another by other government agencies or private companies, professional organizations, and standards bodies. International and industry data model standards that address content and format standards for each theme can be referenced and used as a starting point for the adaptations that are most often required to make these models fit each unique situation.

The classification scheme above is being used as a starting point for the development of a customized geospatial data reference architecture for the BNSDI. This will be subjected to further refinement in collaboration with various groups of BNSDI stakeholders as each specific data area is addressed in later stages of the program. This process will include referencing of available international data content standards from around the world that can be used as a starting point for the development of content standards for Belize.

In addition to the above FGDS there may be a need to also include derived layers that are needed in common. This could include for example, identification of areas prone to landslides or wild fires, soils interpretations for various agriculture, engineering and habitat purposes, etc. Most of such layers can be derived through overlay and multi-factor analysis of FGDS data layers already identified.

The following table provides a summary of the data class, theme, topic and FGDS that were defined within the Data Inventory and Assessment report.

Table 1 – BNSDI FGDS Classification

CLASS	THEME	TOPIC	FGDS

Basemap	Survey Control	Geodetic Control Network	Geodetic and Survey Control Network
Basemap	Survey Control	CORS/RTK Station Locations	CORS/RTK station locations
Basemap	Survey Control	Ground Control Points	Ground Control Points
Basemap	Places	Gazetteer	Gazetteer
Basemap	Places	Points of Interest	Points of Interest
Basemap	Elevation	LIDAR Elevation Data	LIDAR Elevation Data
Basemap	Elevation	Topographic/Bathymetric Contours	Topographic/Bathymetric Contours
Basemap	Elevation	Digital Terrain Model (DTM)	Digital Terrain Model (DTM)
Basemap	Elevation	Digital Elevation Model (DEM)	Digital Elevation Model (DEM)
Basemap	Elevation	Triangular Irregular Network (TIN)	Triangular Irregular Network (TIN)
Basemap	Elevation	Coastline	Coastline
Basemap	Imagery	High Resolution Satellite Imagery	High Resolution Satellite Imagery
Basemap	Imagery	Aerial Photography	Aerial Photography
Basemap	Imagery	Orthophotography	Orthophotography
Basemap	Remote Sensing Data	MSS, SAR, Other	High/Medium Resolution Satellite Data
Basemap	Remote Sensing Data	MSS, SAR, Other	Low Resolution Satellite Data
Basemap	Planimetric Features	Utility Structure, Fences, Walls, Landscape Vegetation, Pavement Edge, Landscape Structures, Parking	Planimetric Features
Basemap	Structures	Building Footprint, Building Points, Street Address, 3D Buildings, Facilities, Accommodation, Eating and Drinking, Attractions, Commercial Services, Education and Health, Public Infrastructure, Retail, Sports and Entertainment, Manufacturing and Production, Accommodations, Restaurants and Bars, Botanical and Zoological, Museums and Art galleries, Recreational Landscapes, Tourism Facilities, Financial Services, Health Practitioners and Establishments, Animal Health, Primary, Second and Tertiary, Education, Recreational and Vocational, Education, Burial Sites and Cemeteries, Government Agencies and Offices, Organizations, Places of Worship, Postal Services, Public Safety, Recycling Facilities, Utilities Companies, Fuel Stations, Parking Lots and Structures, Food, Drink and Multi-Item Retail, Outdoor Pursuits, Venues, Stage, and Screen, Farming Products Facility, Forestry Products Facility, Industrial Products Facility	Building Footprints Building Points
Basemap	Scanned Basemaps	Scanned Topographic Basemaps	Scanned Topographic Basemaps
Basemap	Scanned Basemaps	Scanned Historical Maps	Scanned Historical Maps
Basemap	Grids and Indexes	Coordinate Grids	Coordinate Grids
Basemap	Grids and Indexes	Non-Coordinate Indexes	Non-Coordinate Indexes
Areas	Activity Areas	PSIP, Research Plots, Other	Activity Areas

Areas	Cadastral	Plot Boundaries	Plot Boundaries
Areas	Cadastral	Block Boundaries	Block Boundaries
Areas	Cadastral	Easements	Easements
Areas	Cadastral	Right of Way	Right of Way
Areas	Planning Areas	National Spatial Plan, Area Plans, Regional Plans, Urban Design Areas, Special Development Areas, Natural Resource Management Plans	Planning Areas
Areas	Political/Administrative Areas	National and Sub-National Boundaries	National and Sub-National Boundaries
Areas	Political/Administrative Areas	Electoral Divisions	Electoral Divisions
Areas	Political/Administrative Areas	Municipal Boundaries	Municipal Boundaries
Areas	Political/Administrative Areas	Exclusive Economic Zone	Exclusive Economic Zone
Areas	Service Areas	Utility Service Areas,	Utility Service Areas,
Areas	Service Areas	Government Service Areas	Government Service Areas
Areas	Special Management Areas	Marine Protected Areas, Protected Areas	Protected Areas
Areas	Special Management Areas	Designated Cultural Heritage, Designated Natural Heritage, Private Protected Areas, Designated Sensitive Habitat	Designated Heritage Areas
Areas	Special Management Areas	Mineral Concession, Petroleum Concession	Concession Areas
Areas	Statistical Areas	Wide range of statistical themes	Mostly tied to administrative boundaries
Environmental	Air & Climate	Meteorological Station Locations	Meteorological Station Locations
Environmental	Air & Climate	Air temperature, wind speed and direction, relative humidity, pressure, precipitation, evaporation, and sunshine duration	Climate Summary Data
Environmental	Air & Climate	Air temperature, wind speed and direction, relative humidity, pressure, precipitation, evaporation, and sunshine duration	Derived Climate Isohyets
Environmental	Air & Climate	Green House Gas Emissions	Green House Gas (GHG) Emissions
Environmental	Waste	Municipal Solid Waste, Construction and Demolition Waste Sources, Landscape Waste Sources, Hazardous Waste, Medical Waste, Industrial Emissions	Waste and Emissions
Environmental	Cultural Resources	Historical Sites	Historical Sites
Environmental	Cultural Resources	Archeological Sites	Archeological Sites
Environmental	Cultural Resources	Paleontological Sites	Paleontological Sites
Environmental	Land & Aquatic Use/Cover	Land Use, Land Cover, Vegetation, Benthic Type,	Land and Aquatic Use/Cover
Environmental	Land & Aquatic Use/Cover	Urban Land Use	Urban Land Use
Environmental	Land & Aquatic Use/Cover	Agriculture Land Use	Agriculture Land Use
Environmental	Biodiversity	Habitat Type	Habitat Type
Environmental	Biodiversity	Biological Survey Boundaries, Species Observation Points, Biological Plot Surveys, Animal Tracking Data, Species Range Data,	Biodiversity Study Data

		Population Assessments;	
Environmental	Biodiversity	Biodiversity value, Habitat of species of special concern	Biodiversity Value
Environmental	Biodiversity	Protection status and gap analysis	Biodiversity Protection Gap Analysis
Environmental	Surficial Hydrology	Rivers and Streams	Rivers and Streams
Environmental	Surficial Hydrology	Waterbodies	Waterbodies
Environmental	Surficial Hydrology	Watersheds	Watersheds
Environmental	Surficial Hydrology	Flood Zones	Flood Zones
Environmental	Surficial Hydrology	Coastal Storm Surge	Coastal Storm Surge
Environmental	Subsurface Hydrology	Groundwater Monitoring Locations	Groundwater Monitoring Locations
Environmental	Subsurface Hydrology	Groundwater Basins	Groundwater Basins
Environmental	Subsurface Hydrology	Groundwater Model Outputs, depth to groundwater, salinity, ph, other	Groundwater Model Outputs
Environmental	Soils	Soils boundaries, soil sample points and data	Soil Type Areas
Environmental	Soils	Geotechnical study locations and data	Geotechnical Studies
Environmental	Geology	Geologic Sample Sites, Surficial Geology, Subsurface Geology, Mineral Resource Areas	Geology
Environmental	Seismology	Seismic Faults	Seismic Faults
Environmental	Seismology	Seismic Risk Zones	Seismic Risk Zones
Environmental	Seismology	Seismic Events	Seismic Events
Environmental	Geomorphology	Geomorphology	Geomorphology
Environmental	Geomorphology	Topographic Slope	Topographic Slope
Environmental	Geomorphology	Elevation Regimes	Elevation Regimes
Environmental	Geomorphology	Solar Aspect, Hillshade	Solar Aspect
Environmental	Geomorphology	Landform	Landform
Environmental	Marine Abiotic	Marine Monitoring Station Locations	Marine Monitoring Stations
Environmental	Marine Abiotic	Temperature, Pressure, Light intensity, Light wavelengths, Tides, Current strength and direction, Waves, Storm surge, Tsunami run-up zones, Density of the water medium (dependent on temperature and dissolved materials), Salinity, Concentration of other dissolved salts, Concentration of dissolved minerals such as iron, phosphorus, calcium, magnesium, Concentration of fixed nitrogen, pH, Concentration of dissolved carbon dioxide, Concentration of dissolved oxygen, Concentration of other dissolved solutes and nutrients, Marine sediment type and distribution, Magnetic field strength and direction	Marine Monitoring Data
Utilities	Electric Facilities	Electrical Generation Facilities	Electrical Generation Facilities
Utilities	Electric Facilities	Electrical Transmission Facilities	Electrical Transmission Facilities
Utilities	Electric Facilities	Electrical Distribution Facilities	Electrical Distribution Facilities
Utilities	Electric Facilities	Electrical Utility Communications Facilities	Electrical Utility Communications Facilities

Utilities	Potable Water Facilities	Water Production Facilities	Water Production Facilities
Utilities	Potable Water Facilities	Water Distribution Facilities	Water Distribution Facilities
Utilities	Sanitary Sewer Facilities	Sewer Collection Facilities	Sewer Collection Facilities
Utilities	Sanitary Sewer Facilities	Sewer Treatment Facilities	Sewer Treatment Facilities
Utilities	Stormwater Sewer Facilities	Stormwater Sewer Collection Facilities	Stormwater Sewer Collection Facilities
Utilities	Stormwater Sewer Facilities	Stormwater Sewer Catchment Areas	Stormwater Sewer Catchment Areas
Utilities	Telecommunications Facilities	Telephone Cable Network Facilities	Telephone Cable Network Facilities
Utilities	Telecommunications Facilities	Wireless Towers	Wireless Towers
Utilities	Waste Management Facilities	Landfill Facilities	Landfill Facilities
Utilities	Waste Management Facilities	Solid Waste Management Facilities	Solid Waste Management Facilities
Utilities	Waste Management Facilities	Solid Waste Collection Routes	Solid Waste Collection Routes
Transportation	Land Transportation	Highways, roads, tracks, trails	Road Network
Transportation	Land Transportation	Roads Linear Referencing Scheme	Roads Linear Referencing Scheme
Transportation	Land Transportation	Transit Routes, Bus Routes	Transit Routes
Transportation	Water Transportation	Water Transport Facilities	Water Transport Facilities
Transportation	Water Transportation	Water Transport Routes, Water Taxi Routes, Ferry Routes	Water Transport Routes
Transportation	Water Transportation	Water Transport Aids to Navigation	Water Transport Aids to Navigation
Transportation	Air Transportation	Air Transportation Facility Locations, Airports, Airstrips, Helipads	Air Transportation Facility Locations
Transportation	Air Transportation	Air Transportation Routes,	Air Transportation Routes

The nearly 100 data layers outlined above will be implemented at multiple compilation scales, according to the use and requirements for detail and spatial accuracy. Different applications of geospatial data have different requirements for geographic scale and levels of spatial detail and accuracy. The geographic scale at which information is compiled can be indicative of the level of detail and accuracy that can be reliable achieved. The BNSDI geospatial data can be grouped into three scale ranges:

Large scale (Engineering). 1:1,000 to 1:2,500 – typical scales for an urban neighborhood or for detailed engineering works, or to view a whole village.

Medium scale (Community). 1:2,500 to 1:10,000 – more suitable at the city level, or for a large area of relatively distributed human development;

Small scale (National). 1:10,000 and above – used to visualize large parts of the country. Much smaller scales may be used to depict data at the national and international scales, but these are too general as FGDS for most applications, and are therefore not specifically addressed here;

Positional (horizontal and vertical) accuracy can be of crucial importance, and there is a relationship between this and scale, whereby the level of accuracy generally increases at larger scales.

FGDS data layers are to be maintained in the World Geodetic System 1984 (WGS84) standard. WGS84 comprises a standard coordinate frame for the Earth, a datum/reference ellipsoid for raw altitude data, and a gravitational equipotential surface (the geoid) that defines the nominal sea level. This common geodetic framework is the foundation for the establishment of the common survey control network and topographic base map development at all levels that is needed to ensure the spatial integration of any other thematic data that will use basemaps or orthoimagery as the basis for establishing location. It is also important as a common reference for all field surveys or the accurate spatial enabling of field devices that might be used by utility crews, census takers, environmental observations, geotechnical samples and other activities that will utilize GPS as the spatial reference. The same geodetic framework then further provides for the accurate integration of field-collected data with any thematic data mapped off of the base map.

4.2 Data Catalog and Clearinghouse

A key benefit of the BNSDI program is making commonly needed fundamental data easily accessible to those who need it and are authorized to use it. To accomplish this, the data holdings will need to be cataloged in a standard manner and data should be made accessible through a common data clearinghouse.

It is technically possible for each BNSDI data custodian to self-publish their information in a decentralized manner for access by authorized users over the web, utilizing standardized web map or web feature services. However, due to the current "geomaturity" of most organizations and associated infrastructure, it is expected in the early years of the BNSDI that it will be more convenient and reliable to have all FGDS consolidated to a central data warehouse, accessible through a well-controlled geoportal and metadata catalog. As more organizations become more capable of reliably managing their own data publishing function it will become more feasible to support a data clearinghouse that provides access both to distributed published information as well as the continuation of a centrally published data warehouse managed by the BNSDI Coordination Unit on behalf of data custodian who prefer to avail themselves of that service.

As mentioned in the BNSDI Requirements Analysis report, the community has already de facto adopted the ISO 19115 geospatial metadata standard for use in Belize, although this has not been widely applied as of yet. It will be critical as each FGDS is added to the BNSDI

4.3 Spatial Data Acquisition Programme

As documented in the BNSDI Data Inventory and Assessment report, many GIS data layers exist in some form in Belize today, but generally these have not been standardized, cover only parts of the country and are not up-to-date. While it will ultimately be up to the individual data custodian organizations to ensure their data is accurate and up to date, in the meantime there is a need for a standardized national basemap compiled at the assigned scales that can be used as a geographic foundation for all other geospatial information.

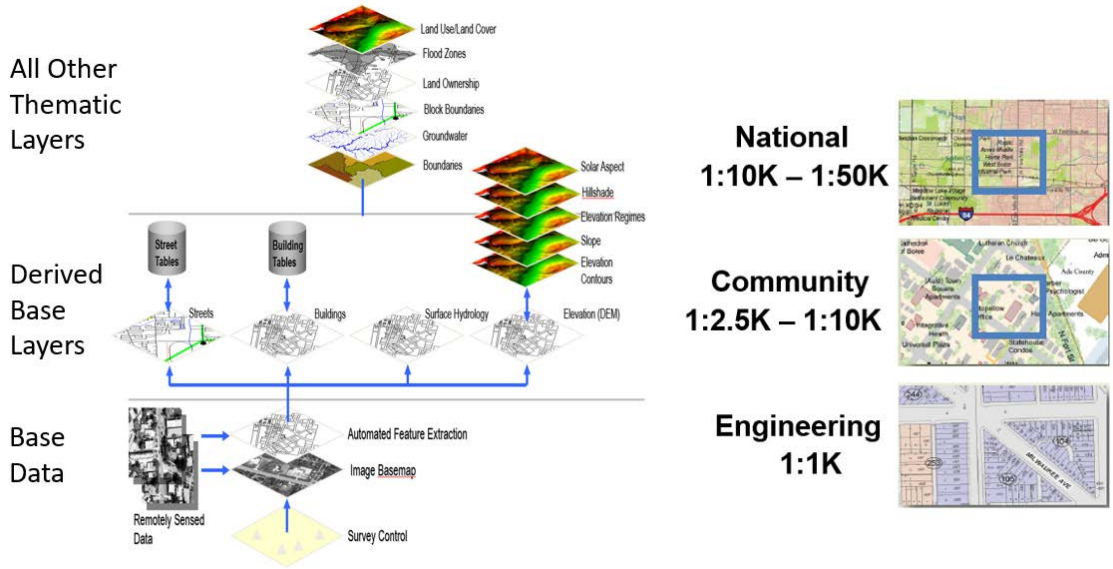
A Belize National Map Programme has been conceived to compile and update this information to a form that meets a wide range of stakeholder needs at national, regional and local levels and can serve as the foundation for all other BNSDI data nationally. This Programme is to address the following layers as a complete national baseline:

- **Survey Control**. Provides the survey control frame of reference for all other geographic information in the country;
- **Imagery**. Aerial orthophotos or high-resolution satellite imagery depict features on the ground that are visible from above;
- **Elevation**. Topographic (land) and bathymetric (underwater) surface elevation, normally expressed as an elevation value above or below mean sea level.
- **Place Names**. Common recognized names for communities, landmarks, urban points of interest, etc.
- **Transportation Network**. Network of highways, streets, tracks and associated tabular information such as street name, class of street, etc.
- **Surface Hydrology**. Rivers, streams, lakes, wetlands, springs and any other features of the surface hydrology system;
- **Buildings**. Structures that may house people or businesses. This also needs to include tabular information providing a unique identifier and basic information for each structure.

As illustrated in Figure 8 below, there are interdependencies and sequencing among these layers that need to be considered in the compilation process. In addition to the content of each layer it will also be important to consider the scale and accuracy at which this information is created to ensure that it meets the needs of the BNSDI stakeholder community.

The development of the initial Belize National Map Programme is conceived as a single, comprehensive, integrated effort covering the entire country at multiple scales. Once these layers have been created, they will provide the common reference for all other geographic data across all sectors, and the individual layers can then be turned over to the appropriate custodian organizations for ongoing updating.

Figure 8 - Conceptual Structure for a Belize National Map Programme



A Belize National Map Programme (BNMP) Working Group has been initiated to engage all the key stakeholders in the development of standards and specifications for each layer to ensure that the resulting data products are responsive to community needs. The Group is further subdivided into Sub-Groups, each addressing one or more of the individual base data layers. This Group/Sub-Group structure is important to ensure that the initial development of these interrelated layers is carried out in an efficient, coordinated and integrated way. The Working Group and sub-groups will address both the specifications required for the near-term BNMP as well as the data security classification, custodianship, and other terms and conditions that will be required to ensure that each layer is properly shared, maintained and managed into the future.

Beyond the layers to be developed in the National Map Programme, the Coordination Centre will need to facilitate a process with the stakeholder community to further prioritize the remaining layers and to undertake a systematic process of developing those layers, making them available to the community per accepted security framework and instituting the permanent processes for maintaining this information by the identified custodians into the future. The development of each layer will involve engagement of working groups comprising representatives of the organizations that have a specific need for such information. Each working group will apply the same basic steps, as follows:

Activity 1 – Confirm business requirements and current situation. The 2016 BNSDI Requirements Assessment and Data Inventory and Assessment reports have identified a broad range of potential business requirements for each fundamental data topic and the existing data sources in Belize that may fulfil part or all of these requirements. This information is contained in both textual reports as well as spreadsheet tables that can be manipulated and further analysed. In the first activity, each sub-group will review those findings and either confirm or refine them to ensure the base information and assumptions being used are accurate and current. Any additions or refinement will be added to updated versions of the reports for common future reference.

Activity 2 – Review international data content standards. In many cases there exist content standards and specifications for specific geospatial data topics that can be used as a starting point for the development of content standards and specifications that are customized to fit the Belize situation. Each sub-group will identify and review any such standards, compared these to the business requirements identified previously and customize or develop original standards accordingly. Where needed, additional input from subject matter experts may be solicited to support or confirm the sub-group assumptions, findings and conclusions.

Activity 3 – Develop content standards, terms and conditions. This activity will involve the development of draft content standards and related terms and conditions for each fundamental geospatial data layer to be included in the National Map Programme. The content standard will include mapping scale, levels of accuracy and information content to be included. The sub-group will also determine any data security considerations relative to each layer by applying a standard process and criteria for this process that will be supplied by the MNR Spatial Data Department. It will also identify the candidate organization that is the most logical custodian of each layer in the future and frequency of updating and other factors that will be required to meet the business needs of the stakeholders into the future. The information from each sub-group will be compiled to a standard format that will have been provided by the Working Group.

5 COMPUTING INFRASTRUCTURE

The following provides a general configuration and specifications for the computing infrastructure that is needed to support the full functioning of the Coordination Centre. This includes a proposed configuration for the hardware and software needed as well as a functional specification for the GeoPortal and GIS and geoprocessing capabilities that are required to support the development, utilization and management of the data repository, the design and publishing of map services to be accessed by the GeoPortal and conducting analytical and other special projects on an as-needed basis. This has been designed to build on and take advantage of the computing infrastructure that is already in place at the Ministry of Natural Resources.

5.1 Coordination Centre System Configuration

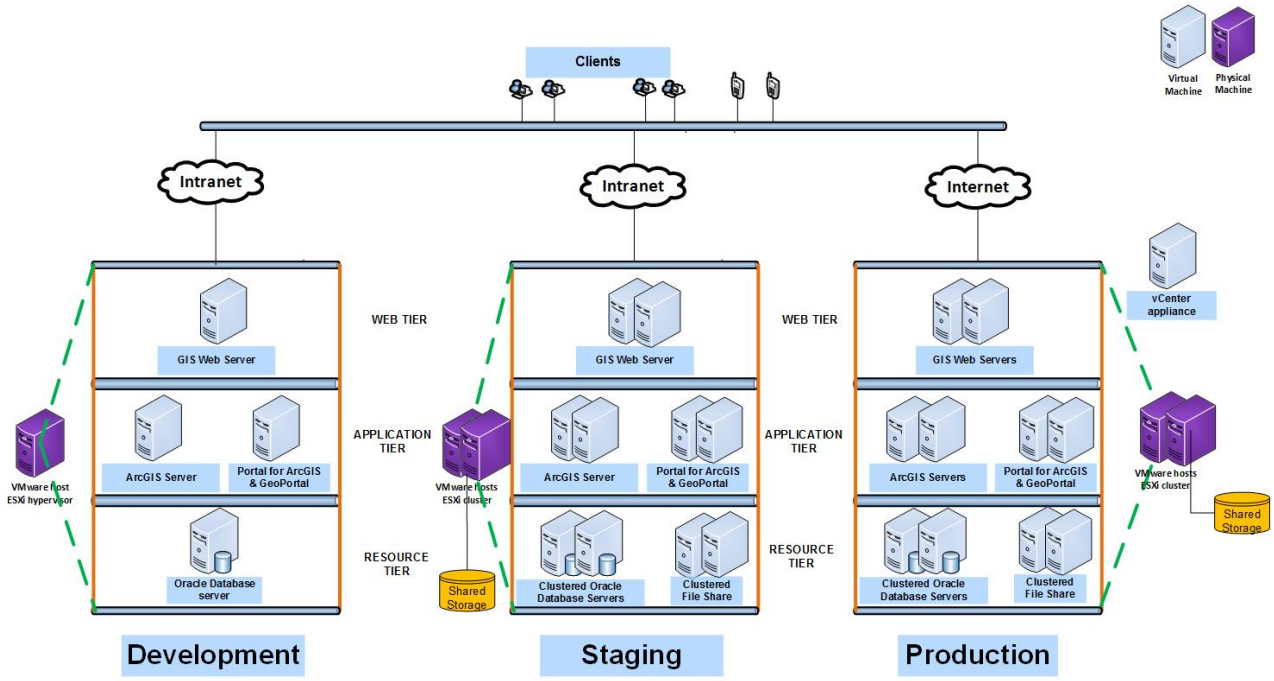
The following provides a conceptual outline for the foundation computing hardware and software that will be needed to support Coordination Centre operations within the first 2-3 years of operation. This conceptual configuration will need further refinement to a physical design and detailed specification during the first phase of implementation to consider the final environment within which the system is to be implemented.

5.1.1 BNSDI High Level Architecture

The purpose of this section is to lay the foundation for detailing the technical specifications for the BNSDI system that will be required to support the activities of the Coordination Centre. It is envisioned for the system to feature three instances [Development, Staging & Production] based on either an on-premise system or cloud setup architecture. The Staging and Production environments are replicas with High Availability built in for fault tolerance and load sharing. Cloud based architecture could provide BNSDI with lower operating costs over time while maintaining the same level of reliability that an on-premise system can provide. Cloud based architecture would also provide ultimate scalability flexibility to expand system capacity over time on an as-needed basis.

A) On-premises System Architecture: -

Whether on-premise system or cloud based, the basic conceptual architecture will be as per the system specifications stated below. Clients will access the solution through the internet or a dedicated connection to the system. The systems availability will be provided with high-availability provided by redundant nodes. All systems are to be hosted on Windows Operating System.



Development Environment:

The development environment consists of four compute instances featuring three tiers.

a) The Presentation Tier
The presentation tier consists of one web server to handle incoming requests and redirect them to the application tier servers as appropriate.

b) The Application Tier
This tier consists of two servers one for ArcGIS Serve, and one for Portal for ArcGIS and the GeoPortal products. The ArcGIS server will be used for GIS request processing while the later server will ne used for fata catalog and metadata management

c) The Resource Tier
This tier consists of one server for hosting an Oracle Database.

Staging and Production Environments:

The Staging and Production environments consist of ten servers each. Each environment supports high availability and features three tiers, as follows.

d) The Presentation Tier

The presentation tier consists of two web servers to handle incoming requests and redirect them to the application tier servers as appropriate.

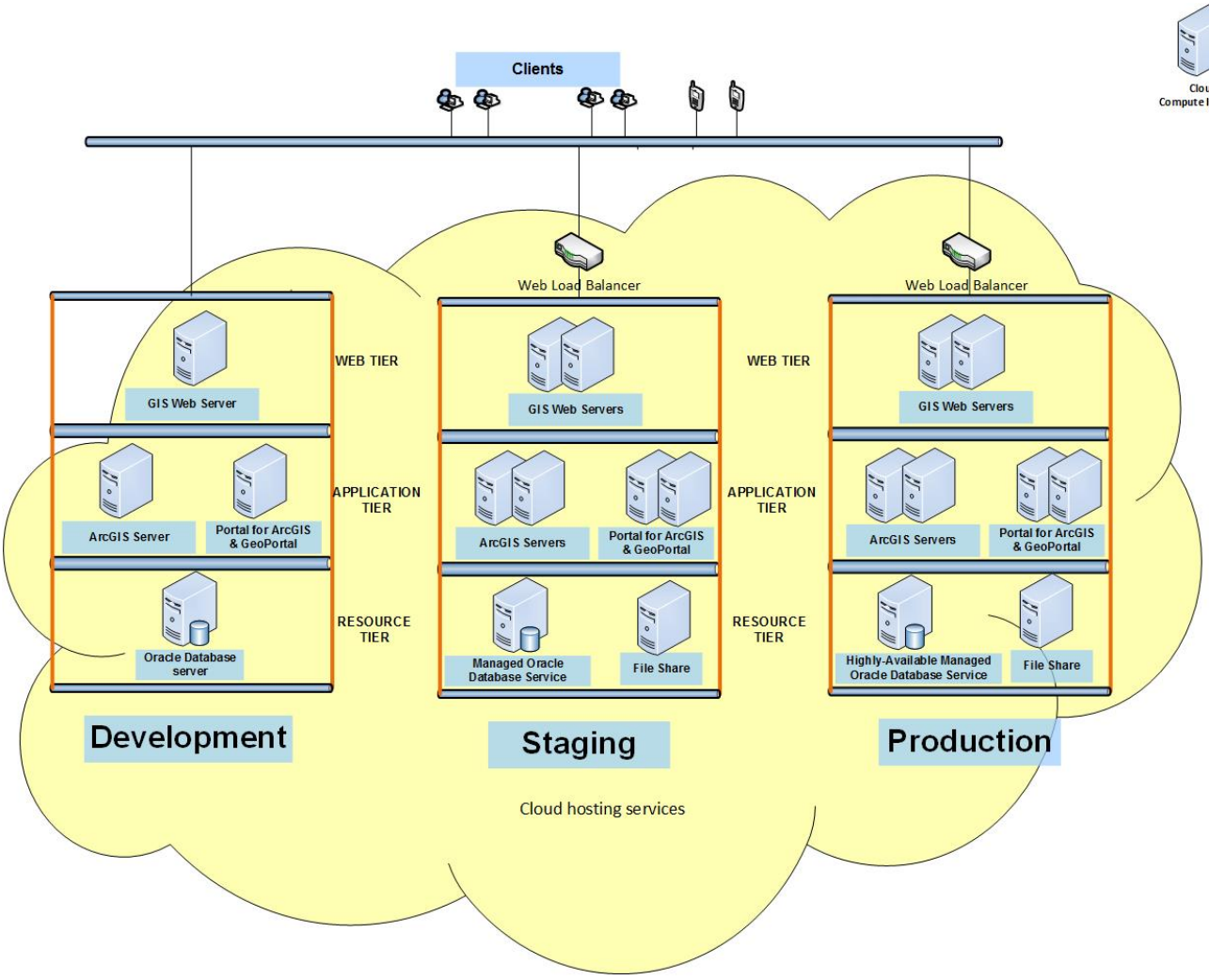
e) The Application Tier

This tier consists of four servers two wo servers for GIS requests processing. And, two servers to host Portal for ArcGIS and GeoPortal.

f) The Resource Tier

This tier consists of two servers for hosting an Oracle Database, and two servers to handle the shared data resources

B) Cloud System Architecture: -



Development Environment:

The development environment consists of four compute instances featuring three tiers.

a) The Presentation Tier

The presentation tier consists of one web server to handle incoming requests and redirect them to the application tier servers as appropriate.

b) The Application Tier
This tier consists of two servers one for ArcGIS Serve, and one for Portal for ArcGIS and the GeoPortal products. The ArcGIS server will be used for GIS request processing while the later server will ne used for fata catalog and metadata management

c) The Resource Tier
This tier consists of one server for hosting an Oracle Database.

Staging and Production Environments:

The Staging and Production environments consist of eight servers each. Each environment supports high availability on the presentation and application tiers and features three tiers, as follows.

a) The Presentation Tier
The presentation tier consists of two web servers to handle incoming requests and redirect them to the application tier servers as appropriate.
b) The Application Tier
This tier consists of four servers. Two servers for GIS requests processing. And, two servers to host Portal for ArcGIS and GeoPortal.
c) The Resource Tier
This tier consists of one server for hosting an Oracle Database, and one server to handle the shared data resources

Assumptions:

1. System to support 400 regular users, with up to 100 simultaneous users.
2. All support services and infrastructure will be provided through the computing environment within which the Coordination Centre system is to be established. These include Active Directory, DNS, Load-balancers, Antivirus, backup and others.
3. The Architecture may be fine-tuned b the addition of an ETL (Extract, Transfer and Load) software like FME from Safe in case if data format conversion imposes that. Otherwise, ArcGIS Server Interoperability extension will be utilized.

5.1.2 Server Configuration

The following table provide a basic specification for the BNSDI server configuration to be implemented within the Coordination Centre.

A) On-premises System Architecture: -

SN	Env	Role	No. Servers	CPU-cores	RAM-GB	OS disk-GB	Data disk-GB	Total disk-GB
1	Dev	Database server	1	4	8	100	400	500
2	Dev	ArcGIS server	1	4	8	100	200	300
3	Dev	Portal for ArcGIS & Geoportal	1	4	8	100	200	300
4	Dev	Web server	1	2	4	100	100	500
5	Stg	Database server	2	4	8	100	400-shared	600
6	Stg	ArcGIS Server	2	4	8	100	100	400
7	Stg	Portal for ArcGIS & Geoportal	2	4	8	100	100	400
8	Stg	Web server	2	2	4	100	100	400
9	Stg	File server	2	4	8	100	400-shared	600
10	Prod	Database server	2	8	32	100	2000-shared	2200
11	Prod	ArcGIS Server	2	8	32	100	200	600
12	Prod	Portal for ArcGIS & Geoportal	2	8	32	100	200	600
13	Prod	Web server	2	2	4	100	100	400
14	Prod	File server	2	4	8	100	3000-shared	3200

B) Cloud System Architecture: -

SN	Env	Role	No. Servers	CPU-cores	RAM-GB	OS disk-GB	Data disk-GB	Total disk-GB
1	Dev	Database server	1	4	8	100	400	500
2	Dev	ArcGIS server	1	4	8	100	200	300
3	Dev	Portal for ArcGIS & Geoportal	1	4	8	100	200	300
4	Dev	Web server	1	2	4	100	100	500
5	Stg	Cloud Managed Database service	1	4	8	N/A	400	400
6	Stg	ArcGIS server	2	4	8	100	100	400

7	Stg	Portal for ArcGIS & Geoportal	2	4	8	100	100	400
8	Stg	Web server	2	2	4	100	100	400
9	Stg	File Share	1	4	8	100	400	500
10	Prod	Cloud Highly Available Managed Database service	1	8	32	N/A	2000	2000
11	Prod	ArcGIS server	2	8	32	100	200	600
12	Prod	Portal for ArcGIS & Geoportal	2	8	16	100	200	600
13	Prod	Web server	2	2	4	100	100	400
14	Prod	File server	1	4	8	100	3000	3100

5.1.3 Workstations and Peripheral Hardware

The following workstation and peripheral hardware will be needed to support the Coordination Centre operations and projects. The designation of personal equipment and software is based on the following allocations:

Table 2 - Allocation of Personal Equipment

Role	System	GIS License
GIO	1 Office Laptop + 1 GIS Workstation	1 ArcGIS Desktop Standard
Secretary	1 Office Desktop	Non GIS
Sustainable Development Support Coordinator	1 Office Laptop	Non GIS
Outreach Coordinator	1 Office Laptop	Non GIS
Systems and Database Administrator	1 Office Laptop	Non GIS
Help Desk Operator	1 Office Desktop	Non GIS
PM/ GIS Consultant	1 GIS Workstation	1 ArcGIS Desktop Advanced
Technical Manager	1 GIS Workstation	1 ArcGIS Desktop Advanced
Geospatial Data Specialist x 2	2 GIS Workstation	2 ArcGIS Desktop Advanced
Geospatial Portal Specialist	1 GIS Workstation	1 ArcGIS Desktop Advanced
GIS Analyst x 2	2 GIS Workstation	2 ArcGIS Desktop Standard

2 x GIS Demonstration Laptops for team use

Table 3 – Personal Equipment Listing

GIS workstation	7	• Duel Intel® Xeon® Processors X7560 (Eight Core, 2.27GHz, 24MB, 4 x 6.4 GT/s) • Operating System: Windows 7 Professional / Windows 10 Pro • 4096 MB Dedicated OpenGL, Dual DVI or Dual VGA or DVI + VGA • 32GB RAM • Optical drive CD/DVD Combo • HD 1TB SAS Hard Drive 1 inch (15,000 rpm) • Internal hard drive controller SATA/SAS Integrated Card - For Connecting Internal Hard Drives • Monitor 20 inch digital Flat Panel, adjustable stand, VGA/DVI • USB KB and Mouse
Office PC	2	• Vendor recommended
GIS demonstration laptop	2	• Intel Core i7-7700 (Quad Core 3.60GHz, 8MB 65W) • 8 GB RAM • 2048 Dedicated, Open GL video card • 500GB internal HD, 7200 rpm • TV out • CD/DVD combo • Bluetooth wireless mouse • 802.11 b/g Wireless card • 17” TFT display • System resources CD • Windows 7 Professional / Windows 10 Pro
Office laptops	4	• Vendor recommended
A0 Color Plotter	1	• Vendor recommended, Network Interface
A0 Scanner	1	• Vendor recommended, Network Interface
A3 Color Printer	1	• Vendor recommended, Network Interface
Plotter and printer supplies		• Vendor to provide pricelist and/or any quantity restrictions

5.2 GIS Functional Specification

The following provides a general specification for the GIS platform that will be needed to support the functions of the Coordination Centre in its first phase of development and operations. Provide all geoprocessing tools needed to compile, manipulate, integrate and visualize existing GIS data needed to support the GeoPortal establishment and demonstration project.

During 2016 there was a decision undertaken by the BNSDI Executive Advisory Committee to utilize the Esri ArcGIS platform as the primary foundation for the

BNSDI. The Esri suite is a well-proven leader in the industry and the CITO has already established a government-wide site license which allows any designated government entity to utilize the software, therefore most, if not all of the functional requirements listed here can be accommodated under that licensing arrangement.

The following sections outline the basic functionality that will be needed to support the operations and management of the Coordination Centre. It will be necessary for the Coordination Centre staff to confer with the appropriate Esri software distributor to determine what specific modules and extensions will be needed to accommodate the required functionality.

5.2.1 Basic data capture and processing.

This refers to software functional requirements for capturing geospatial data either from the field or through the conversion of manual records to digital GIS layers. Once raw data is captured it often must be further processed ensure its quality and to put it in the proper form for use in the GIS. The following summarizes the minimum data capture and processing software functionality that will be required by the Coordination Centre:

- Digitizing – digitizing is a process of capturing geographic features as points, lines, areas or rasters. Digitizing may be carried out on a specially equipped "digitizing table", scanned/processed, or "heads up" digitized from an image on a monitor;
- Tabular data entry – geographic feature attributes may be captured through the manual entry of information through a keyboard. Digital scanning with optical character recognition (OCR) may also be used;
- Scanning – scanners provide the ability to capture the image of a map or aerial photograph in a high resolution form from which geographic features can be derived or digitized;
- Field data capture – Various devices can be used to capture original GIS data in the field. While the Coordination Centre is not expected to carry out original data collection, the GIS platform should support the input and processing of these data. Typical sources include:
    - GPS (x,y coordinates captured from global positioning satellites (GPS).
    - Total Station – electronic survey stations
    - Drone – Drones are increasingly being used to capture geospatial data for relatively small areas. This typically involves the capture of overlapping images (similar to a photogrammetric process) from which topographic and building surfaces and orthophotos can be derived.

- Processing – raw information that is captured through field capture, scanning or digitizing often needs to be further processed to prepare the data to a form that is ready to support user applications.
- Data format conversion. Many GIS systems use their own data formats and there are international standards for a variety of "open" standards. It will be important that the Coordination Centre have the ability to accept data in any standard, convert it to a format for use in the Data Clearinghouse and GeoPortal, and to be able to output it to any other format that a stakeholder may request. There is also a requirement that the format conversion software can be automated to accept and process data from custodians and to output data when requested by stakeholders.
- Quality assurance and quality control (QA/QC) – certain functions are required to conduct quality assurance and quality control checks to ensure the final data meet content, accuracy and format standards. These include code consistency analysis, valid range checking, topology checks, and others;

5.2.2 Basic geospatial analytics.

This refers to a wide range of basic geospatial analytical capabilities that will provide the Coordination Centre with a functional foundation to support a broad range of special project requirements. These foundation geospatial analytic software functions that will be required by the Coordination Centre include, but are not limited to the following:

- Buffer - generate a new polygon by buffering from points, lines or areas based on user-defined distance;
- Overlay analysis – overlay multiple map features to identify associations. There are many different types of overlay analyses including:
  - use one object to select other objects that fall within or intersect with its boundary (e.g. plots within a flood zone);
  - intersect multiple layers to produce a new layer that combines all the features and attributes of the input layers (e.g. combination of soils, slope, vegetation, landuse and flood zones that can be modeled to determine best areas for housing development);
- Network analysis – analyze movement and routing along a network of connected lines. This could be a road network, hydrology network, electrical, water and other utility networks, etc. Types of network analysis that will be required include:
  - shortest path (e.g. find shortest distance between two points on a network considering network distance alone);
  - best route (e.g. find an optimum route based on multiple factors);
  - closest facility (e.g. find the closest hospital);

- allocation (e.g. 3 minute drive times from fire stations);
- location/allocation (e.g. find best sites for facilities based on most efficient access to demand points);
- origin/destination (OD) matrix (e.g. model traffic based on where vehicles are likely to come from and travel to;
- network trace (e.g. identify what customers will be affected by a the shutoff of part of the water network needed to fix a broken pipe).

5.2.3 3D analysis and visualization.

There are a wide range of three-dimensional analysis and visualization tools that will be needed by the Coordination Centre. These tools are useful to analyze factors that cannot be modeled or visualized on a two-dimensional map. Those 3D analysis and visualization software functions that will be required by the Coordination Centre include, but are not limited to the following:

- 3D data modeling – GIS data can be modeled in 3D by including the "z" (or elevation) coordinates for the GIS features. This may include:
  - topographic features (such as topographic elevation contours, digital elevation models, LiDAR);
  - geographic features (buildings, utility pipelines, roads);
  - topographic surfaces (digital elevation models (DEM), digital terrain models (DTM), triangular irregular networks (TINS);
  - statistical surfaces (based on statistical sample data at distributed locations);
  - Surface generation – The GIS software should be able to construct a 3D surface based on regular or irregular sets of points and/or lines to generate surfaces and surface representations such as those topographic features and surface type listed above.
- Topographic analysis – Derived characteristics of the topographic surface of an area which can include:
  - topographic slope;
  - hillshade;
  - solar aspect;
  - watershed boundaries;
  - drainage network;
  - topographic profile sections (vertical profile depiction on a 2D graph).
  - Volumetric analysis – analysis of real or derived 3D objects (e.g. calculation of the volume of a 3D object such as groundwater basin, as well as provide the ability to analyze the intersections of multiple 3D objects)

- Viewshed analysis – viewshed analysis is used to determine what areas can be seen from one or multiple viewer locations.
- Landscape 3D visualization – landscape surfaces can be visualized and navigated in 3D form. 2D maps and imagery can also be "draped" on those surfaces to visualize them in 3D form.
- Urban 3D visualization – the built environment can be visualized in 3D form at various levels of detail (LOD) that extent from simple block building extrusions based on a building footprint and building height, to a fully articulated architectural model with either texture-mapped or simulated, photorealistic surfaces
- Statistical 3D visualization – This includes the representation of geographically referenced statistical information in a 3D surface form. This topic is further explained under the "geostatistical analysis" section presented later.

5.2.4 Remote sensing image processing

Remote sensing software functionality is required to process remote sensing data. Remote sensing applications are similar to graphics software, but they enable generating geographic information from satellite and airborne sensor data. Remote sensing applications read specialized file formats that contain sensor image data, georeferencing information, and sensor metadata. Remote Sensing applications perform many features including:

- Change Detection — Determine the changes from images taken at different times of the same area
- Orthorectification — Warp an image to its location on the earth.
- Spectral Analysis — For example, using non-visible parts of the electromagnetic spectrum to determine if a forest is healthy
- Image Classification — Categorization of pixels based on reflectance into different land cover classes (e.g. Supervised classification, Unsupervised classification and Object Oriented Classification)

5.2.5 Cartographic Design and Production

Provide the tools to compose cartographic design of each layer and publish online map services for access through the BNSDI GeoPortal.

Basic cartographic design functions should include at a minimum:

- Thematic representation of points, lines and areas based on attribute information;
- Display both vector and raster graphical information together;
- Full symbol libraries for cartographic presentation;

  - Full annotation design and presentation tools, including automated conflict identification and resolution;
  - Geostatistical graphics display capabilities;
  - Map series production functions;
  - Feature generalization for presentation at different scales;
- Support the management and administration of the demonstration geospatial database clearinghouse;
- Support Horizontal and Vertical Scalability to full enterprise GIS functionality required to support the full range of BNSDI Coordination Centre functions to be implemented in the next stage.

5.3 GeoPortal Functional Specification

The following provides a general minimum specification for the BNSDI GeoPortal application. At the time of this writing the BNSDI GeoPortal is already under development. A preliminary version of this specification was provided to help inform that effort. This final version of the specification is to be used to cross-check against the

5.3.1 General Requirements

The BNSDI GeoPortal must support the following general requirements:

- Support English interface;
- Provide an accessible and easy to use interface for discovery and access to geospatial data and metadata;
- Support updating of central metadata repository from distributed sources;
- Support the efficient management of geospatial metadata;
- Provide a GIS viewer application with basic map navigation, data query and map output capabilities;
- Support exchange of metadata with other GeoPortal nodes.
- Support OGC standards of exposing spatial data as WMS, WFS,…etc.

5.3.2 GeoPortal Management and Administration

- Allow general public users to access the system public data without user authentication;
- Support user authentication for registered users per their authorization level or role via the Coordination Centre single sign-on system;
- Authenticated privileged users must be able to access public and secured map services;
- Allow registered data publishers to access and update the metadata records they are responsible for;

- Provide metadata harvesting tools to allow the GeoPortal administrator to automatically or on an as-needed basis retrieve new or updated metadata records from preregistered data publishers for posting;
- Provide tools to validate submitted metadata according to multiple international metadata standards as well as the specific standard customized and adopted by the BNSDI. Provide the ability for data publishers to be automatically notified when submitted metadata records are not in compliance with the adopted standard;
- Review and approve submitted metadata prior to publishing;
- Provide ability for GeoPortal administrator to set and control access rights including what data can be viewed, in what form (WMS, WFS, etc.), what can be downloaded directly from the GeoPortal, or referred by email to the publisher for a physical copy of the data;
- Monitor GeoPortal utilization and provide reporting on periodic and as-needed basis;
- Support provision of access to GeoPortal metadata records by other applications such as RSS readers, wikis and content management systems;
- Provide GeoRSS feed that will automatically notify subscribed users when metadata records matching their specific interests are added to the GeoPortal;
- Make GeoPortal metadata available for discovery by others;

5.3.3 End User Functional Requirements

- Provide authorized data publishers with the tools to develop and maintain the metadata records for data for which they are the authorized custodian;
- Provide both simple and advanced search methods;
- Support searching by key-words and themes as well as by geographic area of interest;
- Display summary results of metadata search including a thumbnail image for each selected dataset in an easy to read and understand form. Allow the user to expand any individual metadata record to access the full information.
- Metadata search results should accommodate the ability to add any referenced layer to a map view and to incrementally add additional layers from one or more metadata searches to that same view during a single session;
- Provide the ability to download a selected data layer in different format to restrict the download function to specific authorized roles and within predefined geographic area limits;
- Support discovery, query and map preview of metadata published by others;
- Allow users to access web map services from other online publishers utilizing OGC web map publishing standards;

- GeoPortal software should support access and viewing by multiple map viewer technologies, including Java™ server side Development and JavaScript™ API;

5.3.4 Map Viewer Navigation

General Map Viewer application should provide map navigation tool bar and shall contain following operations.

- Zoom in – This tool enables the user to magnify a specific area of interest on the map to get a more detailed view of the area.
- Zoom Out – This tool enables the user to reduce the scale of the displayed map and so the user can view more areas with fewer details.
- Full Extent – This tool will enable the user to view the default map centered on the screen and displayed in the default map scale.
- Pan – This tool will enable the user to navigate through the map to change the displayed area without changing the map scale.
- Previous – This tool enables user to move back to the previous view while navigating the map. To use this tool, it is required that at least one navigation interaction took place on the map within the existing work session.
- Next - This tool enables user to move forward to the next view while navigating the map. To use this tool, it is required that at least one "View Previous" action took place on the map within the existing work session.

5.3.5 Map Viewer Tools

- Identify - Application shall have Identify tool in the map navigation tool bar. The tool shall be used to perform the identify operation. User shall select the Identify tool from the navigation tool bar and click on a feature(s) on the map view. The tool shall display the attribute information of the feature(s) from the preconfigured layers in selected location;
- Mouse Hover - Application shall have mouse hover functionality, when the user moves the mouse over a map feature, a tooltip shall be displayed with the attribute information of the feature. This function will work on predefined layer(s) as per the configuration;
- Legend - Application shall show map legend with all the symbols of the map services on the current displayed map. The map services legend shall be displayed as part of Table of Contents. User can expand/collapse map services in TOC to show/hide the symbology;
- Map Overview - Application shall have an option of map overview through which the main display range will be shown to the users for the purpose of better view and control;

- Go To Point - Application shall have an option of “Go to point” through which the following operation can be performed:
    - User shall input X/Y or Latitude / Longitude in the UI and shall be able to navigate to specific point on the map.
    - X/Y or Latitude / Longitude shall be provided in WGS84 Format.
- Layers Display & Table of Content - System shall have an option to display list of layers appearing on the current map in Table of Contents (TOC) control. User shall be able to perform following operations through TOC control.
    - User will be able to turn layers on / off as required.
    - Remove any map services from the map
    - User shall save and reload the Table of Content created in the previous time.
- Scale bar - Application shall show the map scale bar, which interactively displays the current scale of the map. The scale bar control shall be placed at lower left side of the map.
- Base Map Toggle - Application shall provide an option to toggle basemaps between satellite image and vector map.
- Add Map Service - Application shall provide an option to add map service, where user can add a map service in following ways:
    - Add map service using valid URL.
    - Add map service from the list of predefined ArcGIS servers. For the selected server, the list of map services shall be displayed. User shall select the required service from the list add it to the map.
    - Adding Map Services from ArcGIS Servers shall be the default option
- Measurement - Application shall provide an option to measure point, line and area on the map.
    - User shall measure distances and perimeter by drawing a line either in meters or in Kilometers based on the selection of units from the dropdown list.
    - User shall measure areas on the map by drawing a polygon either in square meter or in square kilometers.
    - User shall measure coordinate information of a location by clicking on the map. Point will be measured in decimal degrees or DMS. User shall select the measurement unit from the dropdown list.
    - Coordinate information shall be displayed in WGS 84 format.
- Redlining - Application shall support the following redlining operations on the map. User shall able to select any of the following available tools and perform the required operation.

    - Drawing a sketch using Freehand format
    - Drawing a Point
    - Drawing a Line
    - Drawing a Polygon
    - Writing a text on the map

  - Clearing the drawing redlines from the map
  - Modify/delete the drawn redline objects
- Metadata Search – Application shall provide the ability to search for metadata keywords and navigate to search results as appropriate;
- Advanced Search - Application shall provide "Advanced Search" tool where user shall be able to search the selected map service layer by building any custom query on the fly.
  - User shall select the required map service and layer
  - All the relevant fields shall be displayed in a dropdown
  - User shall build a custom query using the fields and conditions like Equals, not equals, Contains, Less than, greater than and providing appropriate values for the fields
  - As per the selections made by the user, system shall perform the query on the selected map service layer.
  - The corresponding search results shall be displayed in the table format with attributes information and feature count.
  - User shall select any of the search results from the results table and zoom to the selected feature.
  - User shall select the "export" option to export the results information to an excel file.
- Identify by Geometry - Application shall provide a spatial search tool to query features in a user defined geographical area.
  - User shall be able to do spatial search by drawing point with buffer zones, polygon and polyline.
  - The corresponding search results shall be displayed in the table format with feature attributes information.
  - User shall select any of the search results from the results table to zoom to the selected feature and display attribute information.
  - User shall select the "export" option to export the results information to an excel file.
- Simple Find Search - Application shall provide a simple search option for querying and displaying the search results
  - User shall enter the required keyword in the search box and press search button.
  - The tool shall search for the keyword in the configured layers and display the search results in a tabular format.
  - User shall select any of the search results from the results table to zoom to the selected feature and display attribute information.
  - User shall select the "export" option to export the results information to an excel file.
- Email Map - Application shall have an "Email Map" option to send the currently displayed map through email.
  - User shall activate the email map function and provide following details

- Recipients mail ids
- Mail Subject
- Mail Body Text
- Tool shall send an email to the recipients with the current map details with user provided subject and email body.

5.4 Website General Specification

This section provides a general minimum specification for elements to be included in the BNSDI website. This initial website will provide basic information concerning the Belize National Spatial Data Infrastructure (BNSDI) program and its benefits, components, stakeholders and resources. It is expected that this website will be developed and operated for several months, following which it may undergo a significant expansion as part of a larger BNSDI development and capacity building program to be carried out subsequently.

5.4.1 General Requirements

In general, major functional requirements of the website will be:

- Content to be in English;
- Long-term ease of content updating needs to be considered to keep the portal information current. An easy to use Content Management System (CMS) and associated training for Coordination Centre staff will need to be provided within the project;
- Links to participating stakeholder agencies will need to be incorporated and vice versa;
- Visually, the portal needs to incorporate professional design, including the development of a suitable brand image (logo, look and feel, etc.) for the BNSDI program.
- The website should be accessible to search engine spiders and be coded with good on-page search engine optimization;
- This site must comply with the standards of accessibility contained in W3C WAI (World Wide Web Consortium Web Accessibility Initiative) level A Guidelines;
- All code on the site should validate to W3C (World Wide Web Consortium) specifications.

5.4.2 Banner Graphic

A "banner graphic" will provide a simple graphical identity that will become part of the BNSDI "brand image". The graphic should be simple, interesting, and

representative of the Belize and BNSDI context. The graphic should be right-sized to minimize download time when opening the site from a browser.

5.4.3 Site Map

A site map should be provided showing the structure of the site and linking to every page on the site

5.4.4 About

This section should provide a general explanation of the BNSDI program and the information and resources that are available through the website. In general, this section of the website will explain:

- The purpose, process and expected results of the BNSDI Program;
- History and background of BNSDI;
- The structure of the BNSDI website, including a summary of each component;

5.4.5 Organization and Stakeholders

This area of the site will need to provide an explanation of the organization of the BNSDI, how it is governed and what organizations and people are involved:

- Governance structure illustrating committees and including a description of their roles and responsibilities (charters);
- Listing and logos of all the participating entities, with links to their websites;
- Overview of existing GIS capacity and related projects and programs within each participating entity;
- BNSDI strategic development plan (timeline and description of stages);

5.4.6 Standards, Products and Services

This section can provide a summary the products and services that can be accessed through the BNSDI website and GeoPortal. Specific topics to be addressed in the initial implementation of this section include:

- Geospatial Data Standards. Provide links to pdf's for all the formally adopted fundamental geospatial data set (FGDS) standards;

- Capacity Building Support. Outline the type of services being offered through Coordination Centre for information management strategic planning and human and technical capacity building;

- Information Technology Products and Services. The section might provide a directory of various information related technologies, products, and professional services that are available in Belize. This might ultimately be a user maintained directory for which a subscription fee would be paid by the participants.

- Data Products and Services. Outline data products and related services that are available for a fee from government and private sector sources. Basic

listing in this directory of products and services might be provided at no cost, but various levels of higher visibility advertising might be accommodated for a fee.

5.4.7 Work With Us

This section will provide a summary of the ways that stakeholders can interface and work with the BNSDI program. It will also include summary information regarding information related initiatives between Belize and other regional and international organizations.

- Directory of GIS Stakeholders in Belize. The list of organizations involved in the Baseline Survey could be used to create a directory of people in Belize interested in GIS, and their contact information. Inclusion in this directory should be confirmed with each individual before this information is published on the site. There should also be the capability for persons to register themselves for inclusion in the directory, and to receive update information by email. Linkage to the registration page should be both through this page, as well as through the top level home page as described elsewhere.

- Other Partners. Other national, regional and international partners to be recognized as those partnerships are initiated.

- Becoming a Member. Instructions on how to become a member of the BNSDI community. Ideally this would support self-registration and management of this information in a Customer Relations Management (CRM) system.

5.4.8 A-Z Subject Index

This section would essentially be an alphabetical directory of all topics that may appear throughout the BNSDI website with associated linkages to those subjects.

5.4.9 Media Center

Provides access to all past and current press releases and other resources that can be accessed and downloaded by the media to inform the public about the BNSDI initiative or to support media research about related topics and events.

5.4.10 Frequently Asked Questions

This section would provide a list of frequently asked questions (FAQ's) and generic answers regarding the BNSDI or related initiatives. Ideally, this area of the website would both provide existing FAQs, as well as allow visitors to the site to enter in new questions. Those new questions could be monitored and periodically compiled and synthesized towards the development of new FAQs and associated answers.

This section should include a comprehensive glossary of technical information management terms in all required languages.

5.4.11 Search

This section will provide a general search function for the entire site. At a minimum, the search engines should provide the capability to do full content search across the web site, including the indexing and searching of documents and data bases on the site.

5.4.12 Links to Related Programs

This section provides an inventory and linkages to other current and planned major programs that relate to the BNSDI.

5.4.13 Time

Has a link to an atomic clock and a map that allows the user to establish what time it is at the central office.

5.4.14 Technology News and Events

This section would include a variety of general and specific interest information regarding technological developments and events that are of interest to BNSDI stakeholders. This could include, but not be limited to, the following:

- News. What are the latest developments concerning BNSDI and related initiatives. This might also include relevant news clippings from print media, and summaries from television, radio, conferences and other events;

- Events. This will include a general calendar with linkages to brief descriptions of upcoming events that are relevant to the BNSDI initiative such as international conferences, seminars and workshops, lectures, vendor demonstrations, and other events;

- Conferences. This section of the website will include a conference of listing of all the major local, regional, and international conferences that are of potential interest to the BNSDI stakeholders in Belize over the next year. This will include a brief overview of each conference venue, general scheduling information, and where appropriate, linkages to the conference web site for additional detailed conference and registration information

- Visitor Information and Directions. This section of the website should include information regarding directions to organizations and participating stakeholder agencies. This should include both textual and graphic (maps) types of information to illustrate the directions.

5.4.15 How to Contact

This section of the website should include a directory with contact numbers and email addresses for organizations, participating stakeholder agencies, key individuals and the webmaster.

5.4.16 Date last updated

A message should be included on the website that indicated the date created and when the website was last updated.

5.4.17 Navigation on secondary pages

Navigation bar is added to the header graphic for all pages after the homepage.

5.4.18 Customer Survey

Linkage to survey form to solicit input and feedback from the GeoPortal user community

5.4.19 Geospatial Portal

Metadata catalog search;
Link to map viewer environment.
(See previous section for full GeoPortal functional specification).

6 FINANCING

The development and sustainment of the BNSDI will require the development of an appropriate means of financing initial building of the required infrastructure as well as its ongoing operations and continuous improvement and upgrade over time.

The decision to invest in geospatial technology comes down to whether the benefits justify the costs. In simple economic terms, the Return on Investment (ROI) on NSDI and geospatial technology and data in general is well accepted today and proven in many studies. In the context of the BNSDI, the ROI needs to be considered at two levels:

Enterprise level - Much the same way that nobody questions the advantages of PC word processing over manual typewriters today, so too GIS at the enterprise level provides an effective, affordable and accessible means of streamlining and improving business operations, planning and decision making. Low cost computing and affordable commercial or open source GIS software has greatly reduced the price of entry to this capability and more and more students coming out of colleges, universities, technical schools and even high schools are increasingly familiar with computing and GIS, thus reducing the need for extensive training. The level of investment and capacity building in any enterprise must of course be tailored to the practical needs of the organization, thus capacities can vary greatly across the stakeholder community;

BNSDI level – The BNSDI provides the framework for reducing redundancy in the creation or purchase of geospatial data. It also establishes the foundation for more rapid and better-informed planning and decisions making, capital investment, more aligned and coordinated government operations and services and many other direct and indirect, tangible and intangible benefits and positive impacts. Whatever additional investment is made in the BNSDI as a national infrastructure only builds on and further extends and leverages the ROI that is already being attained at the enterprise level of the stakeholders.

In Belize some 85% or more of the capital investment in infrastructure and services is financed from external sources. Many of those capital projects are using, or could significantly benefit from using GIS and many are redundantly creating or purchasing data for their own one-time purpose. It is likely that the efficiencies that can be gained from a coordinated approach in this environment alone can more than justify and pay for the cost of establishing the BNSDI and creating baseline FGDS. Once these baseline layers are created, the ongoing maintenance of these data should be accomplished through the day-to-day business transactions of the custodian organizations.

6.1 Capital Expenditure (CAPEX)

There will be some level of capital expenditure required to establish the BNSDI Coordination Centre, infrastructure and fundamental baseline data layers. Investment will be required to recruit and hire the necessary staff for the Coordination Centre and to establish the office environment and computing infrastructure needed for them to operate effectively. There will also be a need to invest in the development of a comprehensive, multi-scale, up to date series of baseline layers for the country that will serve as the base map for the development of all other thematic layers of information. Once these base layers have been developed each will be assigned to the appropriate custodian agency for future maintenance and updating of that information as part of the agency's day to day business transactions, thus becoming a routine operational expenditure to be funded through each custodian agency's own annual operating budgets.

By far, the largest amount of investment will be required in data. The earlier BNSDI Requirements and Data Inventory and Assessment efforts revealed that while there exists a significant breadth and depth of fundamental geospatial data in Belize, the majority of this is not standardized, does not cover the entire country or is not entirely up-to-date because it has been updated opportunistically in response to the needs of specific projects. It will be important therefore to undertake coordinated efforts to create a completely standardized, complete and current baseline layer for each priority data theme. It will be likely that most of such efforts will require more resources than currently available through any organization's operating budget and therefore will require treatment as a capital expenditure budget item. The following outlines options that may be worth considering for such investments:

> ***IFI or Technical Assistance Funding***. Financing of GIS technology or database development by International Finance Institutions (IFI's), bilateral aid agencies and foundations are most often project specific within a particular sector or organization. There is a need for developing some mechanism to pool funds across sectors and funding organizations to be able to finance the development of commonly needed baseline data layers. High resolution aerial imagery and topographic base maps are good examples of this issue. Neither is the specific mandate of any single agency and both are needed nearly universally across the entire spectrum of geospatial data users. The development of a trust fund or other blended fund that is not tied to any particular project or program would provide the flexibility needed to address this issue. Alternatively it may be possible to apply for funding through the Green Climate Fund (GCF) since one of the primary drivers of the BNSDI is to support more effective climate change mitigation and adaptation, in alignment with the

purpose and objectives of the GCF. Likewise the World Bank and Caribbean Development Bank have been actively funding climate resiliency and disaster risk reduction efforts throughout the Caribbean.

PPP or BOT. With some layers there may be an opportunity to explore the use of Public-Private Partnership (PPP) or Build-Own-Transfer (BOT) mechanisms for funding the creation of certain baseline data layers. In a PPP, a partnership is formed between government and a private company or institution to co-finance the creation of one or more data layers. In such cases, fee-based cost recovery is used to repay the invested principle and any agreed interest or profit margin over an agreed period of time. BOT works in a similar way except that the entire effort is funded by the non-government partner and the resulting infrastructure and information assets are transferred to full government ownership at some agreed point of time. In either case, the government is deferring part or all of the initial capital outlay, in favor of paying a higher amount over a period of time. An example of this could be to collaborate with the producers of vehicle navigation streets database, by the government providing updates and receiving a premium discount on the use of the navigable streets database for government purposes.

As a broader concept, the government could also consider a PPP to support part or all of the operational aspects of the Coordination Centre. Under such scenario, the Centre could be operated by a private sector service provider under strict oversight and control by government. The costs for such services could be partially covered under government funding as mentioned previously, but supplemented by fees from products and services that the concessionaire could provide using government data that they have been authorized to use.

Direct government funding. The investment for the establishment of the BNSDI Coordination Centre infrastructure and any associated support services or priority baseline data layers may also be borne directly by the government.

All of the above options will require additional discussions with the Ministry of Finance and others involved in the government budgeting and financing process.

The following provides a summary of the major costs that are expected within the first two years of BNSDI implementation:

Figure 9 - BNSDI Coordination Centre Office Setup Costs

No	Units	Cost/Unit (BZ)	Subtotal (BZ)	Subtotal (USD)
13	Desks	$ 1,800	$ 23,400	$ 11,700
13	Chairs	$	$ 7,800	$ 3,900

		600		
13	Personal Stationary	$ 300	$ 3,900	$ 1,950
1	Common Office Furniture	$ 8,000	$ 8,000	$ 4,000
1	General Office Supplies	$ 3,000	$ 3,000	$ 1,500
1	Color Printer/Copier/Scanner (A4-A3) & supplies	$ 2,000	$ 1,000	$ 500
		subtotal	***$47,100***	***$ 23,550***

The largest outlay for the effective establishment of the BNSDI will be for the development of the Belize National Map programme. This programme is to result in the automation of 7 critical foundation layers at three scales. These layers at these scales are needed to provide a common, standardized, high quality and reliable set of baseline information that will be used as a key reference by all stakeholders. The following table provides a rough estimate of the costs involved in the implementation of the Belize National Map. This is to be refined through the Working Group efforts that are currently underway at the time of this writing.

Figure 10 – Belize National Map Programme Initial Cost Estimation

LAYER	SCOPE	NO.	UNITS	COST/UNIT (BZ)	SUBTOTAL (BZ)	SUBTOTAL (USD)
Survey Control Network	Allowance to upgrade the existing network or re-establishment of CORS	1	Overall estimation	$ 400,000	$ 400,000	$ 200,000
Ground Control Points						
Large Scale	Sufficient control to support 1:1000 scale mapping	2,300	Sq.Km.	$ 100.00	$ 230,000	$ 115,000
Medium Scale	Sufficient control to support 1:5,000 scale mapping	4,600	Sq.Km.	$ 70.00	$ 322,000	$ 161,000
Small Scale	Sufficient control to support 1:10,000 scale mapping	16,100	Sq.Km.	$ 45.00	$ 724,500	$ 362,250
				subtotal	*$ 1,276,500*	*$ 638,250*
Orthophotography						
Large Scale	~ 10 CM resolution	2,300	Sq.Km.	$ 120.00	$ 276,000	$ 138,000
Medium Scale	~ .5M resolution (high resolution satellite - task new imagery)	4,600	Sq.Km.	$ 35.00	$ 161,000	$ 80,500
Small Scale	~ .5M resolution (high resolution satellite from archive)	16,100	Sq.Km.	$ 23.00	$ 370,300	$ 185,150
				subtotal	*$ 807,300*	*$ 403,650*
Topographic Elevation DEM	Digital terrain and surface model to distinguish both ground and cannopy or tops of buildings					
Large Scale	Ground and building top elevations	2,300	Sq.Km.	$ 270.00	$ 621,000.00	$ 310,500
Medium Scale	Ground and tree canopy	4,600	Sq.Km.	$ 175.00	$ 805,000.00	$ 402,500
Small Scale	Ground and tree canopy	16,100	Sq.Km.	$ 150.00	$ 2,415,000	$ 1,207,500

			subtotal	*$ 3,841,000*	*$ 1,920,500*	
Bathymetric Elevation						
Medium Scale	Interior waters - assume using satellite derived bathymetry except for port areas. 2 metre pixel size with 5 metre horizontal accuracy down to 20 metre maximum depth. Parts of interior waters area may be deeper and require other more generalized sources	12,500	Sq.Km.	$ 120.00	$ 1,500,000.00	$ 750,000
Small Scale	Territorial waters	6,410	Sq.Km.	$ 42.00	$ 269,230.50	$ 134,615
Building Points	GPS collection of coordinates for every inhabited strucuture being collected already by SIB and covered under their budget.	70,000	Buildings	$ -	$ -	$ -
Building Polygons						
Large Scale	Urban areas at 1:1000 scale	50000	Buildings	$ 6.00	$ 300,000.00	$ 150,000
Medium Scale	Peri-Urban areas at 1:5000 scale	15000	Buildings	$ 6.00	$ 90,000.00	$ 45,000
Transportation Network	Roads and highway centerlines with basic attribution, upgraded, conflated and updated from existing	1	Allowance - requires further analysis	$ 500,000	$ 500,000.00	$ 250,000
Surface Hydrology Network	Rivers and streams with basic attribution, upgraded and updated from existing	1	Allowance - requires further analysis	$ 500,000	$ 500,000.00	$ 250,000

Place Names Gazeteer	Gazeteer compiled from existing sources only	1	Allowance - requires further analysis	$ 200,000	$ 200,000	$ 100,000
				GRAND TOTAL	**$ 9,684,030.50**	**$ 4,842,015**

National Mapping Scales		**Area (Sq.Km.)**
Large	Urban areas - 1:1,000	2,300
Medium - land	Peri-Urban areas - 1:2,500 - 1:10K	4,600
Small	Rural areas: 1:10K - 1:50K	16,100
	subtotal land area	**23,000**
Medium - sea	1:5K within Internal Waters Zone	12,500
Small - sea	1:10 K for remainder of EEZ Territorial Waters	6,410
	subtotal sea area	**18,910**
	Total land and sea area	**41,910**

Total area of Territorial Sea in square miles	2475
Sq Km per square mile	2.59
Total area of Territorial Sea in sq. km.	6410

6.2 Operational Expenditure (OPEX)

The primary operational expenditure for the BNSDI will be the human resources and maintenance of computing infrastructure (hardware and software) supporting the operations of the BNSDI Coordination Centre. The following table outlines the annual operating costs expected once the Centre is fully operational and staffed. It is expected that the implementation of the Centre will be accomplished incrementally, thus the OPEX for initial years will be less than indicated here.

Figure 11 – BNSDI Annual Operating Costs

Staff Salaries	No.	Annual Cost (B	Subtotal (BZ	U$D	Government Payscale Re
GIO	1	$ 65,000.00	$ 65,000.00	$ 32,500.00	23
PM/GIS Consultant	1	$ 50,000.00	$ 50,000.00	$ 25,000.00	22
Technical Manager	1	$ 50,000.00	$ 50,000.00	$ 25,000.00	22
Sustainable Development Support Coordinator	1	$ 48,000.00	$ 48,000.00	$ 24,000.00	20
Outreach Coordinator	1	$ 45,000.00	$ 45,000.00	$ 22,500.00	18
Portal Specialist	1	$ 40,000.00	$ 40,000.00	$ 20,000.00	16
System and Database Administrator	1	$ 40,000.00	$ 40,000.00	$ 20,000.00	16
Geospatial Data Specialist	2	$ 40,000.00	$ 80,000.00	$ 40,000.00	16
GIS Analyst	2	$ 30,000.00	$ 60,000.00	$ 30,000.00	12
Help Desk Operator	1	$ 28,000.00	$ 28,000.00	$ 14,000.00	10
Secretary & Admin Support	1	$ 25,000.00	$ 25,000.00	$ 12,500.00	7
subtotals	***13***		***$ 531,000.00***	***$ 265,500.00***	
Benefits @30%			$ 159,300.00	$ 79,650.00	
Office Equipment			$ 15,000.00	$ 7,500.00	
Office Leasing (sq. ft.)	2,500	$ 25.00	$ 62,500.00	$ 31,250.00	
Travel			$ 60,000.00	$30,000.00	
Local			$ 20,000.00	$10,000.00	
Foreign (Training, Workshop, Conferences)			$ 40,000.00	$20,000.00	
Local Meetings/Workshops (EC,TC Meetings)			$10,000.00	$5,000.00	
Incidentals			$ 15,000.00	$ 7,500.00	
		Initial Cost			
Software maintenance			$ -	$ -	15% of initial cost annually*
Hardware maintenance			$ -	$ -	15% of initial cost annually*
		subtotal	***$ 311,800.00***	***$ 125,900.00***	
		ANNUAL BUDGET	**$ 842,800.00**	**$ 421,400.00**	
* To be determined					

6.3 Fees for Services and Products

In general principle and as outlined in the BNSDI policy, geospatial data should be freely available across Belize society, within the parameters of national freedom of information policies and data security considerations. Nearly all fundamental geospatial data sets (FGDS) available through the BNSDI will be captured and maintained by custodians through their ongoing business transactions and thus the cost of creating and maintaining this information will have already been paid for through government budgets. Fees for the data under this premise are only levied to the extent needed to recover the cost of reproduction, which if carried out digitally online can be very minimal. International experience and opinions is mixed in respect to the advantages and disadvantages of charging for data, but there is strong anecdotal evidence that by making data freely available there tends to be a much higher rate of utilization, and that the benefits of such utilization far outweigh the revenue that can be gained by charging for this information. This is especially true across government agencies but opening up data access to institutions and the private sector can also catalyze new educational and economic development opportunities, respectively.

A separate issue from charging for basic data is the opportunity to develop and charge for derivative data products and special services. The public, and most private sector companies, won't have the critical mass of need to maintain their own internal GIS capacity and thus would prefer to pay for derivative data products and services that are specifically targeted to their needs. This is a valid area for revenue generation, however consideration needs to be given to whether this should be offered as a government service or rely on the private sector or universities to provide such support. In the case of the BNSDI Coordination Centre, it is suggested that the office be equipped and staffed primarily to provide specialized services to support high level government decision making and that it should not dilute its primary mission with ad hoc general service provision.

ANNEX A – WORKING GROUP CHARTER TEMPLATE

BNSDI Working Group Service

Prepared By	Reviewed By	Approved By	Issued By
Community Organisation Groups Coordinator	**Planning & Development Manager**	**Executive Manager**	**Xxxxxx**

Date of Approval	_____	Date of Issue	_____

Revision Record				
Revision No.	Date of Revision	Reasons and Details of Revision	Revisions Made at the Page No. & Para No.	Revision Reviewed & Approved By

Purpose

To describe the process of providing the service to initiate, manage, report and close an BNSDI Working Group.

Working Groups established to discuss and recommend actions that resolve a business or technology problem. A resolution is typically required by a specific date therefore this service is provided with the understanding that it concludes by the established completion date.

The completion date is defined by management or the person or persons requiring a resolution. Working Groups should not exceed 6 months in duration and objectives should be discrete and well understood so that the group can make its recommendations in the shortest time possible.

Scope

This service is considered a best practice process for discussing and resolving business or technology issues. The service is provided by the BNSDI Coordination Centre as a support mechanism for the implementation and management of the Belize Government's Spatial Data Infrastructure (BNSDI).

The service is generic and can be provided by any service organization reliant on cross department/cross agency problem solving activities to improve business services, lower operating costs, produce innovative ideas, or new programs, etc.

Coordination Centre reserves the right, after consultation with BNSDI community members, to update the provision of this service as necessary to ensure the service meets with customer demands.

Ownership Statement

Executive Manager, Coordination Centre is responsible for ensuring the service is periodically reviewed for adequacy, suitability, applicability, and effective delivery relative to strategy and customer satisfaction.

References

- ISO 9001: 2008 (Clause- 7.2)

Abbreviations

BNSDI	Belize National Spatial Data Infrastructure	GIS	Geographic Information System

Terms and Definitions

Working Group (WG): An BNSDI Working Group is a group of representatives from 3 or more stakeholder entities formed to discuss and resolve a technology driven business or technology only issue; to provide options and make recommendations to entity management and/or Coordination Centre leadership that resolve an issue, or advance technology implementation or business.

BNSDI Member: The BNSDI member refers to the entity which has been officially represented within the BNSDI community and is regularly participating in the BNSDI activities.

Issue: A business problem; a technology problem; or a conflict between 3 or more stakeholders.

Problem Statement: A documented statement clearly and unambiguously describing the issue which the Working Group is formed to resolve.

Charter: The Group's mandate, outlining its purpose and objectives, members and Group Lead, and guidelines for management.

Agenda: A list of aims or possible future achievements, or a list of matters to be discussed at a Group meeting.

Lead/Chair: The person(s) in charge of the Group and Group meetings. Responsible for scheduling Group meetings, issuing meeting agendas, meeting minutes and following up on assigned action items.

WG Coordinator: Person(s) assigned to the Group to support the Chair. Responsible for the administrative duties related to the management of the Group.

Actions Database: Coordination Centre database designed for the recording and tracking of WG actions.

Escalation: The process for highlighting issues from Group discussions, non-conformance to Group activities, or delays in action competition to Coordination Centre management.

E-mails: For the sake of executing procedures as per this document the e-mails will be considered as an official correspondence until superseded by an executed (signed) hard copy equivalent.

Responsibilities and Authorities

Executive Director is responsible for ensuring the necessary support mechanisms for the implementation and maintenance of the Belize Government's BNSDI program are developed as per the annual operations plan.

Planning & Development Manager is responsible for ensuring that the standard operating procedure (SOP) for Working Groups is followed, reviewed yearly (or when requested) and updated to ensure the service continues to meet customer demands and approval.

Community Organisation Group Coordinator has overall responsibility for the Working Groups service, including;

- Reviewing the need for the initiation of a Working Group and development of the problem statement.
- Monitoring the progress of the BNSDI Groups and maintaining the Coordination Centre actions tracking database.
- Initiating the escalation process.

Working Groups Coordinator is responsible for the day to day operations for their assigned Group to ensure delivery of the objectives in the agreed timeframe.

Process and Procedures

Initiating a working group:

Responsibility	Activity	Documents/ Records
Anyone	Discuss business or technology issue Anyone can identify a potential or real problem through various means (meetings, ad-hoc conversations, etc) Outcome: The problem is real, should be addressed and the forum the problem should be addressed (informal meeting, coordination meeting, escalation to leadership, working group meeting, forward to existing committee) If working group is decided as best forum to resolve issue then proceed to define & document problem statement	No documents - Informal discussion among team members
Coordination Centre team CO Groups Coordinator	Define Problem Statement The Problem statement is documented and emailed (circulated) to the senior Coordination Centre team for review, comment, refinement and validation.	Email: Problem Statement.

	Outcome: The problem statement validated by team. Iterate until majority consensus.	
Coordination Centre Management CO Groups Coordinator	Validate the Problem Statement The problem statement is emailed to Coordination Centre/Coordination Centre leadership for review, edit and/or validation. Coordination Centre leadership email authorization to proceed with working group initiation; include desired timeframe to complete if appropriate	Email: Problem Statement Amendment or Email: Problem Statement Agreement
CO Groups Coordinator WG Coordinator Proposed Members	Develop Proposed Charter: Identify members, chair, objectives, time frame Develop proposed charter using template Email proposed charter to senior team for review and sign off Call chair and key members to inform of proposed working group Email proposed charter to working group members; request feedback	Working Group Process Map Charter Template
WG Coordinator Chair Members	Adopt Final Charter; Review charter with working group Develop agenda for first meeting Schedule and conduct first meeting Obtain consensus on problem statement, objectives, tasks and time frames; Make changes as necessary and get initial from group to signify agreement with tasks and timeframe; Develop high level agenda for subsequent working group meetings Do as much as you can in first meeting Schedule next meeting Minute the meeting with actions Email minutes to group	Proposed Charter Final Charter Meeting agenda Meeting minutes Email

Manage Working Groups

Responsibility	Activity	Documents/ Records
Chair WG Coordinator Members	Agenda Management Define proposed Agenda for each meeting based on accomplishments or issues raised from previous meetings and charter tasks and timelines; ensure agenda advance the problem resolution with timeline in mind Email proposed agenda to group at least 3	Working Group Process Map Agenda

	days in advance of a meeting but always respect the schedules and work load of members and give as much notice as possible. Edit or add any additions but ensure agenda directs work to complete by the established due date. Chair controls meeting Discuss agenda; identify actions; Review actions at end of meeting and ensure group is in agreement; Spend extra time to ensure actions are clarified and those responsible fully understand their commitment Minute meeting; email minutes to group Enter actions into actions log	Minutes Actions log Actions Tracking database
CO Groups Coordinator WG Coordinator	Action tracking & Escalation Process Log all actions into Actions tracking database Review weekly or as frequently as needed to ensure actions are completing on time and immediate follow up when an action is likely to not complete on time. Follow escalation process for actions near completion or overdue Review action progress and escalation points with Coordination Centre team weekly	Actions tracking database Escalation process map Weekly reports

Reporting

Responsibility	Activity	Documents/ Records
CO Groups Coordinator WG Coordinator	Weekly Reporting Enter working group status into weekly reports Meet weekly with Coordination Centre team to review weekly progress, escalation points and overall team coordination Highlight escalation points in red; potential future escalation points in yellow Fill in performance measures excel Update dashboard Update website, SharePoint section Email working group (and associates) with update (this may be accomplished by SharePoint through alerts) Monthly Reporting Update Monthly power point report Update website, SharePoint section	Actions Log Weekly Reports Monthly Reports Performance Measurements excel Coordination Centre website SharePoint Website Email

Closing a Working Group

Responsibility	Activity	Documents/ Records
WG Coordinator Chair CO Groups Coordinator	Final Meeting The final meeting is a regular meeting but known prior that it is the last meeting; all tasks are completed, and members agreed this is the final meeting. Discussion may ensure on next steps or other problems to address Coordination Centre presents 'Certificate of Achievement' to members and chair. Thanks everyone for their hard work and dedication. Official Closing Memo WG Coordinator drafts 1 page memo summarizing accomplishments and thanking members Memo is reviewed by Coordination Centre team and/or chair and on approval is translated into Arabic Memo is circulated by chair to members (and cross circulation (cc) associates & supervisors) WG Coordinator prepares updates for Coordination Centre website press release and SharePoint. Reviewed and sign off by CO Groups Coordinator	Minutes Certificate of Achievement Official Memo template Official Memo Email SharePoint Coordination Centre website

Measurements

Responsibility	Activity	Document/ Record
CO Groups Coordinator	Maintain Performance Measures CO Groups Coordinator updates performance measures excel weekly as part of the weekly reporting process	Performance Measurement excel

Continual Improvement Plan
Not Applicable

Records

Records	Responsibility	Retention Period
Utilization reports generated from the system	Coordination Centre Operations Manager	1 Year

Attachments

Attachment #1 – WG Charter Template (Short Form)

Type of Access	Access Description	Notes
Open	All members	Online user manuals will be published on the portal

Attachment #2 – WG Closing Memo Template

Type of Access	Access Description	Notes
Open	All members	Online SOP manuals

Attachment #3 – List of computer files used to manage working groups

Type of Access	Access Description	Notes
Open	All members	Online SOP manuals

Attachment #4 – Example Certificate of Achievement

Type of Access	Access Description	Notes
Open	All members	Online SOP manuals

Attachment #5 – WG Invitation Template

Type of Access	Access Description	Notes
Open	All members	Online SOP manuals

Attachment #5 – WG Minutes Template

Type of Access	Access Description	Notes
Open	All members	Online SOP manuals

Attachment #6 – Performance Measures Template

Type of Access	Access Description	Notes
Open	All members	Online SOP manuals

Attachment #7 – Escalation Process Map

Type of Access	Access Description	Notes
Open	All members	Online SOP manuals

Attachment #8 – Working Group Process Map

Type of Access	Access Description	Notes
Open	All members	Online SOP manuals

Attachment #9 – Web Reporting data model

Type of Access	Access Description	Notes
Open	All members	Online SOP manuals

Attachment #10 – Actions Tracking Template / Manual

Type of Access	Access Description	Notes
Open	All members	Online SOP manuals

ANNEX B – SPECIAL INTEREST GROUP CHARTER TEMPLATE

Special Interest Groups (SIGs) are permanent sub-bodies of the BNSDI Community; they serve as a forum for cross disciplinary, sector-orientated collaboration on those aspects of BNSDI and related matters that are most relevant within their community of practice.

Special Interest Groups (SIG) consist of representatives from BNSDI member entities and subject-matter experts around geospatial data themes or persistent topical areas such as, Public Safety and Security, the Environment, Utilities or other "community of common practice". The Group is a forum for discussion and action on the strategic issues related to the implementation of the BNSDI initiative, for example; policy recommendations, use of standards and specifications and roll out, business guidelines, and issues pertaining to privacy and security.

At any time, an SIG may request the formulation of a Working Group(s) in order to tackle specific topics of interest from the SIG's scope or topical area.

It is considered that the purpose of the SIGs will continue and develop, providing a 'think-tank' for all governance related issues; expanding in representation to all government and key external agencies, committed to the continued development of the Emirate and it's ambition to be one of the five top governments in the World.

SIG Member Selection

Special Interest Groups are an association of individuals or organizations formally organized, on the basis of one or more shared concerns, to attempt to influence public policy in its favour. They provide a channel for special expertise to be made available to decision-makers, and for particular concerns to be brought to their attention.

Entities may be represented in one or several Groups. On the initiation of a new Group, the Group Coordinators liaise with the Entity Account Manager and the Entity Representative to select the most suitable representative(s) for the Group(s). The diagram below highlights some of the key criteria for SIG member selection.

It is expected that SIG members are from a level within their organization where they; influence or delivery policy recommendations; authorize operational strategy initiatives; have an overview of the e-government strategy and understanding of its impact and influence on society.

SIG Responsibilities

The Group responsibilities include, but are not limited to, the following;

- Act as a forum to discuss best practices by Government organisations on a national, regional and municipal level.
- Consider the growing trend, traction and importance of the subject sustainability and its related activities in Belize.
- Define the different needs by various stakeholders for geospatial data.
- Confer on the best mechanism for collaboration in the future to avoid redundancy while meeting the common needs of the different members in the BNSDI Community.
- Establish a forum for sharing information and news.
- Address areas of policy, regulatory, and institutional practice that will have an impact on the BNSDI.
- Facilitate access to resources such as, the web-based Geoportal.
- Identify areas that can be instigated and facilitated by the SIG members.
- Propose the development of tools and methods to stay up-to-date on entity related projects and/or activities (for example, the development and maintenance of a dedicated channel on the BNSDI Portal).
- Contribute toward the development and execution of key events outreach and communication.
- Facilitate the development and coordination of agency activities.
- Promote the publication of digital spatial data.
- Assist Coordination Centre to establish and publish standards, specifications and strategic priorities.
- Promote entity responsibility in complying with SDI standards and thus institutionalizing SDI standards, in consensus with the entities and help cross-agency coordination in data sharing and information exchange.
- Promote Emirate-wide use of defined and published spatial data transfer standards.
- Support development of the Belize Spatial Data Infrastructure through facilitation of partnerships and definition of data framework standards.
- Identify ways in which data from any source may be included in the Belize Spatial Data Infrastructure.

SIG Coordination

Each Group shall be chaired by an individual approved by the Group, and agreed by the Executive Committee and Technical Committees.

Where multiple representatives volunteer for the Group Lead (Chair) position, or for instances where there is no volunteer, Coordination Centre management will make an assignment, either from the member entities or from the Coordination Centre staff.

Meetings shall be held at the call of the Group Lead, and shall be held at least biannually.

All decisions shall be on the basis of consensus agreement. Where an agreement is not reached, the issue will be promptly referred to the Executive Committee for resolution.

The Group Lead will coordinate the Group's activities with other BNSDI Groups by participating in BNSDI meetings.

The Group will employ those tools that are best suited to meeting its responsibilities, such as Group meetings, nationwide user forums, user surveys and analyses, workshops, and research initiatives.

3.1.4. Follow-up Mechanism

Normally, the Group Lead will give notification and an agenda will be distributed to Group members and the Group Coordinator, 10 working days in advance of the meeting.

The Group Lead is responsible for organizing the provision of a draft report of Group meetings (MoMs), including recommendations and action items, to all Group members and SDI Group Coordinator for review prior to approval.

On approval, the Group Lead shall provide the final report of Group meetings to all members, Groups Coordinators, Coordination Centre management, if required, the BNSDI Technical Committee.

The SDI Group Coordinators may take responsibility for the Group administration tasks at the request of the Group.

3.1.5. SIG Documents

Each Community Organization Group is initiated for a specific purpose. A Special Interest Groups general purpose is, for continued cross-sector collaboration to influence policy and provide guidance for decision-makers on a spatially related topic

Each Group is required to produce a Charter; this is the Group's mandate which outlines its scope or purpose, the members and Group Lead, and its operational guidelines or objectives. The Charter is a "living" document which is updated throughout the lifecycle of the Group.

Coordination Centre Team Responsibilities Relative to SIG's

- The Group Coordinator's responsibilities include, but are not limited to, the following:
- Facilitating the initiation of a new Special Interest Groups, including the preparation of the framework papers, i.e., the Charter.
- Identifying the Group members in collaboration with the Entity Account Manager and Entity BNSDI Representatives.
- Setting the agenda for, and organising the initial meeting, and assistance for any meetings of special junctures, e.g. workshops, etc.
- Promoting consensus with the participants on the Group's Charter and Group Lead.
- Monitoring and reporting on Group performance through the SIG Dashboard.
- Follow up on all actions items with, or in coordination with the Group Lead(s).
- Review the requirement for new Working Group, and facilitate initiation process.
- Communicating the status of 'Standards development' in relation to the Project / Class / Theme/ Topic to the DP team to monitor the progress of standards development related to each project.
- Transfer of any the gathered (formal / informal means) intelligence and knowledge on all projects that may have spatial components or relate to ICT/e-gov initiatives for assessment by the Data Projects team.

ANNEX C - COORDINATION CENTRE STAFF JOB DESCRIPTIONS

The following are draft job descriptions for each of the positions that have been identified for the eventual Spatial Data Coordination Center (Coordination Centre). These positions will be filled as qualified candidates are recruited. As with any recruitment program, the job descriptions may need to be adjusted during the hiring process to reflect any shuffling of roles and responsibilities depending upon the skill sets of the high-potential candidates. Position descriptions have been structured in a form suitable to support the recruitment process. The following positions are included:

1. Geographic Information Officer (GIO)
2. Secretary
3. Outreach Coordinator
4. Community Coordinator
5. Sustainable Development Support Coordinator
6. Technical Manager
7. Geospatial Data Specialist
8. Systems and Database Administrator
9. Geospatial Portal Specialist
10. GIS Analyst
11. Help Desk Operator

1. Geographic Information Officer (GIO)

POSITION: **Geographic Information Officer**
MONTHS/HOURS: Full Time
STARTING SALARY: Commensurate with experience
AVAILABLE:
POSTING DATE:
APPLICATION DEADLINE:

DESCRIPTION: The Belize Spatial Data Infrastructure (BNSDI) is conceived as a national initiative to harmonize, integrate and optimize the development and sharing of fundamental geographical and statistical information across all government agencies and institutions. The development of this program is being carried out through a step-by-step, practical process that will establish a strategic and evolving framework for a long term BNSDI, and provide coordination and support to the development of its various components through a carefully conceived and guided incremental process. The Geographic Information Officer (GIO) is to be

commissioned to support the BNSDI program implementation; he or she is intended to be a person with primary responsibility for overseeing and coordinating the BNSDI implementation process, and overseeing the ongoing development and operations of the Coordination Centre.

Duties and responsibilities of the GIO include, but are not limited to:

- Oversee the overall management and administration of the Coordination Centre;
- Provide leadership and guidance to all Coordination Centre staff;
- Serve as primary liaison between the Coordination Centre and Coordination Centre management;
- Define priorities, policies and strategies for consideration by Coordination Centre;
- Provide direct management guidance to the Administrative Support, Technical Manager and Outreach Coordinator roles;
- Prepare Coordination Centre annual plans, with support of other senior staff;
- Review and approve all project and activity plans and budgets;
- Review and approve all major staff resource allocations;
- Support senior staff in preparing and implementing operational plans for their areas of responsibility;
- Review program status reports and take action to mitigate any issues;
- Provide consulting support and guidance to any Coordination Centre projects or activities on an as-needed basis;
- Perform annual staff performance evaluations.

QUALIFICATIONS: A Bachelor's degree (Master's or PhD preferred) with 10 or more years of previous agency or program management or equivalent experience in a related field. The candidate will ideally have both a theoretical and practical understanding and experience with GIS technology, spatial data infrastructure, and the development of multiple agency information sharing federations. The candidate must be highly motivated and must demonstrate proficiency in both bilingual (Arabic/English) verbal and written communication and possess excellent interpersonal and team organizational skills. This position requires a strong team leader with the ability to oversee many diverse activities simultaneously, and to interact with executive management in all the participating agencies. The candidate must be proficient in understanding complex problems and situations and be able to develop strategy and policy recommendations to benefit the BNSDI program.

2. Secretary

POSITION:	**Secretary**
MONTHS/HOURS:	Full Time
STARTING SALARY:	Commensurate with experience

AVAILABLE: Immediately
POSTING DATE:
APPLICATION DEADLINE:

DESCRIPTION: Under the general supervision of the Senior Office Manager, provides administrative, clerical and logistics support to Coordination Centre. This person also serves as confidential assistant and functions as the key support staff person in coordination and implementation of the Coordination Centre's day-to-day office operations.

The duties and responsibilities include, but are not limited to, the following:

- Receive and direct incoming telephone calls, assists all calls when possible and transfers others to the appropriate staff for handling; greets and assists visitors and clients.
- Provide clerical support for the office such as typing, filing, answering phones and take accurate messages and maintains records; sort and distribute mail; prepare and send various mailings; prepare check requests accurately assigning appropriate general ledger account numbers, petty cash and travel reimbursements; copy documents and presentation materials.
- Coordinate set-ups for meetings; calendars for establishing meeting times and locations; prepare room requisition, order and coordinate refreshments, and assist where needed.
- Order and inventory office supplies to ensure the smooth operation of the office.
- Prepare correspondence, report and memoranda involving confidential matters, moderate amounts of computation and confidential financial matters. Uphold the confidentiality of the Coordination Centre, handling all information on a need to know basis.
- Attend selected Coordination Centre meetings and provides minutes, as requested by Coordination Centre staff. Provide coordination of on-site and off-site project meetings and seminars. May be required to provide transportation for Coordination Centre personnel to and from airport and/or meeting areas.
- Prepare completed proposal packages for distribution to various agencies.
- Manage all staff and interns timesheets and ensure their accuracy.
- Contribute to overall office functions by accomplishing related duties as needed.
- Perform other duties and special projects as assigned or directed by the Senior Office Manager.

MINIMUM QUALIFICATIONS: Position requires a high school diploma or equivalent with two (2) to three (3) years of additional coursework in related fields such as business, secretarial, computer software/word processing and spreadsheet programs.

Requires significant self-direction including the ability to prioritize daily work and maintain high productivity. Considerable knowledge of secretarial procedures and word processing (MS Word, Excel, and Outlook), basic math skills and knowledge of recordkeeping required. Must possess exceptional communication, organizational and customer service skills. Ability to interact effectively with on and off-site contacts and handles multiple tasks with tight deadlines.

3. Outreach Coordinator

POSITION:	**Outreach Coordinator**
MONTHS/HOURS:	Full Time
STARTING SALARY:	Commensurate with experience
AVAILABLE:	Immediately
POSTING DATE:	
APPLICATION DEADLINE:	

DESCRIPTION: This person will coordinate with the BNSDI Program staff to identify key opportunities for publicizing, both nationally and internationally, the progress and development of the BNSDI Program and its resulting outputs to the BNSDI using the Geospatial Portal website a and other communication channels such as special events, seminars, exhibitions, conferences and other affairs. In addition, the Outreach Coordinator will work with the BNSDI Technical Committee to prioritize the development of those products that will showcase the BNSDI initiative and leverage external relationships and publicity.

Duties and responsibilities include, but are not limited to:

- Participate in international conferences related to BNSDI;
- Maintain and implement the BNSDI Outreach and Communications Plan;
- Establish and maintain ties with BNSDI related international initiatives and other national BNSDI programs such as the Global Spatial Data Infrastructure (GSDI) organization;
- Transfer experience and knowledge from the international BNSDI community to the BNSDI community;
- Prepare periodical newsletters to keep the BNSDI community abreast of each other's developments and achievements;
- Identify BNSDI related conferences, workshops and seminars and promote attendance by stakeholders;
- Organize local BNSDI related conference, workshops and seminars;
- Establish and maintain stakeholder relations management system;
- Coordinate with Coordination Centre management the development of normalized training and capacity building programs that benefit the entire BNSDI community;
- Oversee the development of pilot projects, "quick win" projects and showcase initiatives and ensure their propagation to the rest of the BNSDI community.

MINIMUM QUALIFICATIONS: The candidate should have at least a business and management background such as a Bachelor of Commerce which is complemented by a strong GIS background. He or she shall have equally excellent marketing and communication skills and five to 10 years experience.

4. Community Coordinator

POSITION:	**PM/ GIS Consultant**
MONTHS/HOURS:	Full Time
STARTING SALARY:	Commensurate with experience
AVAILABLE:	Immediately
POSTING DATE:	
APPLICATION DEADLINE:	

DESCRIPTION: The Community Coordinator will report to the GIO. He/she acts in the position of a generalist consultant with a wide experience in a multi-sector environment. He/she has strong planning and analytical skills, business and management experience and well-rounded GIS background and experience. He/she can plan a role of a project manager on specific assignments with well-defined scope, resources and duration or a program oversight manager.

The duties and responsibilities include, but are not limited to, the following:

- Act as a task force manager for the development/ update of the BNSDI Strategic Plan;
- Work with the GIO to update stakeholder situation assessment, needs assessment, program design, and implementation strategy especially in the context of addition of new stakeholders;
- Handles the assignments delegated to him by the GIO such as the management of specific projects or the oversight responsibility of specific activities under an ongoing program development;
- Is responsible for tracking and reporting progress for all activities in this area;

MINIMUM QUALIFICATIONS: The PM/GIS Consultant shall have a bachelor degree in engineering or equivalent experience. A minimum of eight years experience is required with exposure to multi-sector disciplines in enterprise GIS and/or Spatial Data Infrastructure Programs. He or she shall have excellent verbal and written communication skills in English.

5. Sustainable Development Support Coordinator

POSITION:	**Sustainable Development Support Coordinator**

MONTHS/HOURS: Full Time
STARTING SALARY: Commensurate with experience
AVAILABLE: Immediately
POSTING DATE:
APPLICATION DEADLINE:

DESCRIPTION: The Sustainable Development Support Coordinator will report to the GIO. He acts in the position of a planning support coordinator with a wide experience in the use of geospatial tools and data in supporting physical planning and development investment. He/She has strong land use and resource planning, investment and analytical skills, institutional and management experience and well-rounded GIS background. He/She will coordinate with those entities involved in physical planning and development investment activities to ensure that the BNSDI resources are aligned with those activities and being used effectively for maximum positive impact to the Country's development aspirations.

The duties and responsibilities include, but are not limited to, the following:

- Act as a coordination point between the Coordination Centre and those entities and programs involved in physical planning and development investment;
- Work with the GIO to identify program requirements and the strategic allocation of Coordination Centre resources to best support those requirements;
- Identify planning and investment project alignment opportunities and report these to the involved entities and the Executive Committee for deliberation and decision making;
- Maintain sustainable development goal data and make dashboards available to executive leadership;

MINIMUM QUALIFICATIONS: The Sustainable Development Support Coordinator shall have a Masters degree in land use planning or equivalent experience. A minimum of eight years experience is required with exposure to broad range of sector planning disciplines and the application of GIS technology within these domains. He or she shall have excellent verbal and written communication skills in local language and English.

6. Technical Manager

POSITION: **Technical Manager**
MONTHS/HOURS: Full Time
STARTING SALARY: Commensurate with experience
AVAILABLE: Immediately
POSTING DATE:

APPLICATION DEADLINE:

DESCRIPTION: The Technical Manager will be a single person who has technical expertise in all aspects of information technology management, geospatial analysis including GIS, remote sensing, programming and cartographic production. This person will report to the GIO and be responsible for coordinating all the technical staff, including the Systems Administrator, the Geospatial Data Specialist, GIS Analysts, and the Web Programmer. This person will also be responsible for the technical management of Coordination Centre projects and operations, technical resource allocations and technical staff assignments to projects and activities. It will also include oversight of the content aspects of the BNSDI Geospatial Portal and associated metadata, and data services, as well as the development and management of any associated application services.

Duties and responsibilities include, but are not limited to:

Management and Administration:

- Develop project plans to implement strategic program goals. Conduct project assessment and performs task planning to identify milestones, resource needs, schedule, and budget recommendations;
- Plan, lead and manage tasks such as needs assessment, design, implementation and evaluation;
- Provide top-level technical support for a staff of research analysts, application engineers, and GIS professionals
- Oversee multiple projects and support project leaders in managing project teams;
- Lead proposal development efforts, prepare grant applications, support project development and institute outreach efforts; and act as senior technical editor for all documents.

Analysis and Research

- Track current trends, evaluate, recommend, and support implementation of emerging technology for GIS, hardware, software, and information science for ongoing and planned projects;
- Develop and deliver presentations and demonstrations to BNSDI community, project management, staff, colleagues, and clients;
- Prepare and present conference papers, technical and design documentation.

Technology Management

- Supervise development and implementation of computing infrastructure and management strategies;
- Maintain and apply knowledge of information science principles, including relational and object-relational database design, software development concepts, knowledge management, decision support and information architecture concepts.
- Train staff and others via mentoring, peer-to-peer coaching, or group instruction;

- Support GIS technology planning for various academic programs, including Master of Science in GIS;

MINIMUM QUALIFICATIONS: The candidate should have a Master's Degree in computer science, geography/geographic information science, systems/operations management, or closely related field. He or she must also have five or more years of relevant Information Systems and GIS technology and/or programming experience, and an equivalent level of relevant project management experience with clear demonstration of having successfully handled increasing team supervision and project management responsibilities. The candidate must have the ability to thrive in a multi-project environment with minimal supervision and multiple priorities while exercising personal initiative, excellent analytical and problem-solving skills. The position also requires excellent interpersonal and leadership skills as well as exceptional verbal and technical writing skills.

TECHNICAL SKILLS QUALIFICATIONS

- Extensive experience with the application of information technology and in-depth knowledge of GIS theory, methods and technologies;
- Expertise with spatial analysis, network modeling, raster modeling, and statistical analysis techniques;
- Experience with current Microsoft operating systems, software, and development environments including desktop and server products, web services, and the .NET development framework;
- Experience in administration and use of MS SQL Server for spatial databases;
- Extensive experience with object-oriented analysis and design methods for application development. Additional application design and programming experience with one or more of languages: C, C++, Java, C#, ASP, Visual Basic for Applications (VBA), VB.NET, XML, Python.

7. Geospatial Data Specialist

POSITION:	**Geospatial Data Specialist**
MONTHS/HOURS:	Full Time
STARTING SALARY:	Commensurate with experience
AVAILABLE:	Immediately
POSTING DATE:	
APPLICATION DEADLINE:	

DESCRIPTION: The Geospatial Data Specialist will be responsible for the oversight and facilitation of all issues related to the establishment and operation of all fundamental geospatial data sets (FGDS) for the BNSDI. This includes participation in all FGDS Working Groups, development of data models, establishment of service level agreements (SLA's) between the Coordination Centre and the stakeholder

agencies, and monitoring and follow-up to ensure continuous compliance with the terms and conditions of all FGDS SLA's.

Duties and responsibilities include, but are not limited to:

- Maintain the master FGDS framework data plan and associated documentation concerning current status, identification of data custodianship, participation in associated FGDS Working Group, terms and conditions of any existing service level agreements (SLA's), and other issues related to each FGDS topic;
- Follow-up on all FGDS-related SLA's to ensure that the documented commitments are being complied with;
- Participate in all FGDS-related Working Groups;
- Oversee the maintenance of the master geospatial metadata catalog to ensure that all records are entered correctly and maintained by the appropriate data custodians;
- Perform research in terms of existing or emerging data modeling concepts, principles and practices, and make the findings of this research available to the BNSDI community, in coordination with the Coordination Centre Outreach Coordinator;
- Identify conferences, seminars and workshops that may be informative or otherwise beneficial for FGDS custodians to participate in, and make this information accessible to the BNSDI community, in coordination with the Coordination Centre Outreach Coordinator;
- Ensure that all FGDS data layers are accessible through the BNSDI data clearinghouse, or through distributed agency nodes, in compliance with previously defined SLA's.

MINIMUM QUALIFICATIONS: The candidate should have at least a Bachelor's Degree in computer science, geography/geographic information science, or closely related field. He must also have five or more years of relevant Information Systems and GIS technology and data management experience, and show a strong background in spatial data modeling theory, principles, and methods. Because this position involves direct contact and collaboration with every FGDS custodian agency, as well as other agencies that may participate in the various FGDS Working Groups, this person must also have well developed interpersonal skills, and must be able to facilitate and support multi-agency team activities and interactions.

8. Systems and Database Administrator

POSITION:	**Systems and Database Administrator**
MONTHS/HOURS:	Full Time
STARTING SALARY:	Commensurate with experience
AVAILABLE:	Immediately

POSTING DATE:
APPLICATION DEADLINE:

DESCRIPTION: The Systems and Database Administrator will work under the general direction of the Technical Manager and will be responsible to ensure that the computing infrastructure and geospatial databases and applications are kept in running condition and administered in a systematic and effective manner. The Systems Administrator is directly responsible for definition of information systems needs, systems security, refining system requirements, implementing systems, and maintaining existing systems. This person is also responsible for ensuring that backup needs for individual servers are satisfied. The Systems Administrator will be responsible for a range of operating systems, including variations of Unix and Microsoft operating systems. The Systems Administrator will support a wide range of specialized hardware including large-format printers and high-speed scanners and other peripherals.

Duties and responsibilities include, but are not limited to:

- Handle technical administration of existing systems including security, adding/removing user accounts, configuration of system parameters, adding/configuring peripheral devices, and servicing user requests;
- Direct activities of technical support technicians;
- Provide upper-tier technical support for a variety of customer hardware/software issues;
- Work with the Technical Manager to prepare systems plans and follow up their execution;
- Coordinate directly with ICT professionals in other BNSDI stakeholder agencies on systems administration issues;
- Install and maintain operating systems and third party applications;
- Collaborate with Coordination Centre staff to develop and define system hardware and software needs with guidelines established by the Technical Manager;
- Perform other system management duties as assigned or directed;
- Frequently serve on technology-related committees and/or teams to help facilitate collaborative technology direction for the Coordination Centre;
- Develop and maintain standards and policies for system requirements, security, and usage in collaboration with the Technical Manager;
- Support technology assessment and future systems planning, including resource and budget recommendation.

MINIMUM QUALIFICATIONS: The candidate should have at least a Bachelor's degree in information and communications technology (ICT), or the equivalent, and at least 5 years on-the-job experience in systems administration and technical support. The person must demonstrate a working knowledge of systems administration

principles, practices and tools. Certification in Information Technology Infrastructure Library (ITIL®) or equivalent systems administration best-practices is desirable.

9. Geospatial Portal Specialist

POSITION:	**Geospatial Portal Specialist**
MONTHS/HOURS:	Full Time
STARTING SALARY:	Commensurate with experience
AVAILABLE:	Immediately
POSTING DATE:	
APPLICATION DEADLINE:	

DESCRIPTION: The Geospatial Portal Specialist is responsible for the design, development and maintenance of the BNSDI Geospatial Portal. The Geospatial Portal shall ensure the Portal development and operation are compatible with international good practice and the IT standards adopted by the government body that is hosting the portal services.

Duties and responsibilities include, but are not limited to:

- Develop/ update the Geospatial Portal specifications;
- Monitor development in the Portal technology and propose enhancements/ upgrades as necessary;
- Ensure the development, customization and configuration of the Geospatial Portal services;
- Discuss with the stakeholders the requirements for extra/ enhanced services on the Portal and assess the feasibility of such developments;
- Ensure the provision of both English and Arabic services on the Portal;
- Report to the Technical Manager on the performance, utilization, developments and future plans for the Geospatial Portal.

MINIMUM QUALIFICATIONS: The candidate should have at least computer science training with a strong GIS background applied in the area of Geospatial Portals developments. A minimum of 5 years is required with a minimum of two years experience in Geospatial Portal developments and/or operations supplemented by a well rounded IT background.

10. GIS Analyst

POSITION:	**GIS Analyst**
MONTHS/HOURS:	Full Time
STARTING SALARY:	Commensurate with experience
AVAILABLE:	Immediately
POSTING DATE:	
APPLICATION DEADLINE:	

DESCRIPTION: Several GIS Analysts will be required initially to provide basic technical and analytical support to the participating stakeholder agencies, while also ensuring production of BNSDI program products and services. The GIS Analysts will work also under the general direction of the GIO or Technical Manager. Analysts may have specialization in particular areas such as system and database design, spatial analytical procedures, cartographic design and programming. In addition, the Analysts should have the capability to produce high-quality applications and outputs necessary to demonstrate the effectiveness of the BNSDI program and meet the objectives of the participating stakeholder agencies. There may be different levels of GIS analysts depending on their experience. In the context of this report, the Senior GIS Technical Analyst is referred to in this sense.

Duties and responsibilities of the GIS Analyst include, but are not limited to:

- Apply his strong background using Advanced GIS software and related products such as advanced spatial and 3D analytical tools, thematic mapping, trend analysis, etc…in a project and production environment;
- Work with the GIO, Technical Manager and Outreach Coordinator to support technical GIS analyst activities, data inventory and assessment, derivative data products and support special projects;
- Rely on his strong conceptual and practical understanding of spatial database design, including relational database design and spatial data integration, GIS application software development and spatial analysis, data automation procedures, including vector and raster data automation techniques, data standards, and quality assurance procedures;
- Utilize his hands-on experience in packaging systems, tools and methods in a considerably short period of time in order to answer requests by upper management for specific reporting needs that support decision making;
- Is responsible for tracking and reporting progress for all activities in this area.

MINIMUM QUALIFICATIONS: The candidate should have at least a Bachelor in computer science, engineering, geography or mathematics that is supplemented by a strong GIS background with 2-3 years experience. He should have very strong analytical skills with application in a GIS analysis and reporting environment for decision making. He shall be able to translate the functional requirements that are described to him by his supervisors into workable solutions with tangible outcome using any combination of GIS tools, methods and adhoc custom applications developed by him in order to resolve the problem as stated by management: this could be a feasibility study, a thematic spatial representation or a complex reporting tool that supports decision making by upper management.

11. Help Desk Operator

POSITION: **Help Desk Operator**

MONTHS/HOURS: Full Time
STARTING SALARY: Commensurate with experience
AVAILABLE: Immediately
POSTING DATE:
APPLICATION DEADLINE:

DESCRIPTION: At least one permanent staff should be allocated to operate and maintain a help desk function for the BNSDI. Initially, this role may be filled by the senior administrative assistant, but it is expected that the level of traffic in this area will increase significantly as more organizations start to utilize the BNSDI infrastructure on a more regular basis. Eventually, it is expected that this will be a full time occupation to receive, log, analyze and respond to requests for information or support, or to route such requests to the appropriate person or agency.

Duties and responsibilities include, but are not limited to:

- Receive the calls and trouble tickets from the clients;
- Open trouble tickets and log complaints information;
- Assign trouble tickets to the concerned staff;
- Track work-in-progress until the ticket is closed;
- Inform the client and ensure that the process of follow-up with the client is satisfactory;
- Notify the technical manager of tickets that are critical or urgent;
- Prepare and distribute periodical reports to the stakeholders;
- Participate in internal meetings related to help desk support.

MINIMUM QUALIFICATIONS: The candidate should have at least a technical education with a strong background in the general use of computer and help desk applications. He should have been involved for at least a year in GIS activities or projects and has gained a good understanding of GIS operational issues. This shall allow him to have a good understanding of the issues that are raised by clients and consequently to process them to the appropriate persons for resolution.

ANNEX D - BNSDI HIRING & RETENTION FRAMEWORK

1. Hiring

The hiring practice should be based on best practices and should be an integral part of the Human Resources Management Policy. The check list below provides a reference that helps the manager keep track of the recruiting efforts. The hiring checklist communicates both the recruiting and the hiring process and progress in recruiting to the hiring manager.

- Determine the need for a new or replacement position;
- Think creatively about how to accomplish the work without adding staff (improve processes, eliminate work you don't need to do, divide work differently, etc.);
- Hold a recruiting planning meeting with the recruiter, the HR leader, the hiring manager, and, potentially, a coworker or internal customer;
- Develop and prioritize the key requirements needed from the position and the special qualifications, traits, characteristics, and experience you seek in a candidate. (These will assist the Human Resources department to write the classified ad; post the job online and on your website; and screen resultant resumes for potential candidate interviews.);
- With HR department assistance, develop the job description for the position;
- Determine the salary range for the position;
- Decide whether the department can afford the position;
- Post the position internally on the "Job Opportunities" bulletin board for one week. If you anticipate difficulty finding a qualified internal candidate for the position, state in the posting that you are advertising the position externally at the same time;
- Send an all-company email to notify staff that a position has been posted;
- All staff members encourage talented, qualified, diverse internal candidates to apply for the position. (If you are the hiring supervisor, as a courtesy, let the current supervisor know if you are talking to his or her reporting staff member.);
- Interested internal candidates fill out the Internal Position Application;
- Schedule an interview, for internal candidates, with the hiring supervisor, the manager of the hiring supervisor or a customer of the position and HR. (In all cases, tell the candidates the timelines you anticipate the interview process will take.);
- Hold the interviews with each interviewer clear about their role in the interview process. (Culture fit, technical qualifications, customer responsiveness and knowledge are several of the screening responsibilities you may want your interviewers to assume.);
- Interviewers fill out the Job Candidate Evaluation Form;

- If no internal candidates are selected for the position, make certain you clearly communicate with the applicants that they were not selected. Whenever possible, provide feedback that will help the employee continue to develop their skill and qualifications. Use this feedback as an opportunity to help the employee continue to grow their career;
- If an internal candidate is selected for the position, make a written job offer that includes the new job description and salary;
- Agree on a transition timeline with the internal candidate's current supervisor;
- If you've created another internal opening, begin again;
- End the search;
- If no qualified internal candidates apply, extend the search to external candidates, if you didn't advertise the position simultaneously. Develop your candidate pool of diverse applicants;
- Spread word-of-mouth information about the position availability in your industry and to each employee's network of friends and associates;
- Place a classified ad in newspapers with a delivery reach that will create a diverse candidate pool;
- Recruit online. Post the classified ad on jobs and newspaper-related websites including the company website;
- Post the position on professional association websites;
- Talk to university career centers;
- Contact temporary help agencies;
- Brainstorm other potential ways to locate a well-qualified pool of candidates for each position;
- Through your recruiting efforts, you've developed a pool of candidates. People are applying for your open job. Whether you have developed a candidate pool in advance of the job opening or you are searching from scratch, the development of a qualified pool of candidates is crucial;
- Send postcards or emails to each applicant to acknowledge receipt of the resume. (State that if the candidate appears to be a good match for the position, relative to your other applicants, you will contact them to schedule an interview. If not, you will keep their application/resume on file for a year in case other opportunities arise.);
- Once you have developed a number of applicants for the position, screen resumes and/or applications against the prioritized qualifications and criteria established. Note that resume cover letters matter as you screen;
- Phone screen the candidates whose credentials look like a good fit with the position. Determine candidate salary requirements, if not stated with the application, as requested.
- Schedule qualified candidates, whose salary needs you can afford, for a first interview with the hiring supervisor and an HR representative, either in-person or on the phone. In all cases, tell the candidates the timeline you anticipate the interview process will take;

- Ask the candidate to fill out your official job application, upon their arrival for the interview;
- Give the candidate a copy of the job description to review;
- Hold screening interviews during which the candidate is assessed and and has the opportunity to learn about your organization and your needs;
- Fill out the Job Candidate Evaluation Form for each candidate interviewed;
- Meet to determine which (if any) candidates to invite back for a second interview;
- Determine the appropriate people to participate in the second round of interviews. This may include potential coworkers, customers, the hiring supervisor, the hiring supervisor's manager and HR. Only include people who will impact the hiring decision.
- Schedule the additional interviews;
- Hold the second round of interviews with each interviewer clear about their role in the interview process. (Culture fit, technical qualifications, customer responsiveness and knowledge are several of the screening responsibilities you may want your interviewers to assume.);
- Candidates participate in any testing you may require for the position;
- Interviewers fill out the candidate rating form;
- Human Resources checks the finalists' (people to whom you are considering offering the position) credentials, references and other qualifying documents and statements;
- Anyone who has stated qualifications dishonestly or who fails to pass the checks is eliminated as a candidate;
- Through the entire interviewing process, HR, and managers, where desired, stay in touch with the most qualified candidates via phone and email;
- Reach consensus on whether the organization wants to select any candidate (via informal discussion, a formal discussion meeting, HR staff touching base with interviewers, candidate rating forms, and so on). If dissension exists, the supervising manager should make the final decision;
- If no candidate is superior, start again to review your candidate pool and redevelop a pool if necessary;
- HR and the hiring supervisor agree on the offer to make to the candidate, with the concurrence of the supervisor's manager and the departmental budget;
- Talk informally with the candidate about whether he or she is interested in the job at the offered salary and stated conditions. Make certain the candidate agrees that they will participate in a background check, a drug screen and sign a Non-compete Agreement or a Confidentiality Agreement, depending on the position. (This should have been signed off on the application.) If so, proceed with an offer letter. You can also make the job offer contingent on certain checks;
- If not, determine if negotiable factors exist that will bring the organization and the candidate into agreement. A reasonable negotiation is expected; a

candidate that returns repeatedly to the company requesting more each time is not a candidate the company wants to hire;

- If the informal negotiation leads the organization to believe the candidate is viable, HR will prepare a written position offer letter from the supervisor that offers the position, states and formalizes the salary, reporting relationship, supervising relationships, and any other benefits or commitments the candidate has negotiated or the company has promised;
- The offer letter, the job description and the Company Non-Compete or Confidentiality Agreement are provided to the candidate;
- The candidate signs the offer documentation to accept the job or refuses the position;
- If yes, schedule the new employee's start date;
- If no, start again to review your candidate pool and redevelop a pool if necessary.

2. Retention

Hiring an employee that is a potential fit to the needs of the organization is part of the challenge; the remaining challenge is to retain the successful employees through modern and adaptive human resources policy that stimulate Motivation, Efficiency, Performance, Flexibility and Creativity as described below:

Motivation - a means of stimulating the organization's personnel towards performance and profitability. The study of motivation in a workplace, theoretically and practically, allows to emphasize the factors of influence both internal and individual which determine the employee's motivation (needs, attitudes, interests, behaviors, system of values) and external (wage system, task assigning, work group, control and surveillance system, communication, spare time). The two types of factors interact with each other, influencing employees' behavior, their activity and thus the activity of the organization and implicitly its results. Among the instruments of influencing the motivation of the employees of the organization, for performing an activity based on efficiency criteria, the importance of the following should be stressed:

- A favorable work environment considering the fact that a person generally spends most of his active time at the work place;
- Creating possibilities for employees to participate to decision-making in a higher degree than in the productive field also considering the specificity of the consumer service tourist activity;
- Efficiently solving the employees' problems;
- Stimulating group cohesion;
- The objective appreciation of employees' performances and fixing a reward;
- Money stimulation.

A way of increasing efficiency in the organization activity is represented by teams which present a large variety of advantages: teams combine knowledge and skills which surpass those on any individual within the team; having clear objectives and established communication channels, teams are able to solve various problems in real time: they are fast, flexible and efficient because they can use expertise and means; the team offers a unique social dimension: it does not function unless it overcomes trust and personality barriers. Basically, teams allow organizations to benefit from the skills and creativity of the entire work force instead of relying only on the specialists' ability to detect problems and offer solutions. Today, most medium and large companies are led by managerial teams. The shift of power from the individual to the team is due, more or less, to the environment specific to the activity, which sums up a set of services whose efficient quantification consists of making the client the number one priority by the complete quality of the management in order to rise above the consumers' expectations. In this regard, the following actions are recommended:

- Adopting and understanding the vision of the organization;
- Formulating an appropriate strategy to put the following motto into practice: "our client comes first", through defining the clients' demands and exigencies and defining the vision of the future;
- Defining key results;
- Explaining newly adopted values;
- Selecting and interpreting the information about performances;
- Organizing periodical audit;
- Training the employees;
- Using individual qualities;
- Creating potential advantages.

Development of personnel's creativity - a means of increasing efficiency in an organization. The management of an organization in the present must be based on the creative and initiative spirit of the employees and not on a bureaucratic approach. Human resources, which "constitute the supplementary source of survival and the main source of efficiency, effectiveness and welfare of civilization" (Petrescu I., 1995) must be stimulated from the point of view of their creative potential, because, especially in this field, material, financial and informational resources cannot be properly valued in the absence of creativity:

- Creativity refers to a person's ability and intellectual force to find new ideas, and innovation refers to putting the new ideas in practice (Snak O., 2001). Creativity can represent an important factor of increasing efficiency of a performed activity;
- Creative thinking and imagination are important elements of an BNSDI activity and the absence of creativity undoubtfully leads to stagnation;
- Maintaining the competition implies a continuous activity in the field of creativity and innovation, for developing new products and services, more sophisticated, more refined and more individualized. Innovative activities are not performed as campaigns and no manager can come up with a consistent

support for planning precise deadlines for conceiving an innovation, as well as he cannot foresee or expect the immediate regain of the efforts invested such as energy, money and time, for experimenting and launching new products and services in the BNSDI Community.

In practice, one can resort to a series of measures leading to the stimulation and development of personnel's creativity within the BNSDI Program:

- Providing an environment favorable to creativity by: advanced personnel training, encouraging the employees to discover new solutions for problems occurred within the organization, encouraging free expression of ideas, of information exchange, stimulating the dialogue with the clients and users of BNSDI products and services in order to become closer to them, reducing and eliminating hierarchical distances;
- Providing favourable work conditions to potentially creative persons in order to experiment the proposed solutions;
- Diversifying the individual's integration methods within the creative group through effective participation of employees to organising their own work, arousing the employees' sense of belonging to the organization and the feeling that their dignity and professionalism are recognised within the organization, organising recreational activities outside the organization for a stronger consolidation of the group;
- Granting a high liberty of thought, action and expression by stimulating the employees' formulation of solutions;
- Forming complex creative groups;
- Educating the creative groups by stimulating the knowledge resulted from the group's creative activity, by transferring knowledge and information from the external environment;
- Turning innovation into an important element for the environment which should provide the employees with the motivation of reaching targeted objectives;
- Providing a diversified and flexible informational system;
- Extending the use of methods and techniques of stimulating creativity;
- Selecting, hiring and promoting initiative persons.

Performance Management, Development and Review (PDR) Policy. The Performance Management, Development and Review Policy is described in terms of the following variables:

a) Performance management and evaluation of staff performance may be undertaken for, but need not be limited to, the following purposes:

- To promote individual staff development and career planning strategies;
- To reward staff for excellence in performance which contributes positively to objectives specified in approved plans;
- To improve poor performance;

- To formulate and implement improvement strategies in cases where the performance of employees is below that expected from the classification level descriptions in terms of quality or extent of performance;
- To ensure fairness and due process as well as effective outcomes when dealing with demonstrated unsatisfactory performance which may lead to sanction;
- To facilitate the identification of development needs to assist employees to take responsibility for their career development;
- To provide feedback to supervisors on their performance;
- To identify possible ways of improving the way the job is structured within the work unit.

b) Managing and reviewing employee performance and fostering staff development are critical elements in the achievement of the entity priorities and its overall success. As a tool to assist in the review of performance, supervisors and employees engage in a PDR process appropriate to the employee's work responsibilities.

c) Performance Management is a joint responsibility between an employee and their supervisor. The formal PDR provides an opportunity for employees and supervisors to work together in a structured way to identify and describe work expectations, discuss learning and development needs, recognize achievements and plan for future individual and organizational growth and development.

ANNEX E - TRAINING AND CAPACITY BUILDING ACTIVITIES

The main components of the training and capacity building activity include the following:

Training and capacity building strategic plan. The training and capacity building strategic plan will develop the strategy for building the capacity of the BNSDI community through facilitation and coordination by the Coordination Centre. The plan will propose several implementation activities as needed in order to satisfy the objectives of the tactical and long term strategy. The strategic plan will be reviewed periodically by Coordination Centre.

Training implementation program for Coordination Centre staff. A technical training program shall be developed and implemented during the first year of the Coordination Centre operation in order to build the capacity of the recruited Coordination Centre staff. This will be done after assessment of the competencies and qualifications of the existing staff and the conception of the necessary training activities that will need to be implemented in order to build the capacity of the Coordination Centre staff and help them fulfill their delegated roles effectively.

Capacity building performance evaluation. Performance evaluation framework and standard operating procedures shall be developed and applied in order assess systematically the performance of the training and capacity building programs as well as the individual performance of the trained staff. The purpose is to make sure that the training programs are continuously aligned with the BNSDI Program business objectives and that the end users are achieving maximum benefit from the program.

Collaborative environment for community development. A coordination framework for community training and capacity building will be developed. The purpose is twofold: on one hand, create a common pool for sharing information about existing national and international programs and initiatives related to BNSDI/ EGIS training and capacity building at the level of educational institutions, vendors, non-governmental organizations, etc…on the other hand, benefit from an economy of scale through a central management, where appropriate, of the BNSDI community members participation to on-going training, capacity building programs and joint professional development activities. This can be achieved through the coordination and facilitation role of the Coordination Centre.

Continuing education and professional development strategic plan. A strategic plan shall be developed that will provide the incentive and support environment for agencies staff from different disciplines and with varying experience in order to pursue advanced and/or continued education. This shall be achieved through a spectrum of affordable continuing education and professional development programs that are offered to the staff of the stakeholder agencies.

Partnership program with educational institutions. The activity will develop a toolkit or template for a master partnership program with international and/ or local educational institutions that may include university, colleges, technical education centers, etc…In addition, partnership programs will be established and activated with national and international institutions respectively.

Virtual Training Campus. The Coordination Centre shall implant the seeds of a virtual training campus and shall grow it in the future as needed. The campus will be hosted in the geospatial web portal and will allow the BNSDI community members to access via the internet basic training courses and interactive virtual training material through which they can gain a quick hands-on experience in the utilization of the basic services that are offered by the geospatial portal and data clearinghouse.

ANNEX F - STAFF TRAINING SELF EVALUATION GUIDE

EMPLOYEE PERFORMANCE SELF-EVALUATION FORM

Employee Name (First, MI, last):

Job Title:

Department: Division:

Period of Evaluation: From: To:

1. Overall Performance

Please use this space to describe the overall performance rating. The overall rating should be a reflection of the performance factors, behavioral traits and supervisory factors.

Unacceptable Superior

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Comments: _____

Employee's Signature: Date:

2. Performance Factors

- Knowledge, Skills, Abilities – Degree to which person exhibits required level of job knowledge and/or skills to perform the job and use of established techniques, materials, and equipment;
- Quality of Work – Assignment meet quality standards, considering accuracy, neatness, thoroughness, and adherence to standards;
- Quantity of Work – Results of efforts, demonstrating ability to manage several responsibilities simultaneously, performing work in a productive and timely manner, meeting work schedules;

- Work Habits – Displaying a positive, cooperative attitude toward work assignments and requirements, compliance with established work rules and organizational policies;
- Communication – Job related effectiveness in dealing with others, expressing ideas clearly both orally and in writing, listening well and responding appropriately.

Examples of my positive performance in this area are:

How I can improve in this area:

Rating:

___Well Above	Performance is repeatedly above expectations
___Above	Performance is sometimes above expectations
___Meets	Performance meets expectations
___Below	Performance is sometimes below expectations
___Well below	Performance is repeatedly below expectations

Goals and development needed in this area:

Goal/Objective	Complete by

3. Behavioral Traits

- Dependability – Amount of time required to understand task, monitoring projects and exercising follow-up, adhering to time frames, on time for meetings and appointments, responding appropriately to instructions and procedures;
- Cooperation – Working well with colleagues and supervisors, demonstrating consideration of others, maintaining a rapport with others, helping others willingly;
- Initiative – Seeking and assuming greater responsibility, monitoring projects independently, follow-up appropriately;
- Adaptability – Adjusting easily to changes in duties, procedures, supervisors, or work environment, accepting new ideas and approaches to work, responding appropriately to constructive criticism and to suggestions for work improvement;
- Judgment – Effectively analyzing problems, determining appropriate action for solutions, and exhibiting timely and decisive action, thinking logically;
- Attendance – Number of absences, use of annual and sick leave in accordance with policy;
- Punctuality – Work arrival and departure time in accordance with policy.

Examples of my positive performance in this area are:

How I can improve in this area:

Rating:

___Well Above	Performance is repeatedly above expectations
___Above	Performance is sometimes above expectations
___Meets	Performance meets expectations
___Below	Performance is sometimes below expectations
___Well below	Performance is repeatedly below expectations

Goals and development needed in this area:

Goal/Objective	Complete by

4. Supervisory Factors

- Leadership – Demonstrating effective supervisory abilities, gaining respect and cooperation, inspiring and motivating subordinates, directing work group towards a common goal;
- Delegation – Demonstrating ability to direct others in accomplishing work, effectively selecting and motivating staff, defining assignments, overseeing the work of subordinates;
- Planning and Organizing – Coordinating with others, establishing appropriate priorities, anticipating future needs, carrying out assignments effectively;
- Performing day-to-day administrative tasks, managing time, administering policies and implementing procedures, maintaining appropriate contact with supervisor and utilizing funds, staff or equipment;
- Personnel Management – Serving as a role model, providing guidance and opportunities to staff for their development and advancement, resolving work-related employee problems, assisting subordinates in accomplishing their work-related objectives, communicating well with subordinates in a clear, concise, accurate, and timely manner and making useful suggestions.

Examples of my positive performance in this area are:

How I can improve in this area:

Rating:

___Well Above	Performance is repeatedly above expectations
___Above	Performance is sometimes above expectations
___Meets	Performance meets expectations
___Below	Performance is sometimes below expectations
___Well below	Performance is repeatedly below expectations

Goals and development needed in this area:

Goal/Objective	Complete by

5. Job Specific Competencies

If the supervisor and staff person identified additional competencies during performance planning, those competencies should be listed below, along with the employee's self evaluation of their performance on these competencies.

1._____

(specific job-related competency)

Examples of my positive performance in this area are:

How I can improve in this area:

Rating:

___Well Above	Performance is repeatedly above expectations
___Above	Performance is sometimes above expectations
___Meets	Performance meets expectations
___Below	Performance is sometimes below expectations
___Well below	Performance is repeatedly below expectations

Goals and development needed in this area:

Goal/Objective	Complete by

6. Job Specific Competencies

If the supervisor and staff person identified additional competencies during performance planning, those competencies should be listed below, along with the employee's self evaluation of their performance on these competencies.

2._____

(specific job-related competency)

Examples of my positive performance in this area are:

How I can improve in this area:

Rating:

___Well Above	Performance is repeatedly above expectations

___Above	Performance is sometimes above expectations
___Meets	Performance meets expectations
___Below	Performance is sometimes below expectations
___Well below	Performance is repeatedly below expectations

Goals and development needed in this area:

Goal/Objective	Complete by

7. Review of Goals/Objectives for the Past Year

Where goals, objectives, projects, special assignments, etc. have been clearly established, progress of these tasks should be evaluated. List and evaluate progress made on major pre-determined goals, objectives, projects, and special assignments by marking the appropriate box. The "Comments" space may be used for satisfactory progress but must be used for unsatisfactory progress. Attach additional sheets if necessary.

1. Goal/Objective/Project/Special Assignment

_____

☐ **Accomplished or Satisfactory Progress** ☐ **Unsatisfactory Progress (See "Comments" Below)**

Comments: _____

2. Goal/Objective/Project/Special Assignment

_____

☐ **Accomplished or Satisfactory Progress** ☐ **Unsatisfactory Progress (See "Comments" Below)**

Comments: _____

3. Goal/Objective/Project/Special Assignment

_____

☐ **Accomplished or Satisfactory Progress** ☐ **Unsatisfactory Progress (See "Comments" Below)**

Comments: _____

4. Goal/Objective/Project/Special Assignment

____

☐ **Accomplished or Satisfactory Progress** ☐ **Unsatisfactory Progress (See "Comments" Below)**

Comments: _____

ANNEX G - COORDINATION CENTRE FACILITY

The establishment of the Coordination Centre will require a permanent facility to house the group, and a variety of equipment, furniture and supporting infrastructure (computing infrastructure addressed elsewhere). This will need to be re-assessed and finalized during the final design and implementation of the initial Coordination Centre. This activity addresses the steps that will be required to plan, design and implement the Coordination Centre facility and associated infrastructure as described in here, outside of the computing infrastructure which is addressed elsewhere. Specific major components of this activity include:

Location. It is presumed at the onset that the Coordination Center is to be administered by the Ministry of Natural Resources (MNR). The Coordination Centre should be a showcase of a progressive program and facility in Belize, thus the location should reflect this prominence. The office should be in a central location, with convenient access within Belize where visitors can access and experience the Coordination Centre facility and better understand the role of the BNSDI as a prominent and important support infrastructure for Belize. The chosen location should ideally also have provision for supporting future expansion of the Coordination Centre, should this become necessary in the future.

Space programming. The space programming should make provision for effective functioning of the office, maximize collaboration and communication among Coordination Centre staff, provide group work space for internal and external meetings and workshops, accommodate periodic training and seminars, and support exhibition and explanation of the BNSDI and its many components for the benefit of visitors.

Office design. The space program will be translated by architects and interior designers to a detailed design for the Coordination Centre office. This will include a detailed space design for the entire facility and the specification of equipment, finishes and furnishings, infrastructure, and integration of the computing infrastructure components described elsewhere. The final design will be articulated in plan, profiles, sketches, specifications and bills of quantity to a level that can be used to conduct a competitive tender and/or to provide detailed instructions to the contractor and equipment suppliers.

A space program essentially describes the various components envisioned for the design of an overall physical plan. The space program can be thought of as a tool an architect can use to better understand the space requirements and relationships as they relate to the functionality of each component, which then leads to the development of the physical plan for which more detailed schematics and blueprints are prepared.

It is important to stress that the Coordination Centre space be designed in a manner that provides a collaborative environment. The tasks Coordination Centre staff will be engaged in

will cross many sectors where open dialogue and collaboration will be necessary in order to develop effective and compelling products. Secondly, the office design should achieve an attractive look and feel due to its high visibility. Ten components of the Coordination Centre are suggested to accommodate these dynamics.

Reception Area. The reception area will be the first place viewable to staff and incoming visitors, and therefore, will deliver the first impression of the BNSDI Coordination Centre. As such, the reception area should be designed in an attractive manner with adequate lighting to convey a welcoming feeling, and demonstrate the BNSDI Coordination Centre as a functional, well organized office. In addition, the reception area should also accommodate wall space for laying out a storyboard discussion that describes the BNSDI mission. In other words, this area can be used to display high-quality posters and images of various maps and graphical outputs created by the Coordination Centre and the general BNSDI community.

Executive Office. Because the Coordination Centre will have interaction with high-level officials, it will be necessary for the Geographic Information Officer (GIO) to have an office that accommodates any necessary private discussions. This office space should be designed such that the GIO has the functional space necessary to complete his business activities, while also accommodating for more casual meeting space with visitors and other staff.

Personal Workspaces. There are basically two perspectives when designing workspaces. Those that are enclosed and provide a more private environment, but offer less room for collaboration, and those that are more open, offer less privacy, but offer more collaboration. It is recommended that a combination of both approaches be adopted. It is important for staff to feel that they have a certain level of privacy, however, the Coordination Centre environment should be one that is highly dynamic and collaborative, which stems from the need to cover a wide spectrum of topics and issues. Therefore, it is recommended that the personal "cube" space format not be utilized, but rather personal spaces within an open room that have low walls or no walls at all, so that staff members can still see and talk to one another while still having a personal space they can call their own. Adequate lighting should be provided with the necessary office furniture needed to conduct regular business activities.

Open Space Work Room. The open space work room is conceived to be a highly dynamic work space where Coordination Centre staff and visitors can collaborate and openly discuss various topics and issues. This is an area that is supposed to foster ideas through useful tools such as whiteboards, large desk space to spread out posters, maps and other graphics, projectors for visualizing presentations, and plotters/printers to print out and evaluate completed products. In addition, this room should also have adequate wall space for hanging up posters, maps and other graphics, including adequate shelving space for storing supplies, files, and any necessary manuals.

Multi-purpose Room. This room can serve multiple purposes such as an interactive training room and media center for presentations, simulations and dynamic visualizations. The difference between the multi-purpose room and the open space work room is that the former offers a higher level of technology for more dynamic interactions and can be used for formal venues such as prototype demonstrations, high-level executive presentations and formal training classes.

Formal Conference Room. It is understood that the Coordination Centre will have several options for informal meeting spaces throughout the facility. However, a more formal conference room will be required for high-level meetings. This conference room should also provide the basic technology needed for giving presentations, while more sophisticated, dynamic presentations can be given in the Multi-purpose Room.

Kitchenettes. Productive work requires a well-fed staff. Therefore, it is suggested that the Coordination Centre accommodate a kitchenette, essentially a smaller kitchen that allows for refrigerating food and drinks, provides a sink for washing dishes, and cabinet space for storing food and kitchen utensils. In addition, this space can also be used to accommodate the storing of items necessary to cater large meetings or special functions. An option would be to also include an eating area as part of this component.

The facility shall be characterized by the following:

- Be fully furnished, equipped with CATV infrastructure and central air conditioning distributed control thermostats.
- The offices shall have enough physical space and closets for documents storage
- A space shall be dedicated for editing and publishing room i.e. it shall accommodate at least two plotters, one scanner, one digitizer, and three workstations work desks

ANNEX H - GENERAL ADMINISTRATION ACTIVITIES

The general administration activities are described below:

General Administrative Support. The Coordination Centre daily administration is handled by a Senior Office Manager and Secretariat that manages several administrative activities related to the Coordination Centre operation:

- Attend meetings with the Executive and Technical Committees and be responsible for preparation, coordination of review and distribution of minutes of meetings to the various stakeholders;
- Schedule and follow-up meetings of the GIO and the Technical Manager;
- Chair quality management initiatives in the Coordination Centre
- Maintain personnel files in coordination with the Personnel Affairs

Financial Management Support. The Coordination Centre will manage its own revenues and expenditures in coordination with the appropriate managing entity in the government. It will secure equipment and other resources. Basic activities carried out in this area may include:

- Develop Coordination Centre budget
- Monitor revenues and expenses
- Arrange for periodic financial audits

Supplies/ General Services. Running the Coordination Centre requires a wide range of stationery supplies, small equipment, and other incidental supplies. There are also specialized general services such as printing and copying that may be outsourced. The process for procurement and management of supply stores and the provision of fast and effective general services is important to maintaining staff productivity and efficient public services. Basic activities that often are carried out within this functional area include the following:

- Administer supply request and procurement;
- Maintain stores;
- Provide or arrange for general services (reproductions, fax, mailing, etc.).

Monitoring & Reporting. The monitoring and reporting function is an important activity in the Coordination Centre operation because it allows monitoring through systematic measurement and standard reporting the evolution of the BNSDI program. This activity consists of the following:

- Prepare and submit reports to the GIO and Technical Manager by the Coordination Centre staff and supervisors summarizing their routine activities and projections on monthly basis;
- Consolidate the input received from the Working Groups and interactions taking place with the BNSDI Community and present an integrated view of the work-in-progress including issues, opportunities and constraints;

- Prepare and submit quarterly reports by the GIO and Technical Manager to the BNSDI Steering Committees;
- Assess the deviations and/or compliances to the strategic plan and reflect the outcome of the assessment in the periodical reporting;
- Call out any issues related to the performance of the member agencies in relation to their service level agreements commitments or to the evolution of the BNSDI implementation projects according to the established rules and benchmarks;
- Propose any additions or enhancements to the BNSDI Program implementation based on an assessment of the internal and external environments and the evolution in maturity of the BNSDI Community.

Office Administration. One of the most important assets of the Coordination Centre is its people. The recruitment, hiring, management, reward, and retention and professional development of the organization's personnel are critical to the effective functioning of the organization. Effective personnel management involves ensuring that once sound business practices are defined that qualified people are hired or trained to carry out those jobs, and the programs are in place to provide these people with a healthy and productive work environment, competitive salary and other benefits, professional development opportunities and merit based salary and position enhancement. Typical activities in this functional area include:

- Manage staff recruitment and retention;
- Manage personnel records;
- Conduct performance reviews and provide systematic, merit-based salary and position advancements;
- Coordinate staff training and professional development.

ANNEX I - BNSDI AND COORDINATION CENTRE PROJECTS DEVELOPMENT

BNSDI Projects Development

Scope and Application

All significant BNSDI development proposals will need to be evaluated to determine potential impact to the community, and based on this determination of the appropriate measures to be taken in how the project or program is structured and run. The following presents a basic procedure by which information management related projects or programs are introduced and deliberated to determine the breadth of interest and potential impact of each. This deliberation will determine the range of stakeholders that need to be involved, and level of bureaucratic structure and oversight that needs to be applied to each initiative.

Summary of Method

The implementation steps have been adopted for use by the BNSDI from those used in ISO processes. This general approach is further illustrated in figure 3.

Proposal Stage (steps 1-3). The Proposal Stage defines the needs for and benefits of a standard. At the end of the Proposal Stage the BNSDI Community recognizes the proposal as a project and adds it to the projects' register, but work or funding for the project may not yet be identified.

Project Initiation Stage (step 4). The Project Initiation Stage defines the funding and administration for the BNSDI development project. The development methodology, work groups and members, and development schedule are documented. At the end of the Project Initiation Stage work begins on project development.

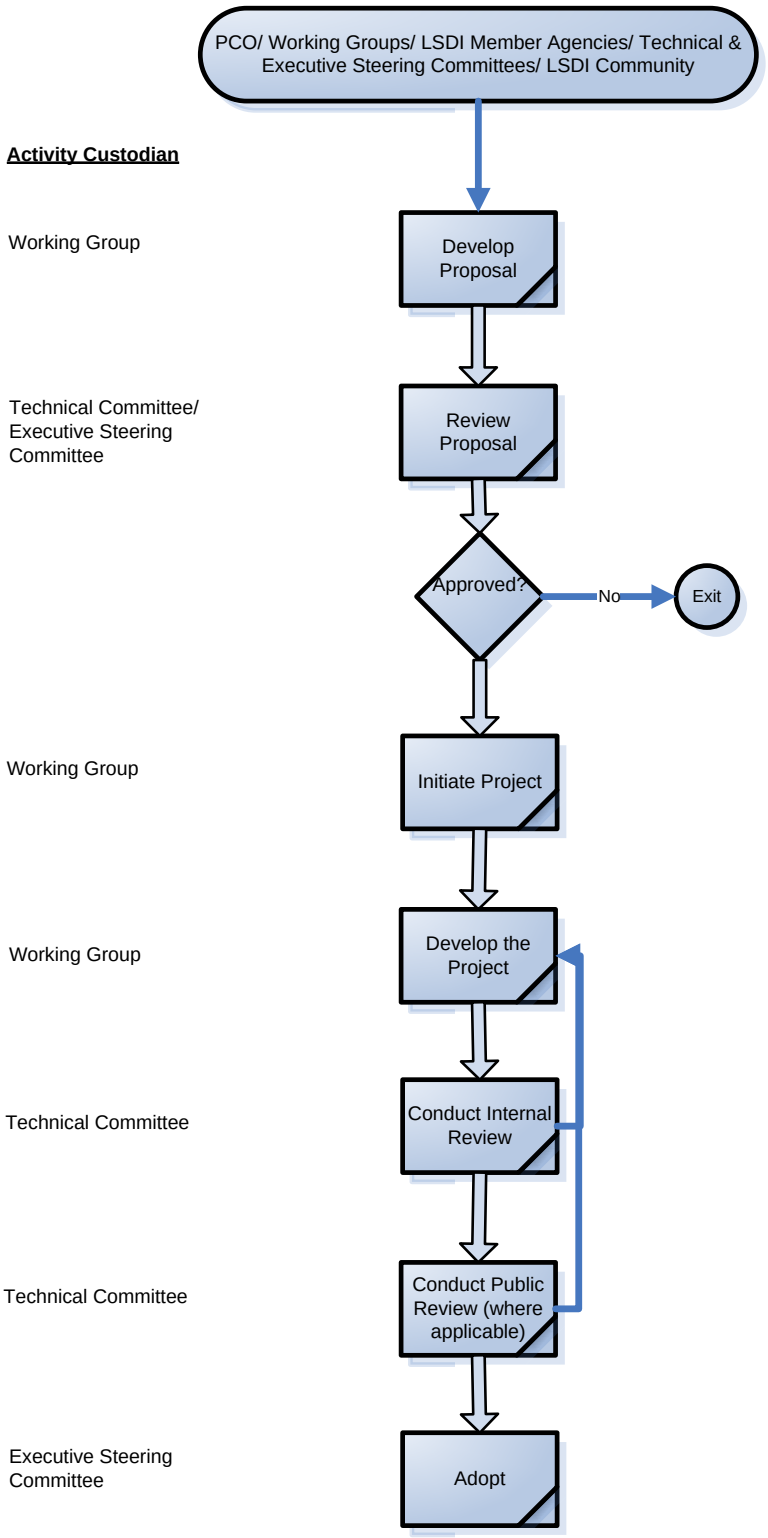
Project Development Stage (step 5-6). The project development stage receives comments and input from as project many constituent groups as possible. At the end of this stage, the project outcome is ready for public review.

Review Stage (steps 7-8). The first portion of the review stage is for public comment and official public review. The latter portion of this stage is for internal BNSDI format and integration review. At the end of this stage the project is ready for BNSDI approval.

Final Adoption Stage (step 9). The Final Adoption Stage is where the project outcome becomes an officially recognized BNSDI development.

In each step, an identified group has responsibility for the project; this is the project custodian. The project custodian is responsible for determining when the project is ready to advance to the next step. Each step is described below with a description of the activities and custodian for the standard. A diagram of the steps follows the descriptions.

Figure 12 BNSDI Projects Development Process Flowchart



Definitions

BNSDI Development Proposals. The BNSDI development proposals are triggered by a request or proposal by any member of the BNSDI Community for an BNSDI related development. The proposal could be related to metadata standard development, data standards development or any implementation project related to the BNSDI Program. The request may be initiated by the Executive Committee, Technical Committee, Coordination Centre, Sub-Committees and Working Groups. The Coordination Centre, will log the proposal and track its evolution in a projects tracking data base until its completion or closure.

BNSDI Project. As described in the implementation steps of the this SOP, an BNSDI project is a requirement that has been recognized by the BNSDI Community as important or critical and may thus be prioritized for implementation depending on the availability of budget and resources. It is important to highlight the fact that the Coordination Centre, as the technical arm of the BNSDI Technical Committee, has the capability through its existing resources and flexibility of mobilizing domain experts through hiring of consultants, has a freedom of maneuver for supporting the BNSDI Community through the processing of Requests for Projects (RFPs) and Requests for Information (RFIs) up to a certain threshold as described in the next SOP. Those support activities and/or services may include special or adhoc projects, consulting services, requests for information, data products and services that require limited resources. The resources requirements to handle the above services are reflected in the yearly operational budget of the Coordination Centre. When the projects become above a certain threshold as identified in the RFI/RFP SOP, then they follow-up the same development process outlined in the current SOP.

Working Draft Deliverables. The working draft project deliverables refer here to the outcome activities that will result from a specific project. In the case of standards development, this is referring to draft standards whereas in the case of data projects, the outcome is FGDS digital data, data maintenance procedures, configuration management procedures, etc…

Cautions

BNSDI FGDS data development projects shall be supplemented by data maintenance procedures that are put in place by the custodian agencies in order to ensure that the data updates are maintained and that the data quality will not degrade with time.

Interferences

BNSDI development projects may have dependencies and overlaps among each other that may necessitate close collaboration and cooperation among the various players in order to avoid negative interferences among them.

Personnel Qualifications

The following personnel qualifications have been identified to be needed:

Project Development Working Group. As described in the project implementation steps, a project is usually assigned by the Technical Committee to the Working Group that is in charge of a particular area of interest. However, the Working Group my split into sub-groups who conduct different missions or activities. The project in question may be assigned to one of the sub-working groups that is alternatively labeled here project development working group.

Project Manager. The project manager is usually designated by the Working Group in charge of the particular area of interest. The project manager could be the chair of the WG. Alternatively, the project manager could be selected as a member from the WG and/or the steward agency of that particular area of interest such as FGDS data custodian. Nevertheless, the WG is recognized to be the project custodian and should exercise its technical and executive oversight on the project development and report the outcome to the BNSDI Technical Committee (TC).

Project Team Members. Similarly to the project manager, the project team members are selected preferably from within the Working Group/ steward agency circle taking into consideration their involvement and experience in the subject matter. The project team members may be supported by local and/ or international consultants as deemed necessary by the project manager in consultation with the WG chair.

Contractors/ Consultants. Consultants and contractors may be hired on an as-need basis in order to support and execute the project implementation respectively.

Coordination Centre/ Technical Committee Secretariat. The TC secretariat and/or the Coordination Centre shall be in a vantage point in terms of capturing, tracking and reporting all developments taking place in relation to the BNSDI program. They shall use the necessary tools and methods to do so such as a Projects Tracking and Configuration Management database that is used by the Coordination Centre.

Equipment & Supplies

The following equipment and/ or supplies have been identified as necessary in order to conduct the SOP instructions effectively:

Configuration Management System. The configuration management process is inherent to the Coordination Centre daily operation. This applies to all components of system design; in particular the BNSDI implementation projects that have impact on the BNSDI Program evolution and performance.

Coordination Centre Projects Tracking Database. The Coordination Centre shall develop, deploy and maintain an application that is integrated with the configuration management system and the help desk support system through which all projects are logged and tracked since inception until completion or cancellation. The application includes also advanced reporting capabilities and is spatially enabled via a link to the geospatial portal metadata which permits to visualize the geographical extent of a data project, for example, where applicable.

Official Notification Framework. The BNSDI Community including Steering Committees, Coordination Centre and Working Groups shall utilize a common communication platform for formal and non-formal exchange of information related to BNSDI developments. This may include an e-mail and correspondence exchange mechanism such as BNSDI exchange server through which communication takes place, correspondence, notifications and documents are archived.

Projects Reporting Templates. The BNSDI Community shall develop and adopt normalized templates for reporting working drafts and work-in-progress related to BNSDI projects developments as well as minutes of meetings, working plans, annual reports, etc…

BNSDI e-community environment. The BNSDI community shall develop electronic forums for exchanging of ideas, knowledge and experience related to the BNSDI development initiatives. Those forums that can be organized in the form of chat rooms, e-conferences and webinars, blobs, etc…could be hosted on the BNSDI Web Portal and can be made accessible by all member agencies and working groups.

Procedures

The following implementation stages are described in detail.

Proposal Stage

Step 1 Develop Proposal. A new Belize Spatial Data Infrastructure (BNSDI) project proposal is submitted. The proposal identifies the need, the scope of the project, the benefits, the consequences of not implementing, and a date by which the project completion is needed. The proposal may be for development of a new standard, adaptation or adoption of an existing standard or the implementation of an BNSDI activity such as FGDS data developments or agency capacity building strengthening and community developments. The proposal may suggest a target authorizing body outside

of the Community, such as the National Institute for Standards (NIS), or International Standards Organization (ISO). A proposal may be made by any BNSDI subcommittee or working group, any member agency including local, national or regional government agencies. Project proposals will also be considered from non-government groups such as professional societies, private companies, and consortia which participate with the BNSDI Community in the development of the BNSDI.

Custodian: Working Group

Step 2 Review Proposal. The TC reviews and evaluates the project proposal using pre-defined criteria to be developed by the TC. If a proposal is approved, the TC will assign the approved project to the appropriate Working Groups and the TC secretariat/ Coordination Centre will register the proposal as an BNSDI approved project. When no appropriate group exists, the TC will identify the need for the creation of a new subcommittee or working group. If disapproved, the proposal is returned to the proposing entity with a statement outlining the objections to the proposal. When appropriate, the TC will suggest changes to the proposal that would make it acceptable. TC decisions may be appealed to the ESC. The proposed projects will be thoroughly assessed and documented in terms of key information, including, but not limited to:

- Proposed project/program description;
- Business impact, benefits, and projected lifecycle costs;
- Involved or affected stakeholders;
- Potential relationships and linkages to existing systems and existing or planned projects and programs;
- Define whether to be conducted in-house or outsourced;
- Proposed implementation approach and schedule;
- Issues, alternatives, opportunities, constraints and risks.

Custodian: Technical Committee

Step 3 Ad Hoc or Emergency Requests. It is recognized that ad hoc and emergency requests cannot be totally avoided, and that it will be desirable to be ready to handle special cases. Ad hoc or emergency requests may be submitted directly to the ESC for immediate consideration outside the systematic submittal proposal and configuration management process, if they are urgent or believed to be highly specialized and of interest only to the proposing party. The same basic information listed above will be required as part of this application, but in an abbreviated form that is sufficient for others to understand the purpose, scope and magnitude of the proposed project or program. This information should be logged to the BNSDI developments project tracking system and routed for preliminary assessment. The assigned Working Group will support the ESC in carrying out such rapid assessment.

Custodian: ESC

Project Initiation Stage

Step 4 Set Up Project. An BNSDI Subcommittee or Working Group is assigned by the ESC to lead the project implementation. A project leader is assigned for each project. This may be, but is not necessarily, the group leader (for example, a Subcommittee Chair). A subgroup of the Subcommittee or Working Group may be formed. A project editor should also be assigned for each project. The editor maintains all documentation and makes all official revisions to drafts of the project deliverables.

Custodian: BNSDI Subcommittee or Working Group.

Project Development Stage

Step 5 Produce Project Working Draft Deliverables. The project development Working Group proceeds with project development after determining a development approach. The group identifies existing related projects and projects development activities and assesses their relevance to the project in accordance. Depending on the scope and impact of any approved project there will be an appropriate level of oversight established to ensure that the project both accomplishes user needs and aligns with community interests through the entire project lifecycle.

Each significant project must be planned in detail, managed and controlled by the Project Manager. Project management involves balancing the scope of the work to be performed, the timeframe in which the project is to be accomplished, the resources available, and the overall quality and impact of the project outcomes. Project control involves comparing actual progress with the plan and taking corrective action when the two do not correspond. The project plan will be prepared by the Project Manager and will detail all the work that will need to be done. The plan also lists the individuals in the BNSDI Community whose skills are needed to work on the project, a work breakdown chart for the project, and a projected time line with milestones. The Project Manager may find it necessary to revise the plan during the process due to additional user input or discovery of new information. However, before beginning the development step, a plan must be laid out and users kept informed of changes, especially time line changes. The Project Manager should keep the Working Group informed of changes to the project plan as they occur. The WG, in turn, informs the TC if there are changes in the time line or other significant events.

In the case of standards, adoption of existing specifications, whether those be international, national, agency, or de facto standards should be considered first. If an existing standard cannot be adopted, the group may consider adapting an existing standard, which is using an existing standard as the basis for a new standard. When adoption or adaptation of existing standards is inappropriate or insufficient, the group may begin development of a new standard. The project group may involve representatives outside the BNSDI Community.

Project Team Composition and Responsibilities. The Project Team will vary greatly depending upon the scope and requirements of the project. Some projects will be heavily dependent upon only one technical expert as the source for the entire project. Others may depend upon team members from throughout the community. Inclusion in a Project Team is not dependent upon the agency to which the member is assigned, but is dependent upon his technical skills. The appointed Project Manager leads the project, assigning tasks to team members and completing specific technical tasks. The Project Manager must provide input on each individual to the WG and TC.

Project Members. Project members are selected by the WG from the pool of available steward agency personnel based on the skills required for completing a project. Project Team Members will be given assignments and due dates based on the project structure. The Project Team Member will update the Project Manager at milestones and upon completion of a task. All documentation that the Project Team Member is responsible for will be turned over to the Project Manager.

Project Manager. The Project Manager is assigned by the TC based on the recommendation of the WG. Planning, monitoring, and managing the project steps defined above are the Project Manager's primary responsibilities. The Project Manager must be flexible and adjust the project plan when required, informing the WG when significant milestones will not be met, and the WG will notify the TC where such delays may have some impact to the organization.

Project Management Coordination. The TC will track the progress of all projects and provide technical consulting as necessary. Any significant delays and problems encountered in any phase of the project must be brought to the attention of the ESC.

The project manager for any BNSDI developments project will be responsible for preparing and posting monthly status reports, as required by the project plan. This information will be posted to the Coordination Centre BNSDI developments Project Tracking System for common reference. Each status report will at a minimum address the following:

- General description of project progress and status;
- Larger projects will include summary of status by major component;
- Project schedule, including original schedule and any significant deviations;
- Identification of any issues that have arisen, and short description of how they are being resolved.

Custodian: Project Development Working Group.

Step 6 Review Working Draft Deliverables **-**The project development Working Group submits the working draft deliverables for pre-public review by the entities that would be

affected by the working draft, but at this stage the review is targeted and does not constitute an open, public review of the working draft. The WG coordinates the review as necessary. The working draft is revised as needed following BNSDI standards guidelines and best practices. After this step, the working draft becomes a TC Draft.

Custodian: BNSDI Subcommittee or Working Group.

Review Stage

Step 7 Review and Evaluate. The TC evaluates the TC Draft and approves it for further processing following the BNSDI Standards guidelines and criteria. If approved, the TC sends the TC Draft and a recommendation to advance the draft to public comment to the ESC where necessary e.g. in the case of standards development. If not approved, the TC Draft is returned to the Standard Development Group (Step 5). The final accepted program for the implementation of any significant BNSDI developments project/program will include the identification of a peer review panel assigned by the TC, and schedule for periodic project review and assessment. The members of the panel, and the scope and scheduling of such review will be dependent upon the specific project or program, and will be identified by the TC, in consultation with the WG. In general, the review will address the following topics:

<u>Project review and assessment</u>

- Project definition and formation;
- System development methodology;
- Project management methodology;
- Interactions and coordination with project stakeholders;
- Linkages to other BNSDI systems and/or projects (current or potential);
- Current status and expected outcomes;
- Plans for project follow-on;

<u>Committee assessment and recommendation</u>

- Recommendations for project refinements and follow-on plans;
- Recommendations for refinements to the project review panel;

<u>Revision of project and project plans</u>

- Refinement of current project plans and future follow-on;
- Review by peer review group;
- Technical Committee briefing;
- Submission of project refinement documentation for use in the BNSDI Configuration Management program.

Results from such review and assessment will be recorded to the Coordination Centre BNSDI developments project tracking system. The issues that arise during this review effort that cannot be resolved within the project will be referred back to the ESC for further deliberation.

Custodian: Technical Committee.

Step 8 Coordinate Public Review (where applicable). The TC secretariat announces and coordinates a public review of the Proposed BNSDI project. Coordinating Public Review encompasses making public announcements, handling distribution, and receiving public comments. At a minimum, the completed project is announced in the government Register with a request for comments. The announcement may also be published in professional journals, in trade magazines, and on the Internet to obtain the widest possible public exposure. The TC Secretariat, the responsible Subcommittee or Working Group, may conduct presentations about the standard at public meetings and conferences, including those involving state and local governments, and the private sector. The WG reviews and coordinates the feedback from the public, resolves all comments, determines what revisions are to be made and prepares a public response document. After satisfactory results with the public response, the draft is submitted again to the TC who in turn submits the draft to the ESC for final approval.

Custodian: Technical Committee.

Final Adoption Stage

Step 9 Act on the recommendations. The EC reviews the recommendation of the TC. If the recommendation of the TC is approved, the project final acceptance is signed by the BNSDI Program Chair. Approved BNSDI projects are submitted for final publication and public release. If not approved, the recommendation is returned to the TC.

Custodian: EC.

Quality Control & Quality Assurance

The BNSDI projects development and review process including multi-stage review and opening for public consultation provides a self-regulated quality control environment.

Reference

The following websites have relevant reference related to BNSDI projects development framework:

- FGDC
- INSPIRE
- ISO

Coordination Centre Project Management

Scope and Application

The Coordination Centre project management SOP refers specifically to the BNSDI projects that are managed by the Coordination Centre and focuses on the resource management perspective and internal organization by the Coordination Centre for handling projects of various scope and complexity.

Summary of Method

Several categories of projects and activities have been identified in the current SOP; they include:

- Projects and Adhoc services
- Operation services
- Administrative services

The emphasis is given to the projects and adhoc services that are organized in their turn into:

- Projects
- Special Projects
- Consulting
- Request for Information (RFI)

The nuances among the projects categories are described under the procedure section and are based on the amount of resources needed combined by the type of the activity.

The Definitions

Not Applicable.

Cautions

The Coordination Centre project management SOP helps the Coordination Centre create a mechanism through which community support services are provisioned in an organized and effective way. This will help to optimize the allocation of resources as well as to leverage the experience and lessons learned from historical and on-going projects. This can be achieved through integration with the Coordination Centre configuration management environment.

Interferences

The Coordination Centre staff are subject daily to interferences from the BNSDI Community through sudden requests for services with an urgent status portrayal by the requester who may be a VIP, agency executive, other prominent members of the BNSDI community as well as normal users and beneficiaries of the BNSDI platform. Unless the RFI/ RFP process is organized properly, this may cause interruption to the daily activities of the Coordination Centre staff and deterioration to their activity performance.

Personnel Qualifications

The following roles and profiles are involved in the Coordination Centre projects management SOP:

Coordination Centre Consultants. The Coordination Centre consultants are hired on occasional basis by the Coordination Centre in order to support the Coordination Centre staff in conducting their activities. This may include the hiring of resources to supplement coordination and support capabilities by the Coordination Centre for member agencies such as FGDS coordinators, GIS analysts, etc…or to provide specific services as instigated by the RFI/RFPs.

Coordination Centre staff. The Coordination Centre staff could be any employee of the Coordination Centre who is delegated by the GIO to perform a specific role related to Coordination Centre project management implementations. This is done in consultation with the direct supervisor of the staff where applicable.

Procedures

There is a limit to the amount and type of work that can be accomplished by Coordination Centre BNSDI developments staff in the various Departments and units. Formalized procedures are defined to use finite resources and targeted outsourcing to get the most good for Coordination Centre as a whole, and to leverage outsource contractor support wherever it makes sense to do so. The combination of formalized procedures, a freer flow of information and ideas, and the matrix organization approach will enable Coordination Centre to better prioritize work and develop a unified and standardized approach to providing BNSDI development services.

The Coordination Centre classifies its BNSDI development activities into three primary categories of work for the purposes of work planning and manpower allocation, including a) projects and ad hoc services, b) operational services, and c) administrative tasks. Any one the Coordination Centre departments can provide all classes of service, according to the roles and responsibilities as defined in its mandate. The following subsections address the work planning and manpower allocation issues and procedures.

Projects and Ad Hoc Services

1. Projects

Projects are any significant, extended package of work (requiring more than 80 hours of concentrated effort), require significant effort on the part of Coordination Centre staff, and may require other information technology resources, such as the purchase of new software, hardware, etc. Projects are managed by a designated Project Manager and are structured by the project management process outlined in this document. Projects can be initiated by

requirements from within Coordination Centre. Managing projects is described in more detail elsewhere.

2. Special projects

Special projects include unplanned requests from Coordination Centre upper management, the Executive Committees, or other VIP's. These requests are very important, very visible, and often very disruptive of other day-to-day activities that Coordination Centre staff need to carry out. A service bureau function will coordinate and handle most of these sorts of requests. On the other hand, manpower planning should always assume a certain allocation of time on a monthly basis that will need to be expended by the Coordination Centre staff to carry out special project work, based on roles and responsibilities and historical requests to the Office.

3. Consulting

Consulting tasks are ad hoc user requests that occur when a user problem is referred to a Coordination Centre staff. These are more informal and unstructured than formal projects, however, consultation requests received by Coordination Centre staff are logged with pertinent information and retained for future reference. Most consulting inquiries should be resolved at the Help Desk. The person assigned the task will resolve the consulting issue or refer it to an appropriate functional expert. If the consultant is working on a higher priority task, he will document the problem (letting the caller know when to expect a reply), research it and reply later. The Service Bureau must be kept abreast of all consulting requests that require more than 40 hours to resolve.

4. Request-for-information (RFI)

Requests for information for BNSDI developments may come from any department within the Coordination Centre, higher authorities, other agencies, institutions, and the public. A 'Request for Information' (RFI) service provides members of the BNSDI stakeholder community the ability to request products, information, or services from the Coordination Centre. This centralizes and simplifies stakeholder information requests through a centralized system, so that requests can be tracked, assigned, and managed. Importantly, this also provides the Coordination Centre with the capacity to evaluate frequent requests for common needs. As a result, future requestors can receive products similar to their needs, reducing the need to generate custom products. The basic process for managing any given RFI includes the following:

- Request received by the Coordination Centre by phone, email, personal request, or entry to the Coordination Centre web portal;
- Request reviewed, logged to system, and routed to appropriate department;
- BNSDI Service Bureau review request and respond directly if requires less than 4 hours. In some cases, this may require additional contact with the requestor to clarify what is needed;

- If more than 4 hours, notify department head for approval;
- If more than 4 hours but less than 80 hours, initiate an BNSDI Project in the project tracking system, without TC oversight;
- If greater than 80 hours, initiate an BNSDI emergency project request through procedures described previously.

Operational Services

1. Operations and Maintenance

Operations and Maintenance includes recurring tasks or trouble-shooting related to the reliability and availability of information resources. These tasks include all information technology resources that are available to the Coordination Centre staff such as the central facility, the data networks, and related software systems.

2. Help Desk

Via email or phone, Coordination Centre internal consultants staff the center to answer general or routine questions and resolve minor problems. Complex problems requiring lengthy solutions will be referred to the appropriate staff member. The rule-of-thumb is that routine consulting involves an issue that can be resolved within four hours. By directing consulting questions to a central point within Coordination Centre, users have a quicker response and each user receives the same solution. This also helps to reduce work interruptions and increase the productivity of Coordination Centre's staff work on assigned projects.

Administrative

Administrative tasks include tasks that are required for personnel administration (evaluations and awards), or certain types of safety or supervisory training. Not all administrative tasks are specifically related to the business of BNSDI developments, but are required administrative tasks and must be accomplished in a timely manner to ensure that mandatory guidelines are met. Many administrative tasks are recurring, so they can be fit into workforce loading plans.

Equipment & Supplies

The following equipment is identified to be needed or have dependency with the Coordination Centre project management SOP:

> ***Configuration Management System.*** The configuration management process is inherent to the Coordination Centre daily operation. This applies to all components of system design; in particular the BNSDI implementation projects that have impact on the BNSDI Program evolution and performance.

Coordination Centre Projects Tracking Database. The Coordination Centre shall develop, deploy and maintain an application that is integrated with the configuration management system and the help desk support system through which all projects are logged and tracked since inception until completion or cancellation. The application includes also advanced reporting capabilities and is spatially enabled via a link to the geospatial portal metadata which permits to visualize the geographical extent of a data project, for example, where applicable.

Helpdesk. The helpdesk will be developed and deployed by the Coordination Centre in such a way that it is integrated with the day-to-day operation of the Coordination Centre in relation to configuration management, project tracking and reporting. In this way, management can check, at any one time, the status or work-in-progress in any one of the implementation projects.

Quality Control & Quality Assurance

In order to ensure effective performance of the Coordination Centre Projects Management SOP, an internal periodical review shall be performed by the Coordination Centre management in order to check the applicability of the SOP and its achievement of its organizational and institutional objectives. This can be done on a semi-annual basis through the configuration management plan internal audit or quality management reviews.

Reference

The Coordination Centre project management SOP shall be reflected in the future quality management operating procedures in the Coordination Centre. In addition, the Coordination Centre project management SOP is recognized as a complement of the BNSDI projects development process SOP that is described in the previous section.

ANNEX J - STANDARD SLA TEMPLATE AND MASTER SERVICE LEVEL AGREEMENT

The standard SLA template includes the following chapters and sub-chapters:

Introduction

- Purpose & Objectives
- Parties to the Agreement
- Commencement Date
- Duration of the Agreement
- Non-Exclusive Agreement
- Definitions

Scope of Work

- Standard Services
- Non-Standard Services
- Service Availability
- Place of Service Delivery
- Changes to Services
- Client Delays

Performance, Tracking and Reporting

- Key Personnel Changes
- How Each Individual Service Will Be Monitored
- Benchmarks, Targets and Metrics To Be Utilized
- Service Level Reporting
- Service Review Meetings

Problem Management

- Support and Service Desk Services
- Problem Definition

Compensation

- Professional Fees
- Invoices
- Payment Terms
- Taxes
- Interests For Late Payment

Customer Duties and Responsibilities

- Processing and Authorization of Invoices
- Client Personnel, Facilities and Resources
- Training on Specialized Equipment
- Approvals and Information

Warranties & Remedies

- Quality of Service
- Indemnification
- Third Party Claims
- Remedies for Breaches
- Exclusions
- Force Majeur

Security

- Physical Access
- Logical Access
- Compliant with Client Security Policies
- Information and Data Security Measures
- Disaster Recovery
- Encryption

Intellectual Property Rights & Confidential Information

- Intellectual Property Rights
- Confidentiality
- Court Orders
- Destruction of Data and Records

Legal Compliance and Resolution of Disputes

- Governing Law
- Export Control
- Information Resolution
- Arbitration
- Limitation of Action
- Duration of Liability

Termination

- Termination After Initial Term
- Termination For Convenience

- Termination for Cause
- Payment of Termination

General

- Notices
- Standard of Care
- Assignment
- Entire Agreement
- Severability
- Changes to the Agreement
- Non-Solicitation
- Exhibits

Signatures

Master Service Level Agreement (MSLA)

1 Introduction

1.1 Purpose & Objectives

The purpose of this Master SLA is to describe the general agreements that govern the relationship between the Coordination Centre and the member agencies of the BNSDI community.

1.2 Parties to the Agreement

Party 1: Coordination Centre
Party 2: Member Government Entity

Beneficiary: Client i.e. member government entities or third parties benefiting from the AD-BNSDI data services offered by the member government entity either directly or via the Coordination Centre

1.3 Commencement Date

The commencement date is reflected in the Addendum SLA that is signed between the Coordination Centre and the individual Entity.

1.4 Duration of the Agreement

The duration of the agreement is reflected in the Addendum SLA that is signed between the Coordination Centre and the individual Entity.

1.5 Non-Exclusive Agreement

This Master SLA is by default non-exclusive. Any specifics in the relation between the Coordination Centre and the individual Entity are reflected in the Addendum SLA.

1.6 Definitions

1 "Metadata" means information describing spatial data sets and spatial data services and making it possible to discover, inventory and use them.

2 "BNSDI member Entity" refers to the government Entity that is a member and a key stakeholder of the BNSDI community.

3 "Third party" refers to any Entity, organization or institution that is not part of the BNSDI community such private sector, educational institutions, non-governmental organizations, etc…

4 "Interoperability" of data sets refers to the adoption of common data structure and unique identification codes for spatial objects by various data sources that are created for different purpose. This facilitates cross-referencing information for the same physical objects with spatial representation.

5 "Spatial data and related services" refer to the BNSDI FGDS data sets that are captured, maintained and disseminated by the BNSDI member Entity as a steward and custodian of the data topics under consideration.

2 Scope of Work

2.1 Standard Services

The member Entities of the BNSDI community shall agree to provide the following services:

- Metadata
- Spatial Data Sharing
- Spatial Data Services

The scope of the spatial data sharing services that are offered by an BNSDI member Entity is supplemented by requirements that are described in the following documents or references:

- Addendum SLA
- BNSDI Projects Development SOP

- FGDS Data Maintenance SOP

2.1.1 Metadata

1 BNSDI member Entities shall ensure that metadata are created for the spatial data sets corresponding to the themes that are under their custodianship (refer to attachment) and that those metadata are kept up to date.

2 Metadata shall include information on the following:

a) Conditions applying to access to, and use of spatial data sets and, where applicable, corresponding fees;
b) The quality of spatial data, including whether they are validated and the quality measures, specifications and procedures that were adopted for data validation;
c) The custodian Entities i.e. responsible for establishment, management, maintenance and distribution of spatial data sets and services including contact information;
d) Limitations on public access and the reasons for such limitations in accordance with government laws;

3 Entities shall take the necessary measures to ensure that metadata are complete and of a quality sufficient to fulfill the purpose set out in the metadata definition

2.1.2 Spatial Data Sharing

1 Implementation of spatial data sets and related services shall be based on the definition and classification that were adopted for the fundamental geographic data sets (FGDS) and the way in which those spatial data are geo-referenced;

2 Member Entities shall ensure interoperability of spatial data sets through the provision of the following:

a) Solutions to ensure unambiguous identification of spatial objects (place code), to which unique identifiers under existing national systems can be mapped in order to ensure interoperability between them;
b) The relationship between spatial objects;
c) Information on the temporal dimension of the data;
d) Updates of the data.

3 Consistency of information shall be maintained for the spatial data sets between items of information which refer to the same location or between items of information which refer to the same object represented at different scales;

4 The BNSDI member Entities shall ensure that any information, including data, codes and technical classifications, needed for compliance with spatial data sets implementation is made available to member Entities or third parties in accordance with conditions that do not restrict its use for that purpose;

5 In order to ensure that spatial data relating to a geographical feature the location of which spans the frontier between two or more member Entities are coherent, member Entities shall, where appropriate, decide by mutual consent on the depiction and position of such common features.

6 Each BNSDI member Entity shall adopt measures for the sharing of spatial data sets and services among the member Entities. Those measures shall enable those member Entities to gain access to spatial data sets and services, and to exchange and use those sets and services. The measures provided for by the member Entity shall preclude any restrictions likely to create, at the point of use, practical obstacles to the sharing of spatial data sets and services;

7 The provisions of paragraph 6 do not prevent member Entities that supply spatial data sets and services from licensing them to, and requiring payment from, the member Entities or institutions and bodies of the community that use these spatial data sets and services. The mechanisms for sharing spatial data sets and services between government and other public administrations and natural or legal person performing public administrative functions under national law may involve laws, regulations, licensing or financial arrangements or administrative procedures, for instance to protect the financial viability of those member Entities that have a duty placed on them to raise revenue;

8 By way of derogation from paragraphs 6 & 7, member Entities may limit sharing when this would compromise the course of justice, public security, national defense or international relations;

9 The provisions for data sharing and services do not affect the existence of member Entities' intellectual property rights;

10 Member Entities shall ensure that appropriate structures and mechanisms for coordinating the contributions of all those with an interest in their infrastructures for spatial information. These structures shall coordinate the contributions of, inter alia, users, producers, added-value service providers and coordinating bodies, concerning the identification of relevant data sets, user needs, the provision of information on existing practices and the provision of feedback on the implementation of data sharing and related services;

11 The BNSDI Executive Committee shall be responsible for coordinating the infrastructure for spatial information, as referred to in the executive mandate and this

Master SLA, in the community at community level and shall be assisted for that purpose by member Entities representatives. Each member Entity shall designate a contact point to be responsible for contacts with the Executive Committee in relation to this agreement;

12 The spatial data sharing and related services implementation shall take due account of standards adopted by the national and international bodies that are approved by the BNSDI Technical Committee;

13 Member Entities shall monitor the implementation and use of their spatial data infrastructures. They shall make the results of this monitoring accessible to the BNSDI Executive Committee and to the public on a permanent basis;

14 Member Entities shall report periodically a summary description of:

e) How public sector providers and users of spatial data sets and services and intermediary bodies are coordinated, and of the relationship with the third parties and of the organization of quality assurance, as far as practicable;
f) The contribution made by member Entities or third parties to the functioning and coordination of the infrastructure for spatial information;
g) Information on the use of the infrastructure for spatial information;
h) Data-sharing agreements between member Entities where applicable;
i) The costs and benefits of implementing the sharing of spatial data sets and services.

2.1.3 Spatial Data Services

1 The Executive Committee shall establish and operate an BNSDI geo-portal at community level.

2 Member Entities shall provide access to the spatial data services through the BNSDI geo-portal referred to in paragraph 1. Member Entities may also provide access to those services through their own access points.

3 Member Entities shall establish and operate the following spatial data services:

a) Discovery services making it possible to search for spatial data sets and services on the basis of the content of the corresponding metadata and to display the content of the metadata;
b) View services making it possible, as a minimum, to display, navigate, zoom in/out, pan, or overlay viewable spatial data sets and to display legend information and any relevant content of metadata;
c) Download services, enabling copies of spatial data sets, or parts of such sets, to be downloaded and, where practicable, accessed directly;
d) Transformation services, enabling spatial data sets to be transformed with a view to achieving interoperability;

e) Customized services allowing spatial data services to be invoked from the BNSDI Geospatial Portal or directly via the Entity node.

Those services shall take into account relevant user requirements and shall be easy to use, available to the public and accessible via the Internet or any other appropriate means of telecommunication.

4 For the purposes of the data services referred to in paragraph 3(a), as a minimum the following combination of search criteria shall be implemented:

a) Keywords;
b) Classification of spatial data and related services;
c) The quality of spatial data, including whether they are validated;
d) Geographical location;
e) Conditions applying to the access to and use of spatial data sets and services;
f) The Entities responsible for the establishment, management, maintenance and distribution of spatial data sets and services.

5 Every member Entity shall ensure that other member Entities are given the technical possibility to link their spatial data sets and services to the spatial data services that are offered by that individual Entity. This service shall also be made available upon request by third parties whose spatial data sets comply with data standards requirements in regard to metadata, spatial data and data interoperability.

6 By way of derogation from paragraph 3, 4 & 5, member Entities may limit public access to spatial data sets and related services where such access would adversely affect any of the following:

a) The confidentiality of the proceedings of public authorities, where such confidentiality is provided for by law;
b) International relations, public security or national defense;
c) The course of justice, the ability of any person to receive a fair trial or the ability of a public authority to conduct an enquiry of a criminal or disciplinary nature;
d) The confidentiality of commercial or industrial information where such confidentiality is provided for by national or Community law to protect a legitimate economic interest, including the public interest in maintaining statistical confidentiality and tax secrecy;
e) Intellectual property rights;
f) The confidentiality of personal data and/or files relating to a natural person where that person has not consented to the disclosure of the information to the public, where such confidentiality is provided for by national or Community law;
g) The interests or protection of any person who supplied the information requested on a voluntary basis without being under, or capable of being put

under, a legal obligation to do so, unless that person has consented to the release of the information concerned;

7 The grounds for limiting access, as provided for in paragraph 3, shall be interpreted in a restrictive way, taking into account for the particular case the public interest served by providing this access. In every particular case, the public interest served by disclosure shall be weighed against the interest served by the limiting or conditioning the access.

8 Member Entities shall ensure that the requirements of directives by government, parliament and councils in charge of information laws adoption such as the protection of individuals with regard to the processing of personal data and on the free movement of such data is complied with.

9 Member Entities shall ensure that:

a) The services referred to in paragraph 3(a) are available to the public free of charge;
b) The services referred to in Article 3(b) are, as a rule, available to the public free of charge. However, in cases where charges and/or licenses are an essential precondition to maintain the spatial data sets and services or to fulfill requirements of already existing international spatial data infrastructure in a sustainable way, member Entities may apply charges and/or licenses either to the person providing the service to the public, or, where the service provider chooses, to the public itself.

10 Data made available through the view services mentioned in Article 3(b) may be in a form preventing their re-use for commercial purposes.

2.2 Non-Standard Services

Not Applicable

2.3 Service Availability

2.3.1 Place of Service Delivery

The services will be delivered electronically or physically through one of the following:

- BNSDI Geospatial Portal
- Member Entity node
- Downloads from the GeoPortal website or Entity website
- Physical delivery (on CD or hardcopy)

2.3.2 Changes to Services

The BNSDI member Entities or Coordination Centre shall notify the other BNSDI member Entities and third party of changes to the agreed upon services through appropriate communication channels (refer to the notices in section 1.13.1).

2.3.3 Delays

Any delays in the provision of the data services shall be notified through adequate communication channels as described in the section above.

2.4 Performance, Tracking and Reporting

2.4.1 Key Personnel Changes

The BNSDI member Entity has assigned a Technical Coordinator in order to maintain the agreement as reflected in the Master SLA and related SLA addendum. Any decision for replacement of the Technical Coordinator shall be notified to the Coordination Centre and through the Coordination Centre to the rest of the BNSDI member Entities.

2.4.2 How Each Individual Service Will Be Monitored

The BNSDI member Entity shall dedicate BNSDI/ EGIS staff that will be monitoring the quality of their provisioned data services. This can be achieved through automated and manual monitoring and reporting tools.

2.4.3 Benchmarks, Targets and Metrics To Be Utilized

Every member Entity shall develop and publicize through the Coordination Centre its own benchmarks, targets and metrics for monitoring the quality of its services and customers experience. The periodical reports that are generated by the Entity would refer to the measured metrics, comparison to benchmarks and fore sought action plan.

2.4.4 Service Level Reporting

Every member Entity would reflect in its quarterly performance reports its assessment of its service level achievement compared to the set benchmarks and targets.

2.4.5 Service Review Meetings

Every quarter, the Entity representatives will conduct internal service review and supplement that by review meetings held with the Coordination Centre and Entity representatives as appropriate. The final review meetings will be compiled and publicized with reference to the resulting action plan.

2.5 Problem Management

2.5.1 Support and Service Desk Services

Every member Entity shall dedicate support and service desk services that are available during the government working hours.

2.5.2 Problem Definition

The helpdesk environment will log and trace all customers' inquiries or complaints and ensure that all tickets are closed satisfactorily.

2.6 2.6 Compensation

2.6.1 Professional Fees

As pointed out in the data sharing and data services sections above and the BNSDI Policy Framework, the member Entities may charge fees for the provision of spatial data services where appropriate. Information about the fees structure should be made easily available as a minimum through the Entity website, the BNSDI Geospatial Portal website and Entity desk service.

2.6.2 Invoices and payment terms

Invoices shall be settled within a reasonable time frame between the client and the service provider.

2.6.3 Taxes

Prevailing government taxes shall be charged on top of the basic services according to existing fiscal laws.

2.6.4 Interests For Late Payment

To be defined on case by case basis.

2.7 Customer Duties and Responsibilities

2.7.1 Processing and Authorization of Invoices

The clients shall process and authorize the invoices in due time.

2.7.2 Client Personnel, Facilities and Resources

The client shall provision the necessary resources including personnel, equipment and physical facilities in order to access and process the provided data services for its internal use and benefit.

2.7.3 Training on Specialized Equipment

The BNSDI member Entity shall provide the client with the necessary support in order to access and utilize the offered data services effectively. This may include helpdesk, access to webinars, training manuals, etc…On the other hand, the client shall allocate qualified resources and/ or provide them with the necessary training in order to utilize the services efficiently.

2.8 Warranties & Remedies

2.8.1 Quality of Service

The BNSDI member Entity commits to the provision of the data services with a satisfactory quality to the client. In the case of complaints raised by the client either directly to the member Entity or via the Coordination Centre, then the member Entity should react to the customer complaint and allocate the necessary resources in order to resolve the problem satisfactorily.

2.8.2 Indemnification and third party claims

The BNSDI member Entities are not liable to any indemnification or legal claims by third parties regarding their provided services.

2.8.3 Exclusions

Exclusions to the promised services shall be described clearly in the agreement.

2.8.4 Force Majeur

In the case of force majeur, the member Entity is not obligated to the provision of its services that are described in this agreement.

2.9 Security

2.9.1 Physical Access

The BNSDI member Entity and the Coordination Centre shall deploy necessary security measures against physical access and tampering of their FGDS data services.

2.9.2 Logical Access

The BNSDI member Entity and the Coordination Centre shall deploy necessary security measures against logical access and tampering of their FGDS data services.

2.9.3 Compliant with Client Security Policies

The BNSDI member Entity shall ensure that the data services that are downloaded by the clients are free from viruses and related threats.

2.9.4 Information and Data Security Measures

The BNSDI member Entity and the Coordination Centre shall put in place the necessary tools, procedures and methods in order to protect data security.

2.9.5 Disaster Recovery

The BNSDI member Entity and the Coordination Centre shall deploy the necessary disaster recovery environments in order to preserve the data in the case of natural or man-made disasters.

2.9.6 Encryption

The data transfer between the member Entity node and the client site shall be protected by standard encryption and security digital signature where appropriate.

2.10 Intellectual Property Rights & Confidential Information

2.10.1 Intellectual Property Rights

Provision of data services to the BNSDI community does not prevent the BNSDI member Entity from applying and protecting intellectual property rights.

2.10.2 Confidentiality

Confidentiality of information shall follow the existing legislation in relation to protecting private information. On the other hand, the client should refrain from providing access or use of the information to third parties without consent of the provider.

2.10.3 Court Orders

Violations of intellectual property rights and confidentiality of information will result in the recurrence to prevailing laws and jurisprudence decisions. Libyan local law shall apply in this case.

2.10.4 Destruction of Data and Records

The destruction of data and records shall be according to the data retention policy that is agreed upon by the BNSDI community via decisions that are taken collectively by the member Entities i.e. the BNSDI Technical Committee decisions. Those decisions are reflected in the Service Level Agreements between the Coordination Centre and the individual member Entities.

2.11 Legal Compliance and Resolution of Disputes

2.11.1 Governing Law

In the case of litigation, the local Libyan law shall apply.

2.11.2 Export Control

The data that is provisioned by an BNSDI member Entity to other government Entities or third parties shall not be sent by the latter, electronically or physically, to outside Libya without a written consent of the provider.

2.11.3 Information Resolution

Information resolution including quality, accuracy and timeliness shall be expressed clearly in the SLA addendum.

2.11.4 Arbitration

Arbitration shall follow international law for arbitration.

2.11.5 Limitation of Action

The BNSDI member Entities are not liable either directly or indirectly in the case where they fail to provide the data services that are reflected in this agreement. However, the BNSDI steering committees (technical and executive) reserve the right to transfer the data custodianship to another Entity in case the latter does not meet the service level agreements to which it has committed itself. In this case, the Entity will be notified officially by the governing body of such decision after a formal process of escalation by the BNSDI steering committees. The entire resolution process and settlement for alternatives shall be resolved within a not-to-exceed period of 6 months.

2.11.6 Duration of Liability

In the case of infringement that is caused by the client in relation to the use of the data, the duration of liability shall be defined as part of the litigation resolution process.

2.12 Termination

2.12.1 Termination After Initial Term

The agreement shall be renewed automatically after the initial term unless there are justifiable reasons that preclude from doing so.

2.12.2 Termination For Convenience

The BNSDI member Entities have an obligation to contribute to the capture, maintenance and dissemination of FGDS data sets for data topics that fall under their stewardship. From this perspective, the notion of termination for convenience shall not apply.

2.12.3 Termination for Cause

The Entity may request, in the case of difficulties, the temporary transition or support of the data maintenance activity by another government Entity as an interim measure.

2.12.4 Payment of Termination

Not applicable.

2.13 General

2.13.1 Notices

Notices shall be delivered to the parties of this agreement with 48 hours. The notices shall be acknowledged by the receiving party and enacted upon within 20 working days.

2.13.2 Changes to the Agreement

Any desires for changes to the agreement can be raised during the periodical meetings of the BNSDI steering committees or through formal notification. The changes can be agreed upon mutually between the Coordination Centre and the BNSDI member Entity and take effect according to the schedule outlined in the documented decisions.

2.14 Signatures

Party 1: Coordination Centre ***Party 2:*** BNSDI Member Entity

Organization: ---------- Organization: ----------

Name: ---------- Name: ----------

Signature: ---------- Signature: ----------

Attachments

- Addendum SLA

ANNEX K - CONFIGURATION MANAGEMENT PLAN

1. Scope and Application

The primary goal of the ITIL Configuration Management process is to achieve, through the implementation of Asset Management, a single integrated configuration management database for all configuration items. The application seamlessly supports Incident Management, Problem Management, Change Management, and Service Level Management processes. Configuration Management function is very critical for a successful and smooth operation and maintenance of the BNSDI Program. It deals with the entire process of change and configuration management related to the BNSDI system components i.e. data, applications, hardware, staff capacity building and procedures. It includes, but is not limited to, the following:

- System development automation procedures
- System maintenance automation procedures
- Logging and tracking BNSDI Enhancement Requirements
- BNSDI System Administration
- Helpdesk
- Other requirements

The Coordination Centre will design and develop a configuration management strategy and internal support capacity, systems and tools that will be needed to support and manage the BNSDI Program operation. A configuration management plan should be prepared. This will ensure that the Coordination Centre staff that will be in charge of the system operation and maintenance will have all the necessary tools and procedures to support their activities. This configuration management plan should be in line with the existing configuration management policies adopted by the Coordination Centre. The objective is to define a configuration management process to manage the system routine operation activities:

- Change Management
- Quality Assurance/Quality Control
- Version Control
- Release Management

In order to support the above endeavor, the Coordination Centre shall procure, customize and deploy a complete configuration management system.

2. Summary of Method

The Coordination Centre shall develop and install a Configuration Management System. Once the system is installed, the Coordination Centre will assign a Configuration Management Lead to be responsible for maintaining the system. This Coordination Centre Configuration Management Plan provides detailed guidance for implementing configuration management (CM) for project documentation, software, and hardware, and at the project-wide level. The CM Plan is not intended to provide comprehensive guidance for performing

day-to-day CM activities on the Coordination Centre BNSDI projects, but does provide the structured framework from which project processes and procedures should be developed. This CM Plan will incorporate the following:

- Configuration item (CI) identification schema.
- System and subsystem baselines.
- Change request (CR) classification schema.
- CM organizational components and hierarchy.
- Change request review and approval process.
- Change status reporting

The Coordination Centre CM encompasses:

- CM of BNSDI projects documentation, hardware and software.
- CM of BNSDI subproject documentation, hardware, and software, as they relate to the project system baselines.

The proposed CM Plan shall describe the following:

- The BNSDI CM organization and its responsibilities.
- The processes and procedures to be applied throughout the present and future Coordination Centre BNSDI projects lifecycle.
- How CM controls and changes to those products will be applied towards Coordination Centre BNSDI products.
- How CM controls will be applied towards system changes that affect the design, development, or operation of products, subprojects, or systems within Coordination Centre BNSDI.

The CM activities described in this plan provide the Coordination Centre management that ability to identify, control, and manage all configuration items (CIs) comprising or related to the BNSDI project (s). CIs are any document, hardware, or software item – or aggregation of documents, hardware, or software – requiring configuration control. The CM activities will also provide status reporting of all proposed, in process, approved, and disapproved changes to the BNSDI project (s). In addition, the CM activities that will be described in this plan will provide Coordination Centre management with additional CM control of CIs by providing a mechanism for determining the impact of change requests from one BNSDI system to another. The proposed CM Plan will reflect recognized industry concepts and practices. It will be a living document. The Plan will be reviewed and updated at the end of each life cycle phase, among with other project documents. These reviews will provide an appropriate forum for reassessing CM processes, procedures, and organization in light of specific decisions regarding implementation.

3. Definitions

The following definitions were identified:

Configuration Management (CM). Configuration Management is the process, approach for introducing a Configuration Management organizational framework in a team or specific organization. The Configuration Management process, which supports to streamline the activities of the staff especially in relation to the change and maintenance management of existing and planned information management solutions, is supported by the development of a plan and the deployment of the tools that support execution of the plan as well as integration within the routine operational activities in the Entities.

Configuration Management Plan (CMP). The Configuration Management Plan (CMP) is developed in order to support the introduction of a configuration management process within the organization.

Configuration Management software. The configuration management software is an application that is procured, customized and deployed in order to support the organization in the management of the configuration management process and the maintenance of its components.

Configuration Items. The configuration items are the components of the CM process that will be tracked and updated through their entire lifecycle.

4. Cautions

Configuration Management is one of the topics that are less understood by business leaders and may necessitate an important share of awareness, commitment and resiliency by management.

5. Interferences

In order for the configuration management developments to be effective, the following dependencies and variables shall be considered that have direct impact on the Configuration Management Plan performance:

- Development of a Configuration Management Plan where configuration management roles and responsibilities are defined
- Incorporation of the configuration management business rules in the configuration management software
- Ensuring that the configuration management plan involves change management and control of the various system design components i.e. software, data, hardware, training and procedures
- Integrating the CM software with the help desk functions and the document management system in place
- Performing periodical audits and preparing management reports in order to ensure that agreed upon CM procedures are being followed

6. Personnel Qualifications

The following functional profiles will need to be handled by the Coordination Centre configuration management staff:

Configuration Management Operational Plan Lead. The Lead of the Configuration Management Operational Plan is the person in charge for the development, operation and maintenance of the entire CM plan. This role could be assigned to the GIO or the Technical Manager.

Configuration Management Auditor. The CM auditor is the person in charge for conducting a periodical audit, once or twice per year, on the performance of the CM program. This person should be independent from the CM development and operational roles assigned to the various members of the Coordination Centre staff. It is preferable that this person is assigned from outside the Coordination Centre office.

Configuration Management Project Lead. The Configuration Management Operational Plan creates profiles for each one of the BNSDI projects under implementation. Therefore, the project lead is the person assigned for the creation, development and maintenance of the Configuration Identification components related to that particular project.

Configuration Management System Component Lead. The lead of a CM System component could be a person with specific expertise in that component i.e. Business and Institutional, Computing Infrastructure, Application Software, Data, and Staff Development, Recruitment and Retention.

Quality Management Coordinator. The quality management coordinator will be the person in charge for ensuring the cooperation and synchronization between the Configuration Management Plan and the Quality Management Plan.

7. Equipment & Supplies

The following tools and related developments have been identified as needed by the CM Plan:

Configuration Management Software. A CM software will be procured, customized and deployed in order to meet the Coordination Centre requirements including the integration workflows with the BNSDI stakeholder Entities. The software will be configured to accommodate the five components of the BNSDI system design that are described in the attachments to the current SOP. The CM software shall have flexibility for integration with supplementary information management solutions as described below as well as the capability to custom-design and generate reports on the fly.

Interface and/or integration with HelpDesk. The helpdesk solution that is used by the Coordination Centre shall be fully integrated with CM software. In this way, BNSDI

development activities and projects will be tracked, at any one time, through an integrated change management and configuration management environment.

Integration with Electronic Document Management System. The CM software shall be fully integrated with the Electronic Document Management System. In this way, the documents change management process related to the routine Coordination Centre operation will be integrated in the configuration management process.

Alignment with ISO 9000 Certification tools and resources. The Configuration Management Operational Plan will overlap and supplement activities that are overseen by the ISO 9000 system. Therefore, it will be important that both programs are coordinated through design and implementation including the use of tools and methods for tracking changes to documentation and operating procedures.

8. Procedures

Configuration management is the implementation and execution of processes and procedures that ensure the systematic and orderly control of a system and its components throughout their life cycle. CM ensures system integrity by controlling changes to any component of a system. CM involves the disciplined application of technical and administrative management of four purposes:

- Identify and document functional requirements and physical system component characteristics;
- Control system component changes;
- Record and report change request, processing and implementation status;
- Audit system components to verify conformance to requirements, specifications, and/or technical documents.

CM is key in all project environments. It is directly related to project management and quality. Effective CM is necessary to:

- Prevent delivery of incorrect products;
- Avoid high rework costs of incorrect product builds;
- Provide processes for effective control of changes;
- Manage product information;
- Quantify the impact of changes;
- Ensure reliability and a quality environment.

CM benefits include:

- Improved management of requirement change;
- Better impact analysis;
- Improved management of product information;
- More accurate project, and subproject status information;
- Increased support in managing risk;
- Greater synergy within systems, projects and subprojects.

The immediate benefits of the Configuration Management System that will be developed and deployed by the Coordination Centre can be summarized as follows:

- All the major change management activities on the BNSDI Program development starting from its strategic system design stage and later its implementation and commissioning stages will be managed, tracked and archived through clearly defined policies and procedures;
- The entire baseline program and implementation projects documentation will be properly archived and referenced including version management and brief updates on version changes;
- The Coordination Centre would have established a configuration management organization structure that will serve as a common framework for all future change management activities on the BNSDI Program;
- The entire procedures related to system operation and maintenance would have been developed by the Coordination Centre and incorporated under the proposed configuration management organization structure. This may include, for example, logging, tracking the status and processing change requests on the system design components such as data models, applications, computing infrastructure, training, business processes, etc…;
- The CM development process would prepare Coordination Centre staff since the early project implementation i.e. starting form the system strategic design and onward to be deeply involved in the system configuration management process including its design and implementation.

The following items are typically subject to CM:

- All required documentation.
- All operational software and hardware components.
- All support software and hardware.
- Any additional items considered necessary, including test data, test cases, and other resources used to test the acceptability of a system component.

CM provides visibility into the status of evolving systems. Software developers, testers, project managers, Quality Assurance (QA) personnel, and customers benefit from CM information. CM answers the following:

- What changes were made to the system?
- When were the changes to the system made?
- Who made changes to the system?
- Why were the system changes made?

The CM discipline comprises five requirements categories:

- CM organization requirements;
- Configuration identification requirements;
- Configuration control requirements;
- Configuration status accounting requirements;
- Configuration auditing requirement.

These five categories are the foundation for successful CM. Subsections 8.8.1 though 8.8.5 describe each of the five categories.

i. Configuration Management Organization Requirements

CM organization regulates established CM practices (such as configuration identification, control, status accounting and auditing) and facilitates coordination among systems that interface or have design, functional, and/or operational dependencies. The CM organization's operational objectives include:

- Verifying that CIs meet the specified requirements.
- Ensuring that CIs are recorded with all known cross-system interfaces.
- Tracking CI status through auditing activities, and taking appropriate corrective action when problems are discovered.
- Confirming that representatives from all affected systems agree on the configuration of pertinent CIs and changes to the configuration of those pertinent CIs.
- Prioritizing change requests.

The CM organization must comprise individuals who:

- Possess authoritative influence and can control or provide direction regarding CM responsibilities and assignments.
- Have a vested interest in the successful integration and certification of the enterprise-wide system.
- Have a vested interest in the success of the system.
- Possess authoritative influence on resource allocation decisions.
- Have a thorough understanding of CM concepts and procedures.
- Have considerable system life cycle experience.

ii. Configuration Identification Requirements

Configuration identification involves classifying a system's structure, uniquely identifying individual system components, and documenting the components' functional and physical characteristics. The goals of configuration identification are to identify the system's components throughout the life cycle and to provide traceability between a system and related system products. Configuration identification answers the following: *What is the system configuration? What are the system components?* and *What is the version of this system component?*

Configuration identification activities include:

- Selecting items to be placed under configuration control;
- Creating a nomenclature for uniquely identifying system components;

- Identifying the various system component versions;
- Defining relationships and interfaces among various system components.

iii. Configuration Control Requirements

Configuration control begins after CIs are formally identified. Configuration control refers to the evaluation, coordination, approval or disapproval, and implementation of changes. It also involves managing release of, and changes to, system components throughout the system life cycle. The goal of configuration control is to establish mechanisms that will help ensure the production and maintenance of quality system components. Configuration control answers the following: *What is controlled? How are changes to system components controlled?* and *Who controls system changes?*

Configuration control activities include:

- Defining the change process;
- Establishing change control policies and procedures;
- Maintaining system component baselines;
- Processing system component changes;
- Tracking and documenting changes;
- Controlling releases of system components.

iv. Configuration Status Accounting Requirements

Configuration status accounting activities include document and report information describing specific configuration items and their corresponding status. To manage CIs effectively, the CM organization must have access to this status information. The goal of status accounting is to provide a status record of all CIs, thus maintaining the traceability of all changes to a CI throughout its life cycle. Configuration status accounting answers the following: *What is the current configuration status for a CI? What are the current changes being considered? What changes have been made to the CI?* And *how many components will be affected by this change?*

Configuration status accounting activities include:

- Determining types of logs and reports required;
- Tracking the status of CIs;
- Tracking the status of changes to the system;
- Reporting system status;
- Recording and reporting on CM activities.

v. Configuration Auditing Requirements

The goals of configuration auditing are to:

- Ensure that CM processes and procedures are properly applied and support the organization's goals and objectives;
- Verify that all CIs are correctly identified, described, cross-referenced and produced;
- Verify that all approved changes to a CI are completed.

For application software, Internal Audits (IAs) will be implemented. Configuration audits answers the following: *Has the CI been controlled using the defined CM procedures?* and *Are all changes incorporated in this version of the CI?*

Configuration audit activities include:

- Defining audit schedule and procedures;
- Performing audits of the established baselines;
- Documenting and reporting audit results.

8. Quality Control & Quality Assurance

The quality control and quality assurance of the Configuration Management process is integrated inherently in one of the organizing components of the CM Plan that was described in section 8.8.5 Configuration Auditing Requirements.

9. Reference

The Coordination Centre Configuration Management SOP is complemented by instructions describing the development and maintenance framework for the various components of an information system. Those instructions are described in detail below for the following:

- Instruction for Business and Institutional Component
- Instruction for Computing Infrastructure Component
- Instruction for Application Software Component
- Instruction for Data Component
- Instruction for Staff Development, Recruitment and Retention Component

Attachment A Instruction for Business and Institutional Component

The Coordination Centre information management systems will therefore be structured specifically to meet critical business requirements of the BNSDI Community. The Coordination Centre information management system design and configuration management approach will therefore be structured around a business centric perspective to take advantage of both the use of new tools to carry out existing work, as well as introduction of technology-supported innovations in the basic business activities with the end goal being to make the Coordination Centre more efficient and effective.

vi. Business Process Management

Coordination Centre business process management. Coordination Centre Officer is responsible to ensure that all information management initiatives carried out by the Coordination Centre are consistent with its primary mandate and responsibilities. He will also be responsible to ensure that any information management solution development undertaken by the Coordination Centre is well integrated into the actual business workings and processes of the Coordination Centre, and external stakeholders where these are involved. Annual review of issues and associated configuration management efforts will take into account issues related to business and business process alignment that may be needed to optimize system utilization.

Community business process management. The Technical Committee is responsible to ensure that all enterprise BNSDI developments are well integrated into the cross-agency business processes and interactions with external Entities where these are involved. Annual enterprise review of BNSDI development issues and associated configuration management efforts will take into account issues related to business and business process alignment that may be needed to optimize system utilization with external stakeholders.

vii. IM Budgeting

Coordination Centre operation budgeting. The GIO is responsible to assess operational resource requirements on an annual basis. Funding for new initiatives, projects and programs will be established through the methods described previously.

Community BNSDI developments budgeting. The GIO will submit its annual budget to the SEC after consultation with the Technical Committee, and will provide the SEC with an assessment of any areas that need alignment or refinement to best support community interests and optimize the community BNSDI investments.

viii. Institutional Performance Monitoring

The strategic plan shall make provision for the Coordination Centre to conduct "Balanced Scorecard" type institutional performance monitoring, assessment and adaptive management for its BNSDI developments and internal operation initiatives. Once the GIO has received the requisite training in the Balanced Scorecard or equivalent method, he will design a monitoring and assessment program for the Coordination Centre, and the procedures therein will be used to complete this section of the SOP instruction manual.

Attachment B Instruction for Computing Infrastructure Component

The planning, design, implementation, operations, maintenance and configuration management of the Coordination Centre computing infrastructure will be carried out in reference to the ITIL best practices. The BNSDI project team has made provision for the

Coordination Centre to adapt the ITIL model to fit the BNSDI Program requirements. Once this program has been completed, the procedures from that adaptation will be summarized to complete this portion of the current instruction manual.

ix. CI Development

TO BE DETERMINED

x. CI Maintenance and Configuration Management

TO BE DETERMINED

Attachment J Instruction for Application Software Component

The precise method for the development of enterprise application software at the Coordination Centre will be left to the discretion of the project manager and the consultant to maintain maximum flexibility and promote new innovations and creativity in this process. However, in general whatever method is applied should incorporate the basic principles outlined below.

xi. Applications Development

Applications development consists of the following steps:

1. ***Problem Definition*** - After a user's request is received, the EC makes a decision whether to accept or reject a project. The user's request and any comments or refinements recommended by the EC and explicit direction to proceed becomes the basis for the Project Manager to begin the project. Once assigned, the Project Manager reviews all documents with the project and begins to develop a detailed plan, in direct cooperation with all the relevant team members and end user representatives.

2. ***Process Analysis*** - The project team will begin the project with a thorough understanding of the business process being modeled. The project team must become familiar with the user's business processes before developing the discrete tasks to accomplish the project. This includes determining problems that exist in the current system, specifying objectives and goals, and listing possible system constraints or limitations. A determination and definition of interfaces with any other existing system, and requirements within or between departments, must also be completed. This involves all organizations that either are sources of data or users that require information from this particular system. Full analysis of the system must be conducted to produce the functional requirements of the entire system.

3. ***Functional Description*** - After conducting a process analysis, the project team will develop a functional description. The functional description defines the system requirements and provides the requestor with a clear statement of the operational capability to be developed, as well as any relationships or linkages to any existing or in-development systems. If the requirements change at any point, the functional description should be updated and receive concurrence from the users and other overseers, depending on the scale and impact of the initiative. The functional description is the basis for mutual understanding between development team, the users, and the overseers.

4. ***User Requirements*** - After the functional description is developed, the project team must determine exactly what is to be included in the system design and define these elements. A list of every single necessary requirement that the new system must accommodate as well as those features that are desirable must be prepared. System features that the user would like to have incorporated in the new system must be recorded. Specifications must be based on what the user wants and needs, not on what the project team Project wants.

5. ***System Design*** - In the design phase, the functional requirements are further developed and refined. Possibly, several alternate approaches may be conceptualized and compared from the standpoint of best cost and benefit factors, including the potential for using ready-made Commercial-Off-the-Shelf (COTS) software packages where these can meet Coordination Centre needs to a reasonable extent. Mock-ups of new forms, reports, screens, and other systems documents may be prepared, if the project is a software project. Prototyping is encouraged so that the user has an opportunity to approve the design. For software design projects, the file structures and report design must be accomplished. For all projects, the impact on systems and networks must be determined before a design is approved. Once an acceptable design has been developed, the project team may need to refine the work plan timeframe and resource requirements. The Project Manager must consider the project team members' other commitments to develop a realistic time line. The SEC will approve any major revisions to the project team or schedule, and the supervisors of the project team members must be kept notified of these changes. The workforce-loading plan can be in any format, but the Project Manager may find it useful to develop a matrix of tasks and project team members with the number of hours each team member should expect to work on a task. Critical tasks, tasks that must be completed before other work can be done, should be defined. During the design phase the Project Manager should reassess the lifecycle cost and benefit assumptions under which the project was conceived, and obtain re-approval if the changes are significant.

6. ***System Development*** - During this phase, the system design is implemented. If design changes are required, it may be necessary to revisit earlier steps to ensure that the system is designed properly. Operation, use and maintenance information is developed. The system is developed in accordance with prescribed Coordination Centre standards.

7. ***Acceptance Testing*** - A test plan must be devised that states which tests will be conducted to verify that the system complies with the requirements identified in the user requirements specification. The test requirements are developed, the scope of the test is identified along with pass/fail criteria, and the system is tested. The entire integrated system must be tested to ensure that the hardware and all software components work as designed. All testing must take place in a controlled environment before the complete project is introduced to users. A functional configuration audit is performed to ensure that system performance complies with requirements specifications and any approved changes. A physical configuration audit is performed to ensure all deliverables have been in fact produced, procedures were followed, and standards were adhered to.

8. ***User Training*** - Any change in a system requires at least new knowledge and usually new skills on the part of operators, administrators, users, and managers. Orientation on the system is required for everyone in the organization affected by the new system. If the project was not to create a new system, but to revise a system, modify a network, or release a new version of software, somewhat less training may be required. For some, orientation may require only a short memo, for others several hours of briefings. Training requires the teaching of new skills and may include techniques such as formal classroom training sessions, training aids, practice sessions, and assistance on the job. The Project Manager is responsible for developing training plans based on system requirements.

9. ***Documentation*** - Documentation must be prepared as required. At a minimum, there must be sufficient documentation to fully describe and explain all system programs and operations, or changes and the reasons for the changes. A maintenance manual must include, at a minimum, the production environment, location of all external files used, and a list of all files needed by the system with a summary of information on each. This type of document is essential for trouble-shooting purposes, for modifying or upgrading the existing system, and for designing a new one. It is also essential to prepare guidance to the people who will operate the system. Documents must be readable and understandable to the user who must approve them.

10. ***Operation*** - The system is implemented and turned over to the user. Data creation and data conversion from the old system to the new system must be accomplished, if necessary. If the system is a replacement for an existing system, phase out of the old system must be planned.

11. ***Evaluation*** - All team members will contribute lessons learned on the project and send them to the Project Manager for consolidation. These will be carried out both for interim project reviews as described previously, as well as for the final project evaluation. Lessons learned will be compiled into a written record for future reference and maintained with other documentation for the project. If applicable, the Project Manager will prepare a Future Action Plan on possible upgrades and enhancements.

xii. Software Maintenance and Configuration Management

ANNEX L - BUSINESS CONTINUITY AND DISASTER RECOVERY PLAN

The BNSDI platform is intended to support data sharing across a broad community of diverse user organizations in Belize. Many of these organizations will increasingly rely on the platform within their own daily activities, thus the continuous functioning of the BNSDI data and application services will become even more mission critical to the functioning of the government over time. It will be important therefore that an BNSDI Disaster Recovery and Business Continuity Plan be prepared and adopted by the Coordination Centre.

The BNSDI platform is to be built upon the infrastructure of the MNR as the administering government entity. As such, the disaster recovery and business continuity (DR/BC) measures that will ensure the continuous operation of the Platform are in large part dependent upon those adopted by the MNR. In lieu of a full plan, this Annex provides an outline for such plan and identifies those portions that have special considerations that are relatively unique to the BNSDI.

Much of the information provided here has been adapted from material provided online by Disaster Recovery.org [2] and Stay In Business (SIB)[3].

Business Continuity Planning is the way an organization can prepare for and aid in disaster recovery. It is an arrangement agreed upon in advance by management and key personnel of the steps that will be taken to help the organization recover should any type of disaster occur. These programs prepare for multiple problems. Detailed plans are created that clearly outline the actions that an organization or particular members of an organization will take to help recover/restore any of its critical operations that may have been either completely or partially interrupted during or after (occurring within a specified period of time) a disaster or other extended disruption in accessibility to operational functions. In order to be fully effective at disaster recovery, these plans are recommended to be regularly practiced as well as outlined.

In layman's terms, a **Business Continuity Plan** or BCP is how an organization guards against future disasters that could endanger its long-term health or the accomplishment of its primary mission. BCPs take into account disasters that can occur on multiple geographic levels-local, regional, and national-disasters like fires, earthquakes, or pandemic illness. BCPs should be live and evolving strategies that are adjusted for any potential disasters that would require recovery; it should include everything from technological viruses to terrorist attacks. The ultimate goal is to help expedite the recovery of an organization's critical functions and manpower following these types of disasters. This sort of advanced planning can help an

[2] http://www.disasterrecovery.org/index.html
[3] http://www.stayinbusiness.com/

organization minimize the amount of loss and downtime it will sustain while simultaneously creating its best and fastest

Disaster Recovery (DR) is the process that an organization applies to recover access to their computing infrastructure and data and that are needed to resume normal, critical business functions after the event of either a natural disaster or a disaster caused by humans. While Disaster Recovery plans, or DRPs, often focus on bridging the gap where data, software, or hardware have been damaged or lost, one cannot forget the vital element of manpower that composes much of any organization. A building fire might predominantly affect vital data storage; whereas an epidemic illness is more likely to have an affect on staffing. Both types of disaster need to be considered when creating a DR Plan. Thus, organizations should include in their DRPs contingencies for how they will cope with the sudden and/or unexpected loss of key personnel as well as how to recover their data.

Disaster Recovery Plans are generally part of the larger and more extensive Business Continuity Planning (BCP) process. Like BCP's, DR plans should be well practiced so that the key players are familiar with the specific actions they will need to take should a disaster occur. DR plans must also be adaptable and routinely updated, e.g. if new people, a new branch office, or new hardware or software are added to an organization they should promptly be incorporated into the organization's disaster recovery plan. Companies must consider all these facets of their organization as well as update and practice their plan if they want to maximize their recovery after a disaster.

Business Continuity/Disaster Recovery Plans come in various forms, each reflecting the corporation's particular set of circumstances. The following general steps may be taken in the development of a plan:

1. Policy Statement (Goal of plan, reasons and resources;
2. Business Impact Analysis (how does a shutdown impact the business financially and otherwise);
3. Identify Preventive Steps (can disaster be avoided by taking prudent steps);
4. Recovery Strategies (how and what you will need to recover);
5. Plan Development (Write plan and implement plan elements);
6. Plan buy-in and testing (very important so that everyone knows the plan and knows what to do);
7. Maintenance (continuous changes to reflect current situation).

The following provides a summary of the topics that need to be addressed in the BC/DR plan, and an identification of any topical areas that may have special implications for the BNSDI. Once the Coordination Centre has prepared a BC/DR for the Lanka Government Cloud, any special conditions related to geospatial information and the BNSDI can be added to that plan. This outline has been copied and/or paraphrased from the "Business Continuity Plan Template" sponsored by Stay In Business (SIB).

1.0 PROMULGATION STATEMENT

The promulgation statement should briefly outline the organization and content of the Continuity Plan and describe what it is, who it affects, and the circumstances under which it should be executed. Promulgation is the process that officially announces/declares a plan. It gives the plan official status and gives both the authority and the responsibility to organizations to perform their tasks. The organization head or a designee may approve the Continuity Plan. Once signed, the promulgation statement officially announces the Continuity Plan. This will need to include Coordination Centre, the Coordination Centre and all the major data custodian and user organizations.

2.0 ANNUAL REVIEW

On an annual basis, the Continuity Plan, Essential Functions, and Business Process Analysis should be reviewed and updated, if changes occur, as well as documenting the date of the review and the names of personnel conducting the review. This needs to be carried out both for the Coordination Centre as well as each of the major data custodian and mission-critical users of the common infrastructure.

3.0 RECORD OF CHANGES

Planners should track and record the changes using a record of changes table when changes are made to the Continuity Plan outside the official cycle of plan review, coordination, and update. The record of changes should contain, at a minimum, a change number, the date of the change, the name of the person who made the change, and a description of the change.

4.0 RECORD OF DISTRIBUTION

The record of distribution, usually in table format, should indicate the title and the name of the person receiving the plan, the agency to which the receiver belongs, the date of delivery, the method of delivery, and the number of copies delivered. The record of distribution can be used to verify that tasked individuals and organizations have acknowledged their receipt, review, and/or acceptance of the plan.

5.0 PURPOSE, SCOPE, SITUATIONS, AND ASSUMPTIONS

A. PURPOSE. The introduction to the Continuity Plan should explain the importance of continuity planning to the organization and why the organization is developing a continuity plan. It may also discuss the background for planning, referencing recent events that have led to the increased emphasis on the importance of a continuity capability for the organization. For the BNSDI it will be important to point out that this is a major common infrastructure supporting hundreds of business processes across nearly all sectors in government. While not all BNSDI supported business

applications will be mission critical to the minute, some could be and others may suffer consequences if not resolved in a day or two.

B. SCOPE. The scope should describe the applicability of the plan to the organization as a whole, headquarters as well as subordinate activities, co-located and geographically dispersed, and to specific personnel groups in the organization. It should also include the scope of the plan. Ideally, continuity plans should address the full spectrum of potential threats, crises, and emergencies (natural and man-made). The BNSDI will have a central facility in Colombo and subsidiary stakeholder nodes in every Province and District across the entire Country.

C. SITUATION OVERVIEW. The situation section should characterize the "planning environment," making it clear why a continuity plan is necessary. In this section, organizations should reference their risk assessment to summarize the hazards faced by their organization and the relative probability and impact of the hazards.

D. PLANNING ASSUMPTIONS. This section should familiarize the reader with the underlying assumptions made during the planning process. Sample text for this section is provided below.

E. OBJECTIVES. All plans and procedures should list the objectives that the plans are designed to meet. Sample text for this section is provided below.

F. SECURITY AND PRIVACY STATEMENT. This section should detail the classification of the Continuity Plan. Since continuity plans and procedures are sensitive, organization-specific documents, at a minimum, organizations should classify their plan as "For Official Use Only". Further, if the Continuity Plan includes a roster of continuity personnel that includes personal information, such as telephone numbers, that information is protected under the Law. Organizations should consult with their security office, or similar entity, to ensure their continuity plans and procedures are appropriately classified and marked. This section also includes dissemination instructions, including to whom and via what means the organization will disseminate the plan.

6.0 CONCEPT OF OPERATIONS

A. PHASE I: READINESS AND PREPAREDNESS. This section should address the readiness and preparedness activities to ensure personnel can continue essential functions. Readiness is the ability of an organization to respond to a continuity event. This phase includes all organization continuity readiness and preparedness activities. Organizations should only include those readiness and preparedness activities and systems that are applicable to their plan.

B. PHASE II: ACTIVATION. This section should explain the activation process from the primary operating facility and provide a process or methodology for attaining operational capability at the continuity facility(ies) with minimal disruption to operations within 12 hours of plan activation. This section should also address procedures and guidance for organization personnel who will not relocate to the continuity facility.

C. PHASE III: CONTINUITY OPERATIONS. This section should describe the initial arrival process and operational procedures for the continuation of essential functions.
D. PHASE IV: RECONSTITUTION OPERATIONS. Organizations should identify and outline a plan to return to normal operations once organization heads or their successors determine that reconstitution operations for resuming normal business operations can be initiated.
E. DEVOLUTION OF CONTROL AND DIRECTION. Devolution planning should support overall continuity planning and addresses the full spectrum of all-hazard/threat emergency events that may render an organization's leadership or staff unavailable to support, or incapable of supporting the execution of the organization's essential functions from either its primary operating facility or continuity facility. Note: Organizations that use a devolution plan that is separate from their continuity plan should include baseline information from their devolution plan in this section including references to where this information is located in their devolution plan.
F. PROCEDURES FOR DEVOLVING ESSENTIAL FUNCTIONS TO DEVOLUTION EMERGENCY RELOCATION GROUP (DERG) AT DEVOLUTION SITE. This section should identify those procedures and instructions on how the organization will devolve functions to the DERG at the Devolution site and detail the transition of responsibilities to the deployed ERG or DERG.

7.0 ORGANIZATION AND ASSIGNMENT OF RESPONSIBILITIES

This section should include additional delineation of continuity responsibilities of each key staff position.

8.0 DIRECTION, CONTROL, AND COORDINATION

This section should describe the framework for all devolution of control, direction, and coordination activities.

9.0 DISASTER INTELLIGENCE

This section should describe the required critical or essential information common to all continuity events. In general terms, it should identify the type of information needed, where it will come from, who will use it, how it will be shared, the format it will be provided in, and when (time) the information will be needed.

10.0 COMMUNICATIONS

This section should address communications systems needed to ensure connectivity during crisis and disaster conditions. The ability of an organization to execute its essential functions at its continuity facility(ies) depends on the identification, availability, and redundancy of critical communications and information technology (IT) systems to support connectivity among key organization leadership personnel, internal organization elements,

other organizations, critical customers, and the public, during crisis and disaster conditions.

11.0 BUDGETING AND ACQUISITION OF RESOURCES

The Budgeting and Acquisition section should identify the people, communications, facilities, infrastructure, and transportation requirements necessary to the successful implementation and management of an organization's continuity program. In addition, the organization should identify and provide funding and specific budgetary guidance and requirements for all levels of the organization, including subordinate components and state offices. This section aligns with the Administration, Finance, and Logistics section of the Comprehensive Preparedness Guide 101.

12.0 MULTI-YEAR STRATEGY AND PROGRAM MANAGEMENT PLAN

Organizations should develop a Continuity Multi-Year Strategy and Program Management Plan (MYSPMP) that provides for the development, maintenance, and annual review of Continuity capabilities requiring an organization to consider: Essential Functions performance; short- and long-term goals/objectives for plans/procedures; issues, concerns, or potential obstacles to implementing their program and strategies for addressing them; planning/TT&E activities and milestones for accomplishing; ERG members, infrastructure, communications, transportation, and other resources needed to support the program; budgetary requirements; risk management principles and primary and Continuity facility risk assessments to ensure appropriate operational readiness decisions are based on the probability of an attack or other incident and its consequences; geographic dispersion into the organization's normal daily operations; security strategies addressing personnel, physical, and informa tion security to protect plans, personnel, facilities, and capabilities; and a CAP.

13.0 PLAN DEVELOPMENT AND MAINTENANCE

This section should describe the process the organization uses to maintain the currency of the Continuity Plan. It identifies who is responsible for plan currency, how often the plan will be reviewed and updated, and describes the coordination process.

14.0 AUTHORITIES AND REFERENCES

The key authorities and references on which the organization's continuity plan is based should be listed here.

The BNSDI will listing of authorities and references will need to include both the Coordination Centre as well as all the critical data custodian and major user organizations.

ANNEX M - STANDARDS

There are a wide variety of existing standards that have been developed internationally specifically for or related to Geographic Information System (GIS) and National Spatial Data Infrastructure (NSDI) that have some relevance to the BNSDI. These can be categorized as falling generally into several classes, or categories, including:

Terminology and Definitions. It is important that the BNSDI community ultimately speaks the same "language" when referring to terminology and definitions. Adopting a standard glossary can support this and help to avoid miscommunication or confusion.

Metadata. A standardized catalog providing a complete accounting of all the fundamental geospatial data sets (FGDS) available across the BNSDI community is one of the foundation components of the programme. The catalog describes the source of the information and a series of standard characteristics that can interpreted to understand whether a dataset is appropriate for a specific application.

Data Content. Data content standard ensure that any FGDS that is published through the BNSDI contains the information that is needed in common by the stakeholders. Data content standards provide an agreed target to be fulfilled by the assigned data custodian organization, and source of information that is known and reliable for use by the community.

Data Standard Interchange Formats. It can be expected that some stakeholders may be using different systems for developing and managing their GIS data. It is therefore important that data format interchange standards be adopted that will allow the lossless conversion of data to required formats.

Data Principles and Structures. How real world features are represented in a digital GIS environment is important in allowing this information to be manipulated and analyzed effectively. Lower level standards regarding data structure can be referenced to ensure that any open source or commercial systems that are implemented incorporate these lower level standards to ensure consistency and interoperability.

Software Principles and Functions. How GIS and related software functions is important to ensure consistency and interoperability across systems. Lower level standards regarding software principles and functions can be referenced to ensure that any open source or commercial systems that are implemented incorporate these standards.

The international GIS and NSDI communities have over the past two decades developed and adopted a wide range of standards that cover all the key requirements of the BNSDI. Several international and national organizations have been active in the development of standards and these communities continue to develop new standards and evolve legacy standards as new

principles and technological capabilities arise. Most of these standards have been adopted and incorporated into available commercial and open-source software packages and in such cases are not an immediate concern to most end-users. However, understanding the foundations of these standards is important, especially for software developers and others in Belize that may be involved in the customization of existing software, the development of new software or the integration of other business systems with the geospatial resources that will be available through the BNSDI.

The organizations that have been consulted in compiling the standards listed in this document are listed below and the document is organized according to this structure:

International Standards Organisation (ISO). ISO/TC 211 is a standard technical committee formed within ISO, tasked with covering the areas of digital geographic information (such as used by geographic information systems) and geomatics. It is responsible for preparation of a series of International Standards and Technical Specifications numbered in the number range starting at 19101.[4] ISO/TC 211 applies a rigorous, systematic process inclusive of broad professional consultation and involvement in the development and refinement of standards over time.

Open Geospatial Consortium (OGC). The Open Geospatial Consortium (OGC), an international voluntary consensus standards organization, originated in 1994. In the OGC, more than 500 commercial, governmental, nonprofit and research organizations worldwide collaborate in a consensus process encouraging development and implementation of open standards for geospatial content and services, sensor web and Internet of Things, GIS data processing and data sharing.

U.S. Federal Geographic Data Committee (FGDC). The United States Federal Geographic Data Committee (FGDC) is an organized structure of Federal geospatial professionals and constituents that provide executive, managerial, and advisory direction and oversight for geospatial decisions and initiatives across the U.S. Federal government. The FGDC is chaired by the Secretary of the Interior with the Deputy Director for Management, OMB as Vice-Chair. FGDC has since its inception facilitated the development or adoption of existing geospatial standards and guidelines. This has involved a structured process involving a broad spectrum of stakeholder organizations and individuals.

INSPIRE. INSPIRE is "an EU initiative to establish an infrastructure for spatial information in Europe that is geared to help to make spatial or geographical information more accessible and interoperable for a wide range of purposes supporting sustainable development". The INSPIRE directive lays down a general framework for a Spatial Data Infrastructure (SDI) for the purposes of European Community environmental policies and policies or activities which may affect the environment. INSPIRE is based

[4] https://en.wikipedia.org/wiki/ISO/TC_211_Geographic_information/Geomatics

on the infrastructures for spatial information established and operated by the member states of the European Union. The directive addresses 34 spatial data themes needed for environmental applications.

Other. Some de facto standards have emerged through various research and development efforts and are now in common usage in the industry.

The referenced standards are described in extensive documentation that is general accessible online. Those standards that have been deemed to be applicable to the BNSDI are not included in their entirety in this document. Rather, an abstract of each standard as provided by the source organization is included, along with a summary of how that standard may be applicable to the BNSDI programme.

M-1 INTERNATIONAL STANDARDS ORGANISATION (ISO) TECHNICAL COMMITTEE 211 (TC 211).

ISO/TC 211 is a standard technical committee formed within ISO, tasked with covering the areas of digital geographic information (such as used by geographic information systems) and geomatics. It is responsible for preparation of a series of International Standards and Technical Specifications numbered in the number range starting at 19101.[5] ISO/TC 211 applies a rigorous, systematic process inclusive of broad professional consultation and involvement in the development and refinement of standards over time. It is therefore recommended that the BNSDI adopt and following these standards to the extent that they are relevant to the Belize context. The following outlines those specific ISO/TC 211 standards that have some relevance to the BNSDI, with some explanation of such relevance to the programme. Links to the website locations where each ISO standard can be purchased are provided.

A majority of the text in the following sections has been excerpted or paraphrased from the available ISO resources online.

M-1.1 ISO 31000:2009 Risk Management – Principles and Guidelines

ISO 31000:2009 provides principles and generic guidelines on risk management. This guide is not specific to any industry or sector and can be used by any public, private or community enterprise, association, group or individual.

This guide can be applied throughout the life of an organization, and to a wide range of activities, including strategies and decisions, operations, processes, functions, projects,

[5] https://en.wikipedia.org/wiki/ISO/TC_211_Geographic_information/Geomatics

products, services and assets. It can also be applied to any type of risk, whatever its nature, whether having positive or negative consequences.

Although ISO 31000:2009 provides generic guidelines, it is not intended to promote uniformity of risk management across organizations. The design and implementation of risk management plans and frameworks will need to take into account the varying needs of a specific organization, its particular objectives, context, structure, operations, processes, functions, projects, products, services, or assets and specific practices employed.

It is intended that ISO 31000:2009 be utilized to harmonize risk management processes in existing and future standards. It provides a common approach in support of standards dealing with specific risks and/or sectors, and does not replace those standards.

ISO 31000:2009 is not intended for the purpose of certification.

This guideline provides useful information for the preparation of business continuity and disaster recovery plans, both for individual organizations as well as the BNSDI community as a whole.

This standard can be acquired at the following link:
http://www.iso.org/iso/catalogue_detail?csnumber=43170

M-1.2 MISO/TC211 Glossary of Terms

The ISO/TC 211 Multi-Lingual Glossary of Terms is a compilation of terms developed from International Standards developed by ISO/TC 211. Its purpose is to encourage consistency in the use and interpretation of geospatial terms. Every record in the glossary includes a term, its definitions and a reference to an authoritative source document. Abbreviations, examples and notes are also included where available. Terms and definitions that are under review (due to a revision of an International standard) are clearly identified.

This multi-lingual glossary can be accessed at the following URL:
http://www.isotc211.org/Terminology.htm

M-1.3 M-1.3 ISO 6709:2008 Standard representation of geographic point location by coordinates.

This International Standard is applicable to the interchange of coordinates describing geographic point location. It specifies the representation of coordinates, including latitude and longitude, to be used in data interchange. It additionally specifies representation of horizontal point location using coordinate types other than latitude and longitude. It also specifies the representation of height and depth that may be associated with horizontal coordinates. Representation includes units of measure and coordinate order.

This International Standard is not applicable to the representation of information held within computer memories during processing and in their use in registers of geodetic codes and parameters.

This International Standard supports point location representation through the eXtensible Markup Language (XML) and, recognizing the need for compatibility with the previous version of this International Standard, ISO 6709:1983, allows for the use of a single alpha-numeric string to describe point locations.

For computer data interchange of latitude and longitude, this International Standard generally suggests that decimal degrees be used. It allows the use of sexagesimal notations: degrees, minutes and decimal minutes or degrees, minutes, seconds and decimal seconds. This International Standard does not require special internal procedures, file-organization techniques, storage medium, languages, etc., to be used in its implementation.

This standard can be acquired at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=39242

M-1.4 M-1.4 ISO 19101:2002 Geographic information -- Reference model – Part 1 Fundamentals

This part of ISO 19101 defines the reference model for standardization in the field of geographic information. This reference model describes the notion of interoperability and sets forth the fundamentals by which this standardization takes place. It provides a guide to structuring geographic information standards in a way that it will enable the universal usage of digital geographic information. It sets out the fundamentals for standardization in geographic information including description, management, and services, and how they are interrelated to support interoperability within the geographic information realm and beyond to ensure interoperability with other information communities. As such, this part of ISO 19101 develops a vision for the standardization in geographic information from which it would be possible to integrate geographic information with other types of information and conversely. Although structured in the context of information technology and information technology standards, this part of ISO 19101 is independent of any application development method or technology implementation approach.

This standard will provide a basis for developers inside and outside of the BNSDI community to incorporate geographic interoperability into their data and applications, thus extending the value and impact of geospatial referencing across the Country.

This standard can be acquired at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19101:-1:ed-1:v1:en

M-1.5 M-1.5 ISO/TS 19101-2:2008 Geographic information -- Reference model -- Part 2: Imagery

This standard defines a reference model for standardization in the field of geographic imagery processing. This reference model identifies the scope of the standardization activity being undertaken and the context in which it takes place. The reference model includes gridded data with an emphasis on imagery. Although structured in the context of information technology and information technology standards, ISO/TS 19101-2:2008 is independent of any application development method or technology implementation approach.

This standard will provide a basis for developers inside and outside of the BNSDI community to incorporate geospatial imagery and gridded data into their data and applications, thus extending the value and impact of geospatial referencing across the Country.

This standard can be acquired at the following link:
http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=39983

M-1.6 M-1.6 ISO/TS 19103:2015 Geographic information -- Conceptual schema language

ISO 19103:2015 provides rules and guidelines for the use of a conceptual schema language within the context of geographic information. This standard is concerned with the adoption and use of a conceptual schema language (CSL) for developing computer interpretable models, or schemas, of geographic information. Standardization of geographic information requires the use of a formal CSL to specify unambiguous schemas that can serve as a basis for data interchange and the definition of interoperable services. An important goal of the ISO geographic information suite of standards is to create a framework in which data interchange and service interoperability can be realized across multiple implementation environments. The adoption and consistent use of a CSL to specify geographic information is of fundamental importance in achieving this goal. The chosen conceptual schema language is the Unified Modeling Language (UML).

This standard provides a basis for developers inside and outside of the BNSDI community to develop commonly structured computer interpretable schemas, thus increasing compatibility and interoperability of data and applications services.

This standard can be acquired at the following link:
http://www.iso.org/iso/home/store/catalogue_ics/catalogue_detail_ics.htm?csnumber=56734

M-1.7 M-1.7 ISO/TS 19104:2016 Geographic information – Terminology

ISO TS 19104:2016 provides the guidelines for collection and maintenance of terminology in the field of geographic information. The standard specifies requirements for the collection,

management and publication of terminology in the field of geographic information. The scope of this document includes:

- selection of concepts, harmonization of concepts and development of concept systems,
- structure and content of terminological entries,
- term selection,
- definition preparation,
- cultural and linguistic adaptation,
- layout and formatting requirements in rendered documents, and
- establishment and management of terminology registers.

This standard provides the BNSDI community with a framework for developing and maintaining a common lexicon of relevant terminology. This will help to streamline and clarify communications across the community by introducing a common language of terms that are understood by all. The registry for this lexicon would most logically be maintained by the entity responsible for coordinating the overall BNSDI initiative.

This standard can be acquired at the following link:
http://www.iso.org/iso/home/store/catalogue_ics/catalogue_detail_ics.htm?csnumber=63541

M-1.8 M-1.8 ISO 19105:2000 Geographic information -- Conformance and testing

This International Standard specifies the framework, concepts and methodology for testing and criteria to be achieved to claim conformance to the family of ISO geographic information standards. It provides a framework for specifying abstract test suites (ATS) and for defining the procedures to be followed during conformance testing. Conformance may be claimed for data or software products or services or by specifications including any profile or functional standard.

Standardization of test methods and criteria for conformance to geographic information standards will allow verification of conformance to those standards. Verifiable conformance is important to geographic information users, in order to achieve data transfer and sharing. This International Standard is applicable to all the phases of conformance and testing. These phases are characterized by the following major activities:

- the definition of ATS for conformance to the ISO geographic information standards;
- the definition of test methods for conformance to the ISO geographic information standards;
- the conformance assessment process carried out by a testing laboratory for a client, culminating in the production of a conformance test report.

This International Standard specifies the requirements for, and gives guidance on, the procedures to be followed in conformance testing for the ISO geographic information standards. It includes only such information as is necessary to meet the following objectives:

- to achieve confidence in the tests as a measure of conformance;
- to achieve comparability between the results of corresponding tests applied in different places at different times;
- to facilitate communication between the parties responsible for the activities described in 1) and 2).

This standard provides the BNSDI community with a framework for confirming conformance with interoperability standards. This will help to reinforce and support common interoperability across the community.

This standard can be acquired at the following link:
https://www.iso.org/obp/ui/#iso:std:26010:en

M-1.9 M-1.9 ISO 19106:2004 Geographic information -- Profiles

ISO 19106:2004 is intended to define the concept of a profile of the ISO geographic information standards developed by ISO/TC 211 and to provide guidance for the creation of such profiles. Only those components of specifications that meet the definition of a profile contained herein can be established and managed through the mechanisms described in this International Standard. These profiles can be standardized internationally using the ISO standardization process. This document also provides guidance for establishing, managing, and standardizing at the national level.

An ISO geographic information profile is a subset of one or several of the ISO geographic information standards. For example, there may be a profile from ISO 19115 developed to serve a particular application area such as cadastral mapping. The profile would consist of a choice of the metadata elements available in ISO 19115. ISO 19115 would serve as a base standard for the development of the profile. An example for a base standard only introducing a methodology is given by ISO 19110. It contains methods for creating feature and attribute definitions. A profile of ISO 19110 would not contain instances of feature definitions, since there are no instances in the base standard from which to choose. A profile of ISO 19110 would contain only a subset of the rules and methods found in that standard.

This standard provides the BNSDI community with a common framework for defining and documenting standards profiles. This will help to establish a common approach to the development or refinement of custom standards across the community.

This standard can be acquired at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19106:ed-1:v1:en

M-1.10 M-1.10 ISO 19107:2003 Geographic information -- Spatial schema

ISO 19107:2003 specifies conceptual schemas for describing the spatial characteristics of geographic features, and a set of spatial operations consistent with these schemas. It treats vector geometry and topology up to three dimensions. It defines standard spatial operations for use in access, query, management, processing, and data exchange of geographic information for spatial (geometric and topological) objects of up to three topological dimensions embedded in coordinate spaces of up to three axes.

Standardized conceptual schemas for spatial characteristics will increase the ability of the BNSDI community to share geographic information among applications. These schemas will be used by geographic information system and software developers and users of geographic information to provide consistently understandable spatial data structures.

This standard can be acquired at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19107:ed-1:v1:en

M-1.11 ISO 19108:2002 Geographic information -- Temporal schema

This standard defines concepts for describing temporal characteristics of geographic information. It depends upon existing information technology standards for the interchange of temporal information. It provides a basis for defining temporal feature attributes, feature operations, and feature associations, and for defining the temporal aspects of metadata about geographic information. Since this International Standard is concerned with the temporal characteristics of geographic information as they are abstracted from the real world, it emphasizes valid time rather than transaction time.

Historically, temporal characteristics of features have been treated as thematic feature attributes. For example, a feature "Building" may have an attribute "date of construction". However, there is increasing interest in describing the behaviour of features as a function of time. This can be supported to a limited extent when time is treated independently of space. For example, the path followed by a moving object can be represented as a set of features called "way point", each of which is represented as a point and has an attribute that provides the time at which the object was at that spatial position. Behaviour in time may be described more easily if the temporal dimension is combined with the spatial dimensions, so that a feature can be represented as a spatiotemporal object. For example, the path of a moving object could be represented as a curve described by coordinates in x, y and t. This International Standard has been prepared in order to standardize the use of time in feature attributes. Although it does not describe feature geometry in terms of a combination of spatial and temporal coordinates, it has been written to establish a basis for doing so in a future standard within the ISO 19100 series.

This standard provides a common way to express the temporal dimension of data. This will provide developers with the basic formats required to add the spatio-temporal dimension to data in a form that is compatible with other BNSDI data and application services.

This standard can be acquired at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19108:ed-1:v1:en

M-1.12 ISO/CD 19109 Geographic information -- Rules for application schema

ISO 19109:2015 defines rules for creating and documenting application schemas, including principles for the definition of features. The widespread application of computers and geographic information systems (GIS) has led to an increased use of geographic data within multiple disciplines. With current technology as an enabler, society's reliance on such data is growing. Geographic datasets are increasingly being shared and exchanged. They are also used for purposes other than those for which they were produced.

To ensure that data will be understood by both computer systems and users, the data structures for data access and exchange must be fully documented. The interfaces between systems, therefore, need to be defined with respect to data and operations, using the methods standardized in this Standard. For the construction of internal software and data storage within proprietary systems, any method may be used that enables the standardized interfaces to be supported.

An application schema provides the formal description of the data structure and content required by one or more applications. An application schema contains the descriptions of both geographic data and other related data. A fundamental concept of geographic data is the feature.

The scope of this Standard includes the following:

- conceptual modelling of features and their properties from a universe of discourse;
- definition of application schemas;
- use of the conceptual schema language for application schemas;
- transition from the concepts in the conceptual model to the data types in the application schema;
- integration of standardized schemas from other ISO geographic information standards with the application schema.

This standard provides the BNSDI community with a basis for establishing a common formal description of the data structure and content required by one or more applications, thus supporting consistency and interoperability across the community. An application schema contains the descriptions of both geographic data and other related data.

This standard can be acquired at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19109:ed-2:v1:en

M-1.13 ISO 19112:2003 Geographic information -- Spatial referencing by geographic identifiers

ISO 19112:2003 defines the conceptual schema for spatial references based on geographic identifiers. It establishes a general model for spatial referencing using geographic identifiers, defines the components of a spatial reference system and defines the essential components of a gazetteer. Spatial referencing by coordinates is not addressed in this document; however, a mechanism for recording complementary coordinate references is included.

ISO 19112:2003 assists users in understanding the spatial references used in datasets. It enables gazetteers to be constructed in a consistent manner and supports the development of other standards in the field of geographic information. It is applicable to digital geographic data, and its principles may be extended to other forms of geographic data such as maps, charts and textual documents.

This standard provides the BNSDI community with a basis for establishing gazetteer and point of interest identifiers as a basis for identify explicit geographic locations.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=26017

M-1.14 ISO 19113:2002 Geographic information -- Quality principles

ISO 19113:2002 establishes the principles for describing the quality of geographic data and specifies components for reporting quality information. It also provides an approach to organizing information about data quality.

ISO 19113:2002 is applicable to data producers providing quality information to describe and assess how well a dataset meets its mapping of the universe of discourse as specified in the product specification, formal or implied, and to data users attempting to determine whether or not specific geographic data is of sufficient quality for their particular application. This International Standard should be considered by organizations involved in data acquisition and purchase, in such a way that it makes it possible to fulfil the intentions of the product specification. It can additionally be used for defining application schemas and describing quality requirements.

As well as being applicable to digital geographic data, the principles of ISO 19113:2002 can be extended to identify, collect and report the quality information for a geographic dataset, its principles can be extended and used to identify, collect and report quality information for a dataset series or smaller groupings of data that are a subset of a dataset.

Although ISO 19113:2002 is applicable to digital geographic data, its principles can be extended to many other forms of geographic data such as maps, charts and textual documents.

ISO 19113:2002 does not attempt to define a minimum acceptable level of quality for geographic data.

This standard provides the BNSDI community with a basis for defining and assessing data quality characteristics and standards..

This standard can be acquired at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=26018

M-1.15 ISO 19157:2013 Geographic information -- Data quality

ISO 19157:2013 establishes the principles for describing the quality of geographic data. It

- defines components for describing data quality;
- specifies components and content structure of a register for data quality measures;
- describes general procedures for evaluating the quality of geographic data;
- establishes principles for reporting data quality.

ISO 19157:2013 also defines a set of data quality measures for use in evaluating and reporting data quality. It is applicable to data producers providing quality information to describe and assess how well a data set conforms to its product specification and to data users attempting to determine whether or not specific geographic data are of sufficient quality for their particular application.

ISO 19157:2013 does not attempt to define minimum acceptable levels of quality for geographic data.

This standard provides the BNSDI community with a basis for defining data quality assurance criteria and procedures.

This standard can be acquired at the following link:
http://www.iso.org/iso/home/store/catalogue_ics/catalogue_detail_ics.htm?csnumber=32575

M-1.16 ISO 19115:2003 Geographic information -- Metadata

ISO 19115:2003 defines the schema required for describing geographic information and services. It provides information about the identification, the extent, the quality, the spatial and temporal schema, spatial reference, and distribution of digital geographic data.

ISO 19115:2003 is applicable to:

- the cataloguing of datasets, clearinghouse activities, and the full description of datasets;

- geographic datasets, dataset series, and individual geographic features and feature properties.

ISO 19115:2003 defines:

- mandatory and conditional metadata sections, metadata entities, and metadata elements;
- the minimum set of metadata required to serve the full range of metadata applications (data discovery, determining data fitness for use, data access, data transfer, and use of digital data);
- optional metadata elements - to allow for a more extensive standard description of geographic data, if required;
- a method for extending metadata to fit specialized needs.

Though ISO 19115:2003 is applicable to digital data, its principles can be extended to many other forms of geographic data such as maps, charts, and textual documents as well as non-geographic data.

NOTE Certain mandatory metadata elements may not apply to these other forms of data.

This standard is to be adopted as the official metadata catalog standard for the BNSDI community. This standard data catalog will be a fundamental cornerstone of the BNSDI programme.

This standard can be acquired at the following link:
http://www.iso.org/iso/catalogue_detail?csnumber=26020

M-1.17 ISO/DIS 19115-1 Geographic information -- Metadata -- Part 1: Fundamentals

ISO 19115-1:2014 defines the schema required for describing geographic information and services by means of metadata. It provides information about the identification, the extent, the quality, the spatial and temporal aspects, the content, the spatial reference, the portrayal, distribution, and other properties of digital geographic data and services.

ISO 19115-1:2014 is applicable to:

- the cataloguing of all types of resources, clearinghouse activities, and the full description of datasets and services;
- geographic services, geographic datasets, dataset series, and individual geographic features and feature properties.

ISO 19115-1:2014 defines:

- mandatory and conditional metadata sections, metadata entities, and metadata elements;
- the minimum set of metadata required to serve most metadata applications (data discovery, determining data fitness for use, data access, data transfer, and use of digital data and services);
- optional metadata elements to allow for a more extensive standard description of resources, if required;
- a method for extending metadata to fit specialized needs.

Though ISO 19115-1:2014 is applicable to digital data and services, its principles can be extended to many other types of resources such as maps, charts, and textual documents as well as non-geographic data. Certain conditional metadata elements might not apply to these other forms of data.

This standard is to be adopted as the official metadata catalog standard for the BNSDI community, as one part of ISO 19115.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_ics/catalogue_detail_ics.htm?csnumber=53798

M-1.18 ISO 19115-2:2009 Geographic information -- Metadata -- Part 2: Extensions for imagery and gridded data

ISO 19115-2:2009 extends the existing geographic metadata standard by defining the schema required for describing imagery and gridded data. It provides information about the properties of the measuring equipment used to acquire the data, the geometry of the measuring process employed by the equipment, and the production process used to digitize the raw data. This extension deals with metadata needed to describe the derivation of geographic information from raw data, including the properties of the measuring system, and the numerical methods and computational procedures used in the derivation. The metadata required to address coverage data in general is addressed sufficiently in the general part of ISO 19115.

This standard is to be adopted as the official metadata catalog standard for the BNSDI community, as one part of ISO 19115.

This standard can be acquired at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=39229

M-1.19 ISO 19116:2004 Geographic information -- Positioning services

ISO 19116:2004 specifies the data structure and content of an interface that permits communication between position-providing device(s) and position-using device(s) so that the

position-using device(s) can obtain and unambiguously interpret position information and determine whether the results meet the requirements of the use. A standardized interface of geographic information with position allows the integration of positional information from a variety of positioning technologies into a variety of geographic information applications, such as surveying, navigation and intelligent transportation systems. ISO 19116:2004 will benefit a wide range of applications for which positional information is important.

This standard will support location based service delivery and other important non-traditional uses of location information from mobile devices and applications.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=37805

M-1.20 ISO 19118:2011 Geographic information – Encoding

ISO 19118:2011 specifies the requirements for defining encoding rules for use for the interchange of data that conform to the geographic information in the set of International Standards known as the "ISO 19100 series".

ISO 19118:2011 specifies requirements for creating encoding rules based on UML schemas, requirements for creating encoding services, and requirements for XML-based encoding rules for neutral interchange of data.

ISO 19118:2011 does not specify any digital media, does not define any transfer services or transfer protocols, nor does it specify how to encode inline large images.

This standard supports the development of interoperability in data exchange between different formats.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=44212

M-1.21 ISO 19119:2016 Geographic information – Services

ISO 19119:2016 defines requirements for how platform neutral and platform specific specification of services shall be created, in order to allow for one service to be specified independently of one or more underlying distributed computing platforms.

ISO 19119:2016 defines requirements for a further mapping from platform neutral to platform specific service specifications, in order to enable conformant and interoperable service implementations.

ISO 19119:2016 addresses the Meta:Service foundation of the ISO geographic information reference model described in ISO 19101-1:2014, Clause 6 and Clause 8, respectively.

ISO 19119:2016 defines how geographic services shall be categorised according to a service taxonomy based on architectural areas and allows also for services to be categorised according to a usage life cycle perspective, as well as according to domain specific and user defined service taxonomies, providing support for easier publication and discovery of services.

This standard provides a basis for standardizing the categorization and discovery of application services.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=59221

M-1.22 ISO/TR 19120:2001 Geographic information -- Functional standards.

This Technical Report seeks to identify the components of those recognized functional standards and to identify elements that can be harmonized between these standards and with the ISO/TC 211 base standards. This Technical Report provides a starting point for a feedback cycle between the functional standards communities and the ISO 19100 series component project teams.

This Technical Report provides the BNSDI community with a framework for understanding relationships between existing functional standards that are in use today and the base standards of the ISO/TC 211 framework.

This Technical Report can be acquired at the following link:
https://www.iso.org/obp/ui/#iso:std:28928:en

M-1.23 ISO/TR 19121:2000 Geographic information -- Imagery and gridded data

This Technical Report reviews the manner in which raster and gridded data is currently being handled in the Geomatics community in order to propose how this type of data should be supported by geographic information standards.

This Technical Report identifies those aspects of imagery and gridded data that have been standardized or are being standardized in other ISO committees and external standards organizations, and that influence or support the establishment of raster and gridded data standards for geographic information. It also describes the components of those identified ISO

and external imagery and gridded data standards that can be harmonized with the ISO 19100 series of geographic information/geomatics standards.

A plan is presented for ISO/TC 211 to address imagery and gridded data in an integrated manner, within the ISO 19100 series of geographic information standards.

This Technical Report provides the BNSDI community with insights into how the international community is standardizing imagery and gridded data.

This Technical Report can be acquired at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:tr:19121:ed-1:v1:en

M-1.24 ISO/TR 19122:2004 Geographic information/Geomatics -- Qualification and certification of personnel

ISO/TR 19122:2004 is applicable to the following aspects of the field of Geographic Information/Geomatics:

- To develop a Type 3 report, which describes a system for the qualification and certification, by a central independent body, of personnel in the field of Geographic Information/Geomatics.
- To define the boundaries between Geographic Information/ Geomatics and other related disciplines and professions.
- To specify technologies and tasks pertaining to Geographic Information/Geomatics.
- To establish skill sets and competency levels for technologists, professional staff and management in the field.
- To research the relationship between this initiative and other similar certification processes performed by existing professional associations.
- To develop a plan for the accreditation of candidate institutions and programs, for the certification of individuals in the workforce, and for collaboration with other professional bodies.

This Technical Report provides the BNSDI community with a system for the qualification and certification of geo-professional staff.

This Technical Report can be acquired at the following link:
This Technical Report provides the BNSDI community with insights into how the international community is standardizing imagery and gridded data.

This Technical Report can be acquired at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:tr:19121:ed-1:v1:en

M-1.25 ISO 19123:2005 Geographic information -- Schema for coverage geometry and functions.

ISO 19123:2005 defines a conceptual schema for the spatial characteristics of coverages. Coverages support mapping from a spatial, temporal or spatiotemporal domain to feature attribute values where feature attribute types are common to all geographic positions within the domain. A coverage domain consists of a collection of direct positions in a coordinate space that may be defined in terms of up to three spatial dimensions as well as a temporal dimension. Examples of coverages include rasters, triangulated irregular networks, point coverages and polygon coverages. Coverages are the prevailing data structures in a number of application areas, such as remote sensing, meteorology and mapping of bathymetry, elevation, soil and vegetation.

ISO 19123:2005 defines the relationship between the domain of a coverage and an associated attribute range. The characteristics of the spatial domain are defined whereas the characteristics of the attribute range are not part of ISO 19123:2005.

This standard is a useful reference for technical members of the BNSDI community to understand the nature and structure of coverages.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=40121

M-1.26 ISO 19125-1:2004 Geographic information -- Simple feature access -- Part 1: Common architecture

ISO 19125-1:2004 establishes a common architecture for geographic information and defines terms to use within the architecture. It also standardizes names and geometric definitions for Types for Geometry.

ISO 19125-1:2004 does not place any requirements on how to define the Geometry Types in the internal schema nor does it place any requirements on when or how or who defines the Geometry Types. ISO 19125-1:2004 does not attempt to standardize and does not depend upon any part of the mechanism by which Types are added and maintained.

This standard is a useful reference for technical members of the BNSDI community to develop a common understanding of geospatial architectural names and definitions.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=40114

M-1.27 ISO 19125-2:2004 Geographic information -- Simple feature access -- Part 2: SQL option

This part of ISO 19125:2004 specifies an SQL schema that supports storage, retrieval, query and update of simple geospatial feature collections via the SQL Call Level Interface (SQL/CLI) and establishes an architecture for the implementation of feature tables.

This part of ISO 19125:2004 defines terms to use within the architecture. of geographic information and defines a simple feature profile of ISO 19107. In addition, this part of ISO 19125:2004 describes a set of SQL Geometry Types together with SQL functions on those types. The Geometry Types and Functions described represent a profile of ISO 13249-3.

This part of ISO 19125:2004 standardizes the names and geometric definitions of the SQL Types for Geometry and the names, signatures and geometric definitions of the SQL Functions for Geometry.

This part of ISO 19125:2004 does not attempt to standardize and does not depend upon any part of the mechanism by which Types are added and maintained in the SQL environment, including the following:

- the syntax and functionality provided for defining types;
- the syntax and functionality provided for defining SQL functions;
- the physical storage of type instances in the database;
- specific terminology used to refer to User Defined Types, for example, UDT.

This standard is a useful reference for technical members of the BNSDI community to develop a common understanding of SQL/CLI.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=40115

M-1.28 ISO 19126:2009 Geographic information -- Feature concept dictionaries and registers

ISO 19126:2009 specifies a schema for feature concept dictionaries to be established and managed as registers. It does not specify schemas for feature catalogues or for the management of feature catalogues as registers. However, because feature catalogue are often derived from feature concept dictionaries, ISO 19126:2009 does specify a schema for a hierarchical register of feature concept dictionaries and feature catalogues. These registers are in accordance with ISO 19135.

This standard is a useful reference for technical members of the BNSDI community to develop a common schema for feature concept dictionaries to be established and managed as registers.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=44075

M-1.29 ISO/TS 19127:2005 Geographic information -- Geodetic codes and parameters

ISO TS 19127:2005 defines rules for the population and maintenance of registers of geodetic codes and parameters and identifies the data elements, in compliance with ISO 19135 and ISO 19111, required within these registers. Recommendations for the use of the registers, the legal aspects, the applicability to historic data, the completeness of the registers, and a mechanism for maintenance are specified by the registers themselves.

This provides a standard for the development and maintenance of a register of geodetic codes, parameters and data elements in Belize.

This standard can be acquired at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=41784

M-1.30 ISO 19128:2005 Geographic information -- Web map server interface

ISO 19128:2005 specifies the behaviour of a service that produces spatially referenced maps dynamically from geographic information. It specifies operations to retrieve a description of the maps offered by a server, to retrieve a map, and to query a server about features displayed on a map. ISO 19128:2005 is applicable to pictorial renderings of maps in a graphical format; it is not applicable to retrieval of actual feature data or coverage data values.

This standard is useful as a technical reference for web map server interface functionality.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=32546

M-1.31 ISO/TS 19129:2009 Geographic information -- Imagery, gridded and coverage data framework

ISO/TS 19129:2009 defines the framework for imagery, gridded and coverage data. This framework defines a content model for the content type imagery and for other specific content types that can be represented as coverage data. These content models are represented as a set of generic UML patterns for application schemas.

This Technical Specification recognizes that there are many overlapping imagery and gridded data specifications in wide use that differ significantly in how the information content is structured for encoding and in what choices of information form the content model. Different types of encoding may be appropriate in different situations. However, differences in content are difficult to reconcile. The existing different encoding standards do not necessarily conflict because they represent different ways of providing the same information in different contexts. Differences in content are also permitted for different situations, but the content definition must be the same in similar situations for interchange to be achieved without loss of information.

Most of the existing specifications for imagery and gridded data used in industry specify how content is to be expressed, rather than the content itself. They relate content to encoding, encapsulation and transfer of data. Those content descriptions that do appear to vary from one specification to another may not be in conflict or incompatible but reflect different real world situations that require different treatments.

This Technical Specification combines a number of well-defined content structures in accordance with ISO 19123, the International Standard for coverage geometry and functions together with metadata, spatial referencing and other aspects of imagery, gridded and coverage data into a framework. This will foster a convergence at the content model level for existing imagery, gridded and coverage data while allowing for backward compatibility with the identified suite of existing standards.

This standard is useful as a technical reference for imagery and coverage content models in use by the BNSDI stakeholder community.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=43041

M-1.32 ISO/TS 19130:2010 Geographic information - Imagery sensor models for geopositioning

ISO/TS 19130:2010 identifies the information required to determine the relationship between the position of a remotely sensed pixel in image coordinates and its geoposition. It supports exploitation of remotely sensed images. It defines the metadata to be distributed with the image to enable user determination of geographic position from the observations.

ISO/TS 19130:2010 specifies several ways in which information in support of geopositioning may be provided.

1. It may be provided as a sensor description with the associated physical and geometric information necessary to rigorously construct a Physical Sensor Model. For the case where precise geoposition information is needed, ISO/TS 19130:2010 identifies the

mathematical formulae for rigorously constructing Physical Sensor Models that relate two-dimensional image space to three-dimensional ground space and the calculation of the associated propagated errors. ISO/TS 19130:2010 provides detailed information for three types of passive electro-optical/infrared (IR) sensors (frame, pushbroom and whiskbroom) and for an active microwave sensing system [Synthetic Aperture Radar (SAR)]. It provides a framework by which these sensor models can be extended to other sensor types.

2. It may be provided as a True Replacement Model, using functions whose coefficients are based on a Physical Sensor Model so that they provide information for precise geopositioning, including the calculation of errors, as precisely as the Physical Sensor Model they replace.

3. It may be provided as a Correspondence Model that provides a functional fitting based on observed relationships between the geopositions of a set of ground control points and their image coordinates.

4. It may be provided as a set of ground control points that can be used to develop a Correspondence Model or to refine a Physical Sensor Model or True Replacement Model.

ISO/TS 19130:2010 does not specify either how users derive geoposition data or the format or content of the data the users generate.

This standard is useful as a technical reference for documenting or interpreting the imagery geopositioning models that will be in use by the BNSDI stakeholder community.

This standard can be acquired at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=51789

M-1.33 ISO/DTS 19130-2 Geographic information -- Imagery sensor models for geopositioning -- Part 2: SAR, InSAR, Lidar and Sonar

ISO/TS 19130-2:2014 supports exploitation of remotely sensed images. It specifies the sensor models and metadata for geopositioning images remotely sensed by Synthetic Aperture Radar (SAR), Interferometric Synthetic Aperture Radar (InSAR), LIght Detection And Ranging (lidar), and SOund Navigation And Ranging (sonar) sensors. The specification also defines the metadata needed for the aerial triangulation of airborne and spaceborne images.

ISO/TS 19130-2:2014 specifies the detailed information that shall be provided for a sensor description of SAR, InSAR, lidar, and sonar sensors with the associated physical and geometric information necessary to rigorously construct a physical sensor model. For the case where precise geoposition information is needed, this Technical Specification identifies the

mathematical formulae for rigorously constructing physical sensor models that relate two-dimensional image space to three-dimensional ground space and the calculation of the associated propagated error.

ISO/TS 19130-2:2014 does not specify either how users derive geoposition data or the format or content of the data the users generate.

This standard is useful as a technical reference for documenting or interpreting sensor models and metadata for geopositioning images remotely sensed by Synthetic Aperture Radar (SAR), Interferometric Synthetic Aperture Radar (InSAR), LIght Detection And Ranging (lidar), and SOund Navigation And Ranging (sonar) sensors.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_ics/catalogue_detail_ics.htm?ics1=35&ics%202=%20240&ics3=70&csnumber=56113

M-1.34 ISO 19131:2007 Geographic information -- Data product specifications

ISO 19131:2007 specifies requirements for the specification of geographic data products, based upon the concepts of other ISO 19100 International Standards. It also provides help in the creation of data product specifications, so that they are easily understood and fit for their intended purpose.

A data product specification is a detailed description of a dataset or dataset series together with additional information that will enable it to be created, supplied to and used by another party. It is a precise technical description of the data product in terms of the requirements that it will or may fulfil. However, the data product specification only defines how the dataset should be. For various reasons, compromises may need to be made in the implementation. The metadata associated with the product dataset should reflect how the product dataset actually is.

A data product specification may be created and used on different occasions, by different parties and for different reasons. It may, for example, be used for the original process of collecting data as well as for products derived from already existing data. It may be created by producers to specify their product or by users to state their requirements.

The purpose of this International Standard is to provide practical help in the creation of data product specifications, in conformance with other existing standards for geographic information. An aim is to produce a complete list of the items used to specify a data product.

This International Standard makes references to parts of existing standards. Some of the items used to specify the data in a data product can also be used as metadata for a resulting dataset with the same data product.

It is not necessary for a data product specification to specify the production process, but only the resulting data product. Nevertheless, it may include production and maintenance aspects if judged necessary to describe the data product.

This International Standard describes the content and structure of a data product specification. An example of a data product specification is presented in Annex F.

When an item for a data product specification is already defined in another standard of the ISO 19100 series, a reference to that document is explicitly made.

This International Standard can be used by producers, providers and potential users of data products within the BNSDI community.

This standard can be acquired at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19131:ed-1:v1:en

M-1.35 ISO 19132:2007 Geographic information -- Location-based services -- Reference model

ISO 19132:2007 defines a reference model and a conceptual framework for location-based services (LBS), and describes the basic principles by which LBS applications may interoperate. This framework references or contains an ontology, a taxonomy, a set of design patterns and a core set of LBS service abstract specifications in UML. ISO 19132:2007 further specifies the framework's relationship to other frameworks, applications and services for geographic information and to client applications.

ISO 19132:2007 addresses, for an LBS system, the first three basic viewpoints as defined in the Reference Model for Open Distributed Processing (RM-ODP, see ISO/IEC 10746-1). These viewpoints are the Enterprise Viewpoint – detailing the purpose, scope, and policies of the system; Information Viewpoint – detailing the semantics of information and processing within the system; Computational Viewpoint – detailing the functional decomposition of the system.

The fourth and fifth viewpoints are addressed only in requirements or examples. These are the Engineering Viewpoint – detailing the infrastructure for distribution; Technology Viewpoint – detailing the technology for implementation;

Reference models and frameworks can be defined at a variety of levels, from conceptual design to software documentation. ISO 19132:2007 defines the conceptual framework for and

the type of applications included within LBS, establishes general principles for LBS for both mobile and fixed clients, specifies the interface for data access while roaming, defines the architectural relationship with other ISO geographic information standards, and identifies areas in which further standards for LBS are required.

ISO 19132:2007 does not address rules by which LBS are developed, nor general principles for roaming agreements for mobile clients and tracking targets.

This Standard can be used by location based service (LBS) developers within the BNSDI community to define and document services.

This standard can be acquired at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=40601

M-1.36 ISO 19133:2005 Geographic information -- Location-based services -- Tracking and navigation

ISO 19133:2005 describes the data types, and operations associated with those types, for the implementation of tracking and navigation services. It is designed to specify web services that can be made available to wireless devices through web-resident proxy applications, but is not restricted to that environment.

This Standard can be used by location based service (LBS) developers within the BNSDI community to define and document tracking and navigation services.

This standard can be acquired at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19133:ed-1:v1:en

M-1.37 ISO 19134:2007 Geographic information -- Location-based services -- Multimodal routing and navigation

ISO 19134:2006 specifies the data types and their associated operations for the implementation of multimodal location-based services for routing and navigation. It is designed to specify web services that may be made available to wireless devices through web-resident proxy applications, but is not limited to that environment.

This Standard can be used by location based service (LBS) developers within the BNSDI community to define and document multimodal routing and navigation services.

This standard can be acquired at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=32552

M-1.38 ISO 19135:2005 Geographic information -- Procedures for item registration

ISO 19135:2005 specifies procedures to be followed in establishing, maintaining and publishing registers of unique, unambiguous and permanent identifiers, and meanings that are assigned to items of geographic information. In order to accomplish this purpose, ISO 19135:2005 specifies elements of information that are necessary to provide identification and meaning to the registered items and to manage the registration of these items.

This Standard can be used by the BNSDI community to define and document fundamental registries that have a geographic dimension or that can relate to a geographic location. This will need to be aligned and integrated with the eGovernment registries.

This standard can be acquired at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=32553

ISO/TS 19135-2:2012 Geographic information - Procedures for item registration -- Part 2: XML schema implementation

This Technical Specification defines Geographic ReGister XML (grg) encoding, an XML schema implementation derived from ISO 19135. The ISO 19135 series standardizes the procedures for the registration of geographic items. Since it does not provide any encoding for the storage and exchange of registers and register items, implementations may vary based on the interpretation of the base standard.

This Technical Specification defines an XML encoding for the storage and exchange of ISO 19135-compliant registers and register items. This encoding conforms to the rules described in ISO/TS 19139.

The encoding defined in this Technical Specification is intended to be extended to specific registers, e.g. ISO 191451) for registers of representations of geographic point location.

This Specification can be used by the BNSDI community to structure geographic register encoding. This will need to be aligned and integrated with the eGovernment registries.

This standard can be acquired at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:ts:19135:-2:ed-1:v1:en

M-1.39 ISO 19136:2007 Geographic information -- Geography Markup Language (GML)

The Geography Markup Language (GML) is an XML encoding in compliance with ISO 19118 for the transport and storage of geographic information modelled in accordance with the conceptual modelling framework used in the ISO 19100 series of International Standards and including both the spatial and non-spatial properties of geographic features.

ISO 19136:2007 defines the XML Schema syntax, mechanisms and conventions that:

- provide an open, vendor-neutral framework for the description of geospatial application schemas for the transport and storage of geographic information in XML;
- allow profiles that support proper subsets of GML framework descriptive capabilities;
- support the description of geospatial application schemas for specialized domains and information communities;
- enable the creation and maintenance of linked geographic application schemas and datasets;
- support the storage and transport of application schemas and data sets;
- increase the ability of organizations to share geographic application schemas and the information they describe.

Implementers may decide to store geographic application schemas and information in GML, or they may decide to convert from some other storage format on demand and use GML only for schema and data transport.

NOTE If an ISO 19109 conformant application schema described in UML is used as the basis for the storage and transportation of geographic information, ISO 19136 provides normative rules for the mapping of such an application schema to a GML application schema in XML Schema and, as such, to an XML encoding for data with a logical structure in accordance with the ISO 19109 conformant application schema.

GML can be used by the BNSDI community to support standard interchange formatting of data.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=32554

M-1.40 ISO 19137:2007 Geographic information -- Core profile of the spatial schema

ISO 19137:2007 defines a core profile of the spatial schema specified in ISO 19107 that specifies, in accordance with ISO 19106, a minimal set of geometric elements necessary for the efficient creation of application schemata.

It supports many of the spatial data formats and description languages already developed and in broad use within several nations or liaison organizations.

This standard will be useful to the BNSDI community as a technical reference in understanding spatial data formats and description languages from other countries and organizations.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=32555

M-1.41 ISO/TS 19138:2006 Geographic information -- Data quality measures

ISO/TS 19138:2006 defines a set of data quality measures. These can be used when reporting data quality for the data quality subelements identified in ISO 19113. Multiple measures are defined for each data quality subelement, and the choice of which to use will depend on the type of data and its intended purpose.

The data quality measures are structured so that they can be maintained in a register established in conformance with ISO 19135.

ISO/TS 19138:2006 does not attempt to describe every possible data quality measure, only a set of commonly used ones.

This standard can provide the BNSDI community with a set of common quality measurement standards for all fundamental geospatial data sets (FGDS).

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=32555

M-1.42 ISO/TS 19139:2007 Geographic information -- Metadata -- XML schema implementation

ISO/TS 19139:2007 defines Geographic MetaData XML (gmd) encoding, an XML Schema implementation derived from ISO 19115.

The importance of metadata describing digital geographic data is explained in detail in the text of ISO 19115. ISO 19115 provides a structure for describing digital geographic data by defining metadata elements and establishing a common set of metadata terminology, definitions and extension procedures. ISO 19115 is abstract in that it provides a worldwide view of metadata relative to geographic information, but no encoding.

Since ISO 19115 does not provide any encoding, the actual implementation of geographic information metadata could vary based on the interpretation of metadata producers. In an attempt to facilitate the standardization of implementations, this comprehensive metadata implementation specification provides a definitive, rule-based encoding for applying ISO 19115. This Technical Specification provides Extensible Markup Language (XML) schemas that are meant to enhance interoperability by providing a common specification for describing, validating and exchanging metadata about geographic datasets, dataset series, individual geographic features, feature attributes, feature types, feature properties, etc.

ISO 19115 defines general-purpose metadata in the field of geographic information. More detailed metadata for geographic data types and geographic services are defined in other ISO 19100 series standards and user extensions (ISO 19115). This Technical Specification is also intended to define implementation guidelines for general-purpose metadata. Where necessary, interpretations of some other ISO 19100 series standards are incorporated.

ISO 19118 describes the requirements for creating encoding rules based on UML schemas and the XML-based encoding rules as well as providing an introduction to XML. This Technical Specification utilizes the encoding rules defined in ISO 19118 and provides the specific details of their application with regard to deriving XML schema for the UML models in ISO 19115.

This standard provides the BNSDI community with an XML coding schema standard for the metadata described in ISO 19115.

This standard can be acquired at the following link:
https://www.iso.org/obp/ui/#iso:std:32557:en

M-1.43 ISO/DTS 19139-2 Geographic Information -- Metadata -- XML Schema Implementation -- Part 2: Extensions for imagery and gridded data

ISO 19139-2:2012 defines Geographic Metadata for imagery and gridded data (gmi) encoding. This is an XML Schema implementation derived from ISO 19115-2.

This standard is an extension of the previous XML coding schema addressing imagery and gridded data.

This standard can be referenced at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=57104.

M-1.44 ISO 19141:2008 Geographic information -- Schema for moving features

ISO 19141:2008 defines a method to describe the geometry of a feature that moves as a rigid body. Such movement has the following characteristics.

- The feature moves within any domain composed of spatial objects as specified in ISO 19107.
- The feature may move along a planned route, but it may deviate from the planned route.
- Motion may be influenced by physical forces, such as orbital, gravitational, or inertial forces.
- Motion of a feature may influence or be influenced by other features, for example:
  - The moving feature might follow a predefined route (e.g. road), perhaps part of a network, and might change routes at known points (e.g. bus stops, waypoints).
  - Two or more moving features may be "pulled" together or pushed apart (e.g. an airplane will be refuelled during flight, a predator detects and tracks a prey, refugee groups join forces).
  - Two or more moving features may be constrained to maintain a given spatial relationship for some period (e.g. tractor and trailer, convoy).

ISO 19141:2008 does not address other types of change to the feature. Examples of changes that are not adressed include the following:

- The deformation of features.
- The succession of either features or their associations.
- The change of non-spatial attributes of features.
- The feature's geometric representation cannot be embedded in a geometric complex that contains the geometric representations of other features, since this would require the other features' representations to be updated as the feature moves.

Because ISO 19141:2008 is concerned with the geometric description of feature movement, it does not specify a mechanism for describing feature motion in terms of geographic identifiers. This is done, in part, in ISO 19133.

This standard provides a technical reference for BNSDI database and software developers to understand the management of moving features.

This standard can be referenced at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=41445

M-1.45 ISO 19142:2010 Geographic information -- Web Feature Service

This International Standard specifies the behaviour of a web feature service that provides transactions on and access to geographic features in a manner independent of the underlying data store. It specifies discovery operations, query operations, locking operations, transaction operations and operations to manage stored parameterized query expressions.

Discovery operations allow the service to be interrogated to determine its capabilities and to retrieve the application schema that defines the feature types that the service offers.

Query operations allow features or values of feature properties to be retrieved from the underlying data store based upon constraints, defined by the client, on feature properties.

Locking operations allow exclusive access to features for the purpose of modifying or deleting features.

Transaction operations allow features to be created, changed, replaced and deleted from the underlying data store.

Stored query operations allow clients to create, drop, list and describe parameterized query expressions that are stored by the server and can be repeatedly invoked using different parameter values.

NOTE This International Standard does not address the access control issues.

This International Standard defines 11 operations:
— GetCapabilities (discovery operation);
— DescribeFeatureType (discovery operation);
— GetPropertyValue (query operation);
— GetFeature (query operation);
— LockFeature (locking operation);
— GetFeatureWithLock (query and locking operation);
— Transaction (transaction operation);
— CreateStoredQuery (stored query operation);
— DropStoredQuery (stored query operation);
— ListStoredQueries (stored query operation);
— DescribeStoredQueries (stored query operation).

This standard provides a mechanism for the publishing of map information over the web. This is one of several standards that will be most critical to the BNSDI.

This standard can be referenced at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19142:ed-1:v1:en

M-1.46 ISO 19143:2010 Geographic information -- Filter encoding

ISO 19143:2010 describes an XML and KVP encoding of a system neutral syntax for expressing projections, selection and sorting clauses collectively called a query expression. These components are modular and intended to be used together or individually by other International Standards which reference ISO 19143:2010.

ISO 19143:2010 defines an abstract component, named AbstractQueryExpression, from which other specifications can subclass concrete query elements to implement query operations.

It also defines an additional abstract query component, named AbstractAdhocQueryExpresison, which is derived from AbstractQueryExpression and from which other specifications can subclass concrete query elements which follow the following query pattern:
•An abstract query element from which service specifications can subclass a concrete query element that implements a query operation that allows a client to specify a list of resource types, an optional projection clause, an optional selection clause, and an optional sorting clause to query a subset of resources that satisfy the selection clause.

This pattern is referred to as an ad hoc query pattern since the server in not aware of the query until it is submitted for processing. This is in contrast to a stored query expression, which is stored and can be invoked by name or identifier.

ISO 19143:2010 also describes an XML and KVP encoding of a system-neutral representation of a select clause. The XML representation is easily validated, parsed and transformed into a server-specific language required to retrieve or modify object instances stored in some persistent object store.

This standard provides a technical reference for the encoding of system-neutral query expressions.

This standard can be referenced at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=42137

M-1.47 ISO 19144-1:2009 Geographic information -- Classification systems -- Part 1: Classification system structure

ISO 19144-1:2009 establishes the structure of a geographic information classification system, together with the mechanism for defining and registering the classifiers for such a system. It specifies the use of discrete coverages to represent the result of applying the classification system to a particular area and defines the technical structure of a register of classifiers in accordance with ISO 19135.

This part of ISO 19144 is based on publications of the Food and Agriculture Organization (FAO) of the United Nations. The first in a series of International Standards related to geographic classification systems, it defines the structure of such systems, together with the mechanism for defining and registering classifiers.

Since there are many different possible application areas, there is no single classification system that will serve all needs. The method by which classifiers are defined depends upon the application area. In addition, the classifiers used within a particular application area might not be adequate for all situations encountered within that application area and could need to be augmented over time. To facilitate extension of the set of classifiers in a particular application area, classifiers are registered in a register structure compliant with ISO 19135. This allows the set of classifiers to be maintained. The use of the ISO 19135 registration mechanism allows for separate registers to be defined for different sets of classifiers within multiple information communities, thereby satisfying application needs. This approach allows for independence between information communities, but also allows relationships to be developed between different classification systems that potentially allow the conversion, or partial conversion, of data from one classification system to another, or the fusion of data from two separate sources.

The concept of classification systems is well known in the geographic information community. A classification system can be used to subdivide any geographic area into small units, each of which carries an identifier that describes its type. The results can then be represented as a discrete coverage as described in ISO 19123. Many such classification systems can be defined to address any geographic area. Different application areas and different information communities can define their own classification systems. However, if the classification system is defined in a compatible way, interaction between different information communities becomes possible. In addition, in a particular application area, it is desirable that there be a few well-established classification systems, and that these themselves be standardized within information communities.

This standard provides the BNSDI community with a common framework for structuring data classification systems.

This standard can be referenced at the following link:
https://www.iso.org/obp/ui/#iso:std:32562:en

M-1.48 ISO 19144-2:2012 Geographic information - Classification systems -- Part 2: Land Cover Meta Language (LCML)

ISO 19144-2:2012 specifies a Land Cover Meta Language (LCML) expressed as a UML metamodel that allows different land cover classification systems to be described based on the physiognomic aspects. ISO 19144-2:2012 also specifies the detailed structure of a register for the extension of LCML but does not specify the maintenance of the register. ISO 19144-2:2012 recognizes that there exist a number of land cover classification systems. It provides a common reference structure for the comparison and integration of data for any generic land cover classification system, but does not intend to replace those classification systems.

Efficient assessment of land cover and the ability to monitor change are fundamental to sustainable management of natural resources, environmental protection, food security and successful humanitarian programmes. Such information is also required to help towards raising levels of nutrition, improving agricultural productivity, enhancing the lives of rural populations and contributing to sustainable growth of the world economy. However, in the past, policy-makers and planners have not had access to reliable and comparable land cover data, not only for lower-income countries but also at the regional and global levels.

Access has been limited by two factors: Lack of mapping activities and lack of commonality between systems. The solution has been to carry out separate regional mapping projects using national or regional land cover classification systems. However, it has not been possible to compare or to exchange information between current systems.

The aim of this part of ISO 19144 is to enable the comparison of information from existing classification systems in a meaningful way without replacing them. The aim is to complement the development of future classification systems that can offer more reliable collection methods for particular national or regional purposes by allowing them to be described in a consistent manner.

A critical factor in implementing such global activities is the availability of a common, umbrella land cover classification system structure. This then provides a reliable basis for interaction without replacing the increasing number of national, regional and global land cover mapping and monitoring activities. This enables comparisons of land cover classes to be made regardless of mapping scale, land cover type, data collection method or geographic location.

Another critical factor is the availability of a common reference for land cover classification systems. This part of ISO 19144 provides a metalanguage expressed as a UML model that allows different land cover classification systems to be described.

This part of ISO 19144 establishes a metalanguage for a set of objects and rules (language) to describe land cover features based on physiognomy that can be part of different land cover legends (nomenclature). This provides a framework for comparing different systems and nomenclatures such as Corine, Africover, Anderson (USGS), Global Map and national systems without replacing them. This is not a description of a nomenclature nor is it a description of a specific set of classes.

This standard provides the BNSDI community with a common framework for structuring and comparing land cover classifications schemes.

This standard can be referenced at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19144:-2:ed-1:v1:en

M-1.49 ISO/DIS 19145 Geographic information -- Registry of representations of geographic point location

ISO 19145:2013 specifies the process for establishing, maintaining and publishing registers of representation of geographic point location in compliance with ISO 19135. It identifies and describes the information elements and the structure of a register of representations of geographic point location including the elements for the conversion of one representation to another.

ISO 19145:2013 also specifies the XML implementation of the required XML extension to ISO/TS 19135-2, for the implementation of a register of geographic point location representations.

ISO 6709:2008 standardizes the mechanisms for the interoperability of geographic point location representations. However, the representation of geographic point locations takes various schemes (e.g. ISO 6709:1983, DCMI Point encoding scheme, KML, GeoVRML, Natural Area Coding System, ISO 8211, GML Point Profile) depending of the application in which they are used. Accordingly, ISO 6709:2008 recognizes and supports flexibility in the representation of geographic point locations and the requirement for universal interpretation. In order to support the use of a variety of geographic point location representations, ISO 6709:2008 introduces the requirement of a registry of geographic point location representations. A registry of representations of geographic point location gives access to the description of the format in which a geographic point location is encoded and also identifies conversion services to transform the representation of the geographic point location to another representation. As such, knowing in which format a geographic point location is encoded and the format in which it must be encoded for its use by a specific application, it can be possible to perform the appropriate transformation of the representation of a geographic point location. However, this requires that encoding formats and their descriptions need to be made accessible either as part of the geographic point location representation itself or from a registry of representations of geographic point locations. As such, the definition of a standard structure for a registry of representations of geographic point location is required. Such a registry will support the required flexibility identified in ISO 6709:2008 for efficient syntactic interoperability of geographic point location information.

This International Standard defines a standard structure of a register in Unified Modelling Language (UML) that supports the description of geographic point location representation (Clause 7). It also defines the XML implementation of the register's UML structure by extending ISO/TS 19135-2, Annex A. Although the structure for the description of geographic point location representation takes its roots in ISO 19135, it extends that International Standard with specific requirements to an extent that it goes beyond the definition of a profile of ISO 19135.

This standard provides the BNSDI application and database developers with a common UML structure for describing geographic point location representation.

This standard can be referenced at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19145:ed-1:v1:en

M-1.50 ISO 19146:2010 Geographic information -- Cross-domain vocabularies

ISO 19146:2010 defines a methodology for cross-mapping technical vocabularies that have been adopted by industry-specific geospatial communities. It also specifies an implementation of ISO 19135 for the registration of geographic information concepts for the purpose of integrating multiple domain-based vocabularies.

A common language is an essential prerequisite to effective communication. However, a simple knowledge of a language's vocabulary is insufficient to ensure communication integrity. A word can have several meanings depending on the context in which it is used. Similarly, a concept can be referenced by several words, each communicating a different connotation or level of emphasis.

The issues associated with the correct use of language extend far beyond day-to-day communication. Every field of endeavour, from engineering to cookery, has its own technical language and vocabulary. In order to participate in discussions on a subject, it is necessary to understand both the subject's terminology and the context in which it is to be used. The imprecise use of technical or professional language (for example, by using two terms interchangeably when, in fact, they have distinctly different connotations) gives rise to the same traps and dangers associated with the inappropriate use of a spoken language.

This International Standard establishes a methodology for cross-mapping technical vocabularies that have been adopted by industry-focussed geospatial communities (for example, geospatial communities supporting the transport or utilities industries). The processes relate to the unique identification of concepts and ensuring the existence of monosemic relations between concepts and designations. The methodology aims to ensure the consistent use of cross-mapping processes when associating disparate geospatial vocabularies and identifying synonyms.

It is not the objective of this International Standard to define an ontology or taxonomy for geographic information and geomatics. Its purpose is to provide rules for ensuring consistency when implementing cross-mapping processes. The rules, however, have been developed with regard to taxonomic and ontological concepts and with a view to enabling semantic interoperability. Their application to vocabulary cross-mapping, therefore, can be expected to provide input to any future ontology/taxonomy initiatives.

This International Standard applies the provisions of ISO 19135 to the registration of geospatial concepts. An online register of cross-mapped terminology entries, conforming to

the requirements of ISO 19135, is associated with this International Standard. Administrative arrangements for the population and maintenance of the online register are beyond the scope of this International Standard. However, the provisions of ISO 19135 relating to the maintenance of registers apply.

This International Standard adopts terms and concepts that are taken from UML and terminology theory and practice. A cross-mapping between the two terminologies can be found in ISO/TR 24156:2008.

This standard provides the BNSDI community with a common methodology for cross-mapping technical vocabularies that have been adopted by industry-focussed geospatial communities.

This standard can be referenced at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19146:ed-1:v1:en

M-1.51 ISO/CD 19147 Geographic information -- Location based services -- Transfer Nodes

ISO 19147:2015 specifies the data types and code lists associated with those types for the implementation of transfer nodes and their services in transport modelling and location based services.

It includes the following:

- defines transfer nodes in a multimodal way so that the definition is general and valid for all types of transport means and modes;
- links transfer nodes to a location;
- focuses on the attributes defining the transfer node in relation to nodes in mode-specific networks;
- defines the attributes of transfer nodes that are relevant for travel planning and modelling of interoperable transport systems by transport planners;
- defines a set of services and facilities that may be related to transfer nodes and a way to provide information on accessibility, deviations and restrictions related to these services and facilities.

ISO 19147:2015 is applicable for transport infrastructure owners and operators when defining and/or describing their transport infrastructure and for transport-related Service Providers when providing information to travellers and others.

It is limited to the transport of persons and is also limited to the static getting-on and getting-off points. The main focus is on transfer nodes being part of public transport networks, that are located in road networks, but this International Standard is also applicable for transfer nodes in rail networks and in air and sea transport networks.

This standard provides the BNSDI community with a common structure for defining transfer nodes in a multi-modal transport system.

This standard can be referenced at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=44874

M-1.52 ISO 19148:2012 Geographic information -- Linear referencing

ISO 19148:2012 specifies a conceptual schema for locations relative to a one-dimensional object as measurement along (and optionally offset from) that object. It defines a description of the data and operations required to use and support linear referencing. The standard is applicable to transportation, utilities, location-based services and other applications which define locations relative to linear objects. It specifies a conceptual schema for locations relative to a one-dimensional object as measurement along (and optionally offset from) that object. It defines a description of the data and operations required to use and support linear referencing.

This International Standard is a description of the data and operations required to support linear referencing. This includes Linear Referencing Systems, linearly located events and linear segments.

Linear Referencing Systems enable the specification of positions along linear objects. The approach is based upon the Generalized Model for Linear Referencing first standardized within ISO 19133:2005, 6.6. This International Standard extends that which was included in ISO 19133, both in functionality and explanation.

ISO 19109 supports features representing discrete objects with attributes having values which apply to the entire feature. ISO 19123 allows the attribute value to vary, depending upon the location within a feature, but does not support the assignment of attribute values to a single point or length along a linear feature. Linearly located events provide the mechanism for specifying attribution of linear objects when the attribute value varies along the length of a linear feature. A Linear Referencing System is used to specify where along the linear object each attribute value applies. The same mechanism can be used to specify where along a linear object another object is located, such as guardrail or a traffic accident.

It is common practice to segment a linear object having linearly located events, based upon one or more of its attributes. The resultant linear segments are attributed with just the attributes used in the segmentation process, insuring that the linear segments are homogeneous in value for these segmenting attributes.

This standard provides the BNSDI community with a common structure for describing linear reference features and events.

This standard can be referenced at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19148:ed-1:v1:en

M-1.53 ISO 19149:2011 Geographic information -- Rights expression language for geographic information -- GeoREL

ISO 19149:2011 defines an XML-based vocabulary or language to express rights for geographic information in order that digital licenses can be created for such information and related services. This language, GeoREL, is an extension of the rights expression language in ISO/IEC 21000-5 and is to be used to compose digital licenses. Each digital license will unambiguously express those particular rights that the owners (or their agent) of a digital geographic resource extend to the holders of that license. The digital rights management system in which these licenses are used can then offer ex ante (before the fact) protection for all such resources.

NOTE The proper use of a GeoREL includes the preservation of rights access by formula expressed in usage licenses. Thus, data in the public or private domain, when protected, remain in their respective domains if the usage rights granted so state.

These "rights" are not always covered by copyright law, and are often the result of contracts between individuals that specify the proper and allowed uses of resources, as opposed to the threat of copyright litigations which is an ex post facto (after the fact) remediation measure, not an ex ante protection measure. ISO 19149:2011 is not a reflection of, or extension of, copyright law.

Mechanisms for the enforcement and preservation of those contract rights are specified in ISO/IEC 21000, and it is not the intention of ISO 19149:2011 to replace nor redefine those mechanisms, but to use them as previously standardized.

This standard provides the BNSDI community with a common structure for documenting rights and usage conditions associated with data and applications.

This standard can be referenced at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=32567

M-1.54 ISO/PRF TS 19150-1 Geographic information -- Ontology -- Part 1: Framework

ISO/TS 19150-1:2012 defines the framework for semantic interoperability of geographic information. This framework defines a high level model of the components required to handle semantics in the ISO geographic information standards with the use of ontologies.

For more than two decades (since the World Wide Web was established) the web has been a network of data with proper syntax (structure) but without any meaning (semantics) to the machine. The Semantic Web has introduced the Web of data. The Semantic Web became an extension of the already existing web of data, by adding machine-processable data (with embedded semantics) as opposed to just documents. It can be seen as a tremendous worldwide open database that people can query from their own perspective, understanding, or abstraction of real world phenomena or events and get accurate, detailed, and appropriate answers. This approach involves reasoning capabilities based on ontologies. Following this path the notion of "Linked Data" has been introduced for data of various kinds, coming from different sources, to be connected together on the Web by the way of HTTP URIs. As a consequence, the Semantic Web and Linked Data bring new opportunities for the geographic information realm to lay out a new generation of standards in order to benefit from these in achieving semantic interoperability of geographic information.

Ontology consists of a formal representation of phenomena of a universe of discourse with an underlying vocabulary including definitions and axioms that make the intended meaning explicit and describe phenomena and their interrelationships. It supports the representation of concepts that supports the interpretation of data and reasoning to concur to semantic interoperability. Data from different disciplines including geographic information can be integrated and contribute to addressing from specific (e.g. oil spill) to global problems (e.g. climate change).

This Technical Specification defines a high level framework that structures the standards specifically addressing the semantics of geographic information through ontologies. The proposed other parts of the framework include:

ISO 19150-2, Geographic information — Ontology — Part 2: Rules for developing ontologies in the Web Ontology Language (OWL), defines rules and guidelines for the development of ontologies in OWL-DL, including a mapping between UML class diagram elements and OWL-DL and rules for describing application schemas in OWL-DL.

ISO 19150-3, Geographic information — Ontology — Part 3: Semantic operators, defines semantic proximity operators between concepts that complement geometric and temporal operators.

ISO 19150-4, Geographic information — Ontology — Part 4: Service ontology, identifies the framework for service ontology and defines the description of Web services for geographic information in an ontology language.

ISO 19150-5, Geographic information — Ontology — Part 5: Domain ontology registry, defines an international registry of geographic information domain ontologies and its maintenance.

ISO 19150-6, Geographic information — Ontology — Part 6: Service ontology registry, defines an international registry of geographic information service ontologies and its maintenance.

These parts are completed with the ISO/TC 211 Harmonized ontologies that consist of a set of OWL-DL ontologies that translate and complement the ISO/TC 211 Harmonized models developed in UML.

This Technical Specification is intended to be used primarily by standards developers in geographic information. It can also benefit information system analysts, program planners and developers of ISO geographic information standards. It will improve understanding of the basic principles of semantic interoperability and their consistent application to geographic information.

This Technical Specification provides the BNSDI community with a technical reference for monitoring ongoing developments in geographic ontologies as well as a common framework for building semantic interoperability into the future programme as it develops.

This Technical Specification can be referenced at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:ts:19150:-1:ed-1:v1:en

M-1.55 ISO/CD 19150-2 Geographic information -- Ontology -- Part 2: Rules for developing ontologies in the Web Ontology Language (OWL)

ISO 19150-2:2015 defines rules and guidelines for the development of ontologies to support better the interoperability of geographic information over the Semantic Web. The Web Ontology Language (OWL) is the language adopted for ontologies.

It defines the conversion of the UML static view modeling elements used in the ISO geographic information standards into OWL. It further defines conversion rules for describing application schemas based on the General Feature Model defined in ISO 19109 into OWL.

It does not define semantics operators, rules for service ontologies, and does not develop any ontology.

This Standard provides the BNSDI community with ontology rules and guidelines to support better interoperability over the web and across the community.

This Standard can be referenced at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=57466

M-1.56 ISO/FDIS 19152 Geographic information -- Land Administration Domain Model (LADM)

This Standard defines a reference Land Administration Domain Model (LADM) covering basic information-related components of land administration (including those over water and land, and elements above and below the surface of the earth). It provides an abstract, conceptual model with four packages related to parties (people and organizations); basic administrative units, rights, responsibilities, and restrictions (ownership rights); spatial units (parcels, and the legal space of buildings and utility networks); spatial sources (surveying), and spatial representations (geometry and topology). It also provides terminology for land administration, based on various national and international systems, that is as simple as possible in order to be useful in practice. The terminology allows a shared description of different formal or informal practices and procedures in various jurisdictions. The Standard provides a basis for national and regional profiles and enables the combining of land administration information from different sources in a coherent manner.

This Standard provides the BNSDI community with a common framework for describing information-related components of land administration..

This Standard can be referenced at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=51206

M-1.57 ISO/DIS 19153 Geospatial Digital Rights Management Reference Model (GeoDRM RM)

ISO 19153:2014 is a reference model for digital rights management (DRM) functionality for geospatial resources (GeoDRM). As such, it is connected to the general DRM market in that geospatial resources shall be treated as nearly as possible like other resources, such as music, text, or services. It is not the intention to reinvent a market nor the technology that already exists and is thriving, but to make sure that a larger market has access to geospatial resources through a mechanism that it understands and that is similar to and consistent with the ones already in use.

ISO 19153:2014 does not replace any previous standards, but it is dependent upon them. Each resource and service standard that exists or will exist becomes a resource description in ISO 19153:2014, and hopefully will be subject to the same protection that is afforded to other resources.

This International Standard defines:

- A conceptual model for digital rights management of geospatial resources, providing a framework and reference for more detailed specification in this area.
- A metadata model for the expression of rights that associate users to the acts that they can perform against a particular geospatial resource, and associated information used

in the enforcement and granting of those rights, such as owner metadata, available rights, and issuer of those rights.

- Requirements that are placed on rights management systems for the enforcement of those rights. A rights management system shall be necessary and sufficient: it shall implement only those restrictions necessary to enforce the rights defined therein, and it shall be sufficient to enforce those rights.
- How this is to work conceptually in the larger DRM context to ensure the ubiquity of geospatial resources in the general services market.

- A resource in this context is a data file, or service for geographic information or process.

This abstract descriptive standard builds on and complements the existing standards, and defines at an abstract level a rights model to enable the digital rights management of standards-based geospatial resources. Future GeoDRM standards will be written to implement the concepts defined in ISO 19153:2014.

This Standard provides the BNSDI community with a conceptual framework for digital rights management.

This Standard can be referenced at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=32571

M-1.58 ISO/WD 19154 Geographic information -- Ubiquitous public access -- Reference model

ISO 19154:2014 defines a reference model for ubiquitous public access (UPA) to geographic information. This reference model uses standard concepts from both the Open distributed processing Reference model (RM-ODP) in ISO/IEC 10746-1 and ISO 19101.

The reference model specified in ISO 19154:2014 defines the following:

- conceptual models for ubiquitous public access (UPA) to geographic information;
- a reference model and framework to support current and future specification development in this area;
- the semantics of information and processing within systems and services for the UPA of geographic information;
- the architectural relationship between this International Standard and other ISO geographic information standards.

ISO 19154 is applicable to location-based services (LBS), ubiquitous computing environments, linked open data, and other domains that require a seamless public access to geographic information.

Although structured in the context of information technology and information technology standards, ISO 19154:2014 is independent of any application development method or technology implementation approach.

The use of ubiquitous computing in geographic information is often obstructed by legal concerns about the rights of the holders and owners of data and other intellectual property resources. It can be the case that once data or other resource is released into any unconstrained and unprotected environment, the value of the holding is decreased because the underlying data theoretically becomes available from other sources. The multimedia industry has taken the lead in solving this problem by creating a general model for digital rights protection, in which a language was developed in order that instances of those rights might be documented, a rights expression language, specifically in ISO/IEC 21000-5, the ISO REL. This language, used in conjunction with Digital Rights Management (DRM) systems, can protect the value of data and still allow it to be distributed subject to a system of licensing, trust and enforcement.

This International Standard extends the ISO REL to encompass the concerns of holders of geographic data and service resources to equally ensure their protection. This allows the geographic information market to operate with minimal constraints derived from the need for the protection of intellectual property.

There are two major sources for foundational material for this work:

- The first source is ISO/IEC 21000, a multiple part standard that defines digital rights management in general. There is no need to extend this basic foundation for expressing and enforcing rights for resources except in those cases where the special requirements of geographic information and services make it necessary.
- The second source is ISO 19153 (originally an Open Geospatial Abstract Specification volume), which enumerates these special cases for geographic information as well as providing an overall reference model using common geographic information terms that ties the work of the ISO/IEC 21000 work into this spatial standard.

Given these two foundations, the purpose of this International Standard is to extend the ISO REL, consistent with the requirements for such extensions given in ISO/IEC 21000-5, to cover the special cases enumerated in ISO 19153.

This Standard provides the BNSDI community with a common reference model for ubiquitous public access.

This Standard can be referenced at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19149:ed-1:v1:en

M-1.59 ISO 19155:2012 Geographic information -- Place Identifier (PI) architecture

ISO 19155:2012 specifies an architecture that defines a reference model with an encoding method for an identifier of a place. The concept of "place" within ISO 19155:2012 includes "places" not only in the real world but also those in the virtual world. These "places" are identified using either coordinate identifiers, geographic identifiers, or virtual world identifiers such as URI. In ISO 19155:2012, an identifier of a place is referred to as a Place Identifier (PI).

The reference model defines a mechanism to match multiple Place Identifiers to the same place. In addition, a data structure and set of service interfaces are also defined in this reference model.

ISO 19155:2012 is applicable to location based services, emergency management services and other application domains that require a common architecture, across specific domains, for the representation of place descriptions using coordinate, geographic, or virtual world identifiers.

The rapid development of information technology has blurred the boundaries between the real and virtual worlds in such a way that they cannot easily be disassociated from each other. Humans can reference places in both worlds and easily differentiate between them. However for computers to clearly differentiate these places, a set of matched linkages between them are required.

In the discipline of geography, space normally refers to the surface of the earth. However, in other disciplines, space can refer to different paradigms. In architecture, space may be the extent of a room or a building. In mathematics, space is defined as a set having structure. In the context of the World Wide Web space is defined by URLs/URIs that identify web pages.

Within this International Standard “space” is considered as a set having structure, in which a position or location identifies an element.

Currently, within the domain of ISO/TC 211, standards exist for precise positioning and locating using either coordinates or geographic identifiers. However, the concept of place is broader than both position and location. A “place” is referred to as a “position” when that place is identified using coordinates. Similarly, a “place” is referred to as a “location” when that place is identified using geographic identifiers. However, existing standards defined by ISO/TC 211 do not provide a mechanism for the representation of a virtual “place” such as a website, or a construct acting as a “common base” which can be used to refer to the other types of identifiers.

Within this International Standard, “place” is defined as an identifiable part of any space. This may include “places” existing not only in the real world but also those in the virtual world.

Places are identified using either “position” by coordinates, “location” by geographic identifiers, or “virtual world identifiers” such as a URI.

In this International Standard, the identifier of a place is referred to as a Place Identifier (PI). A single “place” may be identified using several separate Place Identifiers. Place descriptions are used for information retrieval. In reality, those identifiers often refer to the same place. Currently these relationships are difficult for machines to correctly distinguish, which impedes the discovery and retrieval of information. The conceptual architecture and reference model defined in this International Standard provides a mechanism for solving these problems.

When implemented, this architecture would enable the access and sharing of place descriptions using the Place Identifier as the standardized method.

Within the reference model, place descriptions are defined using a PI. A PI consists of a reference system (RS), a value, and the valid temporal period of that value.

The internal format and content of the value are determined by each community or domain. The content of the values are not subject to any kind of standardization or unification by this International Standard. The RS is also defined by each community, and should be unique across multiple communities. Subsequently, Place Identifiers are unique within each RS. However, the values of the Place Identifiers may be similar or even identical across multiple communities. This distributed concept ensures that each community would maintain their own Place Identifiers. Well formed Place Identifiers may be shared between communities.

Instead of specifying a framework for a globally unique type of identifier, the key idea of the architecture defined in this International Standard enables the original place descriptions to be easily maintained, without requiring difficult conversions and cross-community harmonization.

An encoding scheme based on Geography Markup Language (GML) (ISO 19136:2007) is normatively defined in this International Standard. In addition, a group of alternate encoding schemes are presented as informative annexes. Depending on the encoding method of choice, globally unique Place Identifiers may be created resulting from the requirements of the encoding method used.

Methods for the conversion of “located features” to Place Identifiers are not covered within the scope of this International Standard. While the direct relationship with the PI Architecture and other Spatial Data Infrastructures (SDIs) is not explained, an implementation of the PI Architecture can be considered part of an SDI. Various constructs, such as registries and databases, may be used to store Place Identifiers. The flexible structure of the Place Identifier will allow for data stored in common GI systems to be easily registered as Place Identifiers, however, the design and implementation of those procedures is out of scope of this International Standard.

This Standard provides the BNSDI community with a common framework and coding method for the identification of places.

This Standard can be referenced at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19155:ed-1:v1:en

M-1.60 ISO 19156:2011 Geographic information -- Observations and measurements

ISO 19156:2011 defines a conceptual schema for observations, and for features involved in sampling when making observations. These provide models for the exchange of information describing observation acts and their results, both within and between different scientific and technical communities.

Observations commonly involve sampling of an ultimate feature-of-interest. ISO 19156:2011 defines a common set of sampling feature types classified primarily by topological dimension, as well as samples for ex-situ observations. The schema includes relationships between sampling features (sub-sampling, derived samples).

This International Standard arises from work originally undertaken through the Open Geospatial Consortium's Sensor Web Enablement (SWE) activity. SWE is concerned with establishing interfaces and protocols that will enable a "Sensor Web" through which applications and services will be able to access sensors of all types, and observations generated by them, over the Web. SWE has defined, prototyped and tested several components needed for a Sensor Web, namely:

- Sensor Model Language (SensorML).
- Observations & Measurements (O&M).
- Sensor Observation Service (SOS).
- Sensor Planning Service (SPS).
- Sensor Alert Service (SAS).

This International Standard specifies the Observations and Measurements schema, including a schema for sampling features.

The content presented here derives from an earlier version published by Open Geospatial Consortium as OGC 07-022r1, Observations and Measurements — Part 1 — Observation schema and OGC 07-002r3, Observations and Measurements — Part 2 — Sampling Features. A technical note describing the changes from the earlier version is available from the Open Geospatial Consortium (see http://www.opengeospatial.org/standards/om).

This Standard provides the BNSDI community with a common schema for recording interoperable sensor web observations and associated values.

This Standard can be referenced at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19156:ed-1:v1:en

M-1.61 ISO/DIS 19157 Geographic information -- Data quality

ISO 19157:2013 establishes the principles for describing the quality of geographic data. It

- defines components for describing data quality;
- specifies components and content structure of a register for data quality measures;
- describes general procedures for evaluating the quality of geographic data;
- establishes principles for reporting data quality.

ISO 19157:2013 also defines a set of data quality measures for use in evaluating and reporting data quality. It is applicable to data producers providing quality information to describe and assess how well a data set conforms to its product specification and to data users attempting to determine whether or not specific geographic data are of sufficient quality for their particular application.

ISO 19157:2013 does not attempt to define minimum acceptable levels of quality for geographic data.

This Standard provides the BNSDI community with a common framework for defining and recording data quality.

This Standard can be referenced at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=32575

M-1.62 ISO/TS 19158:2012 Geographic information—Quality assurance of data supply

ISO/TS 19158:2012 provides a framework for quality assurance specific to geographic information. It is based upon the quality principles and quality evaluation procedures of geographic information identified in ISO 19157 and the general quality management principles defined in ISO 9000.

The framework defined in ISO/TS 19158:2012 enables a customer to satisfy itself that its suppliers, both internal and external, are capable of delivering geographic information to the required quality. Fundamental to the framework is the assurance of the supplier's ability to understand and meet the quality requirements. Through the quality assurance framework both

the customer and the supplier are able to consider the quality required at the earliest opportunity in the production/update process.

Principles and responsibilities of the relationship between the customer and the supplier that facilitate the framework are provided. The responsibility for the quality assessment procedure is shared between the customer and the supplier.

ISO/TS 19158:2012 is applicable to customers and suppliers of all geographic information where the quality of the product may be impacted upon by the supplier's processes in any of the following scenarios:

1) there is an agreement or legislation for the supply of data acquisition services,
2) data acquisition services are being tendered for, and
3) one or more suppliers exist in the supply chain.

ISO/TS 19158:2012 is not applicable for the supply of legacy datasets or “off the shelf’” products where there is no further data production or update activity to manage.

This Standard provides the BNSDI community with a common framework for defining data quality for both internal use and tendering.

This Standard can be referenced at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=32576

M-1.63 ISO/WD 19160-1 Addressing -- Part 1: Conceptual model

ISO 19160-1:2015 defines a conceptual model for address information (address model), together with the terms and definitions that describe the concepts in the model. Lifecycle, metadata, and address aliases are included in the conceptual model. The model is presented in the Unified Modeling Language (UML).

The model provides a common representation of address information, independent of actual addressing implementations. It is not intended to replace conceptual models proposed in other specifications, but provides a means to cross-map between different conceptual models for address information and enables the conversion of address information between specifications.

The model provides a basis for developing address specifications by individual countries or communities.

This Standard provides the BNSDI community with a common model for street addressing.

This Standard can be referenced at the following link:

http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=61710

M-2 OPEN GEOSPATIAL CONSORTIUM (OGC)

The Open Geospatial Consortium (OGC), an international voluntary consensus standards organization, originated in 1994. In the OGC, more than 500 commercial, governmental, nonprofit and research organizations worldwide collaborate in a consensus process encouraging development and implementation of open standards for geospatial content and services, sensor web and Internet of Things, GIS data processing and data sharing.

The following summarizes those OGC standards that may have significant relevance to the BNSDI community. Some of these standards are directly relevant to database and application developers while others are more low level standards intended to support general interoperability across systems from different commercial software vendors and open source software communities.

M-2.1 OpenGIS® Filter Encoding Implementation Specification, version 1

A filter expression is a construct used to constrain the property values of an object type for the purpose of identifying a subset of object instances to be operated upon in some manner. This specification describes an XML encoding of the OGC Common Catalog Query Language (CQL) as a system neutral representation of a query predicate. Using the numerous XML tools available today, such an XML representation can be easily validated, parsed and then transformed into whatever target language is required to retrieve or modify object instances stored in a persistent object store. For example, an XML encoded filter could be transformed into a WHERE clause for a SQL SELECT statement to fetch data stored in a SQL-based relational database. Similarly, an XML encoded filter expression could be transformed into an XPath or XPointer expression for fetching data from XML documents. A large class of OpenGIS; web based service requires the ability to express filter expressions in XML. The filter encoding described in this document is a common component that can be used by a number of OGC web services. Any service that requires the ability to query objects from a web-accessible repository can make use of the XML filter encoding described in this document. For example, a web feature service may use the XML filter encoding in a GetFeature operation to define query constraints.

This Standard provides the BNSDI community with a common framework for XML encoded filgers

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/filter

M-2.2 OpenGIS® Web Map Context (WMC) Documents Implementation Specification, Version 1.1.0 w/Corrigendum 1

This is a companion specification to the OGC Web Map Service Interface Implementation Specification. WMS specifies how individual map servers describe and provide their map content. The Context specification states how a specific grouping of one or more maps from one or more map servers can be described in a portable, platform-independent format for storage in a repository or for transmission between clients. This description is known as a "Web Map Context Document," or simply a "Context." A Context document includes information about the server(s) providing layer(s) in the overall map, the bounding box and map projection shared by all the maps, sufficient operational metadata for Client software to reproduce the map, and ancillary metadata used to annotate or describe the maps and their provenance for the benefit of human viewers. A Context document is structured using eXtensible Markup Language (XML). Annex A of the specification contains the XML Schema against which Context

This Standard provides the BNSDI community with a common framework for XML encoded filgers

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/wmc

M-2.3 OpenGIS® Web Processing Service, Version: 1.0.0 w/ Corrigendum

This is a companion specification to the OGC Web Map Service Interface Implementation WPS provides client access across a network to pre-programmed calculations and/or computation models that operate on spatially referenced data. WPS defines a standardized interface that facilitates the publishing of geospatial processes, and the discovery of and binding to those processes by clients. Processes include any algorithm, calculation or model that operates on spatially referenced data. Publishing means making available machine-readable binding information as well as human-readable metadata that allows service discovery and use. The calculation can be extremely simple or highly complex, with any number of data inputs and outputs.

This Standard provides the BNSDI community with a common framework for Web Processing Service (WPS) Interface Implementation.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/wps

M-2.4 OpenGIS® Symbology Encoding Implementation Specification, version 1.1.0

Symbology Encoding (SE) defines an XML language to encode user-defined styling information that can be applied to digital Feature and Coverage data. SE defines the grammar for styling map data independent of any service interface specification and defines styling language rules that the client and server can both understand to portray the output of Web Map Servers, Web Feature Servers and Web Coverage Servers. SE graphical parameters and their values are derived from SVG/CSS2 standards with identical names and semantics.

This Standard provides the BNSDI community with a common language for encoding user-defined symbology.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/symbol

M-2.5 OpenGIS® Styled Layer Descriptor (SLD) Profile of the OpenGIS® Web Map Service (WMS) Encoding Standard

This specification addresses the need for geospatial consumers (either humans or machines) to control the visual portrayal of the data with which they work. The OpenGIS Web Map Service (WMS) Implementation Specification supports the ability for an information provider to specify very basic styling options by advertising a preset collection of visual portrayals for each available data set. However, while a WMS can provide the user with a choice of style options, the WMS can only tell the user the name of each style. It cannot tell the user what the portrayal will look like on the map. More importantly, the user has no way of defining styling rules. This specification defines a styling language for both purposes that the client and server can both understand.

This Standard provides the BNSDI community with a specification for a styling language for both previewing what a style will look like on a map as well as a basis for defining styling rules.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/sld

M-2.6 Augmented Reality Markup Language (ARML 2.0)

This OGC® Standard defines the Augmented Reality Markup Language 2.0 (ARML 2.0). ARML 2.0 allows users to describe virtual objects in an Augmented Reality (AR) scene with their appearances and their anchors (a broader concept of a location) related to the real world. Additionally, ARML 2.0 defines ECMAScript bindings to dynamically modify the AR scene based on user behavior and user input.

This Standard provides the BNSDI software developers with a specification for describing virtual objects in an Augmented Reality (AR) scene.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/arml

M-2.7 City GML

CityGML is an open data model and XML-based format for the storage and exchange of virtual 3D city models. It is an application schema for the Geography Markup Language version 3.1.1 (GML3), the extendible international standard for spatial data exchange issued by the Open Geospatial Consortium (OGC) and the ISO TC211. The aim of the development of CityGML is to reach a common definition of the basic entities, attributes, and relations of a 3D city model. This is especially important with respect to the cost-effective sustainable maintenance of 3D city models, allowing the reuse of the same data in different application fields.

This Standard provides the BNSDI community with a common schema for developing and using 3D city models.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/citygml

M-2.8 Coordinate Transformation Service

The OpenGIS® Coordinate Transformation Service Standard (CT) provides a standard way for software to specify and access coordinate transformation services for use on specified spatial data. This standard addresses a key requirement for overlaying views of geodata ("maps") from diverse sources: the ability to perform coordinate transformation in such a way that all spatial data are defined relative to the same spatial reference system.

This Standard provides the BNSDI community with a standard way to specify and access coordinate transformation service.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/ct

M-2.9 GeoPackage Encoding Standard

A GeoPackage is a platform-independent SQLite database file that may contain:

- vector geospatial features

- tile matrix sets of imagery and raster maps at various scales
- extensions

Since a GeoPackage is a database, it supports direct use, meaning that its data can be accessed and updated in a "native" storage format without intermediate format translations. GeoPackages are interoperable across all enterprise and personal computing environments, and are particularly useful on mobile devices like cell phones and tablets in communications environments with limited connectivity and bandwidth. This OGC® Encoding Standard defines the schema for a GeoPackage, including table definitions, integrity assertions, format limitations, and content constraints. The allowable content of a GeoPackage is entirely defined in this specification.

This Standard provides the BNSDI community with a method to encode simple geospatial data in a platform independent manner, particularly for use on mobile devices or other situations with limited connectivity.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/geopackage

M-2.10 OGC GeoScience Markup Language (GeoSciML)

GeoSciML is a model of geological features commonly described and portrayed in geological maps, cross sections, geological reports and databases. The model was developed by the IUGS CGI (Commission for the Management and Application of Geoscience Information) and version 4.1 is the first version officially submitted as an OGC standard. This specification describes a logical model and GML/XML encoding rules for the exchange of geological map data, geological time scales, boreholes, and metadata for laboratory analyses. It includes a Lite model, used for simple map-based applications; a basic model, aligned on INSPIRE, for basic data exchange; and an extended model to address more complex scenarios.

The specification also provides patterns, profiles (most notably of Observations and Measurements - ISO19156), and best practices to deal with common geoscience use cases.

This Standard provides the BNSDI community with a common model for mapping geology and related information.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/geosciml

M-2.11 GeoSPARQL – A Geographic Query Language for RDF Data

The OGC GeoSPARQL standard supports representing and querying geospatial data on the Semantic Web. GeoSPARQL defines a vocabulary for representing geospatial data in RDF,

and it defines an extension to the SPARQL query language for processing geospatial data. In addition, GeoSPARQL is designed to accommodate systems based on qualitative spatial reasoning and systems based on quantitative spatial computations.

This Standard provides the BNSDI community with a common way to query geospatial data on the Semantic Web.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/geosparql

M-2.12 Geospatial User Feedback (GUF)

This standard defines a conceptual Geospatial User Feedback (GUF) data model (OGC 15-097) and a practical XML encoding of the conceptual model (OGC 15-098). Geospatial User Feedback is metadata that is predominantly produced by the consumers of geospatial data products as they use and gain experience with those products. The standard allows for documenting feedback items such as ratings, comments, quality reports, citations, significant events, etc. about the usage of the data. Feedback items can be aggregated in collections and summaries of the collections can also be described. This standard complements existing metadata conventions whereby documents recording dataset characteristics and production workflows are generated by the creator, publisher, or curator of a data product. As a part of metadata, the GUF data model reuses some elements of ISO 19115-1:2014 (the updated version of the OGC Abstract Specification Topic 11) but not the general structure. This selective use of ISO metadata elements prioritizes interoperability with developing ISO metadata models. The conceptual encoding is designed to be used combination with an encoding standard. Initially an XML encoding following the ISO 19139 encoding rules is specified in a separate OGC implementation standard (OGC 15-098). In the future other encodings may be defined, including examples such as the use of JSON-LD based on parts of schema.org.

This Standard provides the BNSDI community with a common way to collect and manage user feedback regarding data products.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/guf

M-2.13 OGC IndoorGML

This OGC® IndoorGML standard specifies an open data model and XML schema for indoor spatial information. IndoorGML is an application schema of OGC® GML 3.2.1. While there are several 3D building modelling standards such as CityGML, KML, and IFC, which deal with interior space of buildings from geometric, cartographic, and semantic viewpoints, IndoorGML intentionally focuses on modelling indoor spaces for navigation purposes.

This Standard provides the BNSDI community with a common schema for the development and use of indoor spatial information, expecially for navigation purposes (such as in a large facility or shopping center).

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/indoorgml

M-2.14 KML

Google submitted KML (formerly Keyhole Markup Language) to the Open Geospatial Consortium (OGC) to be evolved within the OGC consensus process with the following goal: KML Version 2.2 has been adopted as an OGC implementation standard. Future versions may be harmonized with relevant OGC standards that comprise the OGC standards baseline. There are four objectives for this standards work:

- That there be one international standard language for expressing geographic annotation and visualization on existing or future web-based online and mobile maps (2d) and earth browsers (3d).
- That KML be aligned with international best practices and standards, thereby enabling greater uptake and interoperability of earth browser implementations.
- That the OGC and Google will work collaboratively to ensure that the KML implementer community is properly engaged in the process and that the KML community is kept informed of progress and issues.
- That the OGC process will be used to ensure proper life-cycle management of the KML Standard, including such issues as backwards compatibility.

The OGC has developed a broad Standards Baseline. Google and the OGC believe that having KML fit within that family will encourage broader implementation and greater interoperability and sharing of earth browser content and context.

KML is an XML language focused on geographic visualization, including annotation of maps and images. Geographic visualization includes not only the presentation of graphical data on the globe, but also the control of the user's navigation in the sense of where to go and where to look.

From this perspective, KML is complementary to most of the key existing OGC standards including GML (Geography Markup Language), WFS (Web Feature Service) and WMS (Web Map Service). Currently, KML 2.2 utilizes certain geometry elements derived from GML 2.1.2. These elements include point, line string, linear ring, and polygon.

The OGC and Google have agreed that there can be additional harmonization of KML with GML (e.g. to use the same geometry representation) in the future. The Mass Market Geo

Working Group (MMWG) in the OGC will establish such additional harmonization activities. OGC specifications such as Context and Styled Layer Descriptor (SLD) may be considered.

This Standard provides the BNSDI community with a common framework for accessing and using KML information.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/kml

M-2.15 Land and Infrastructure (LandInfra)

The scope of the Land and Infrastructure Conceptual Model is land and civil engineering infrastructure facilities. Anticipated subject areas include facilities, projects, alignment, road, railway, survey, land features, land division, and "wet" infrastructure (storm drainage, wastewater, and water distribution systems). The initial release of this standard is targeted to support all of these except wet infrastructure.

Land provides the environment upon which infrastructure facilities exist. This standard includes division of land based on administrative (jurisdictions and districts) as well as interests in land (e.g., land parcels, easements, and condominiums). The standard also includes support for topography (terrain) as well as subsurface information. Finally, this standard regards the surveying needed to locate infrastructure facilities on the terrain in compliance with interests in land.

This Standard is an evolving suite of standards that provide the BNSDI community with conceptual schema for encoding land and infrastructure items.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/landinfra

M-2.16 Location Service (OpenLS)

The OpenGIS® Open Location Services Interface Standard (OpenLS) specifies interfaces that enable companies in the Location Based Services (LBS) value chain to "hook up" and provide their pieces of applications such as emergency response (E-911, for example), personal navigator, traffic information service, proximity service, location recall, mobile field service, travel directions, restaurant finder, corporate asset locator, concierge, routing, vector map portrayal and interaction, friend finder, and geography voice-graphics. These applications are enabled by interfaces that implement OpenLS services such as a Directory Service, Gateway Service, Geocoder Service, Presentation (Map Portrayal) Service and others.

This interface standard provides the BNSDI community with a common way to develop and use location based services.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/ols

M-2.17 Open GeoSMS Standard - Core

The OGC Open GeoSMS Standard provides developers with an extended Short Message Service (SMS) encoding and interface to facilitate communication of location content between different LBS (Location-Based Service) devices or applications. SMS is the open text communication service standard most commonly used in phone, web and mobile communication systems for the exchange of short text messages between fixed line or mobile phone devices. The lightweight and easy to implement Open GeoSMS Standard facilitates interoperability between mobile applications and the rapidly expanding world of geospatial applications and services that implement OGC standard interfaces, encodings and best practices.

This interface standard provides BNSDI developers with a way to enable the encoding, transmission and utilization of geospatial information using SMS.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/opengeosms

M-2.18 Open Modelling Interface (OpenMI) Interface Standard

The purpose of the Open Modelling Interface (OpenMI) is to enable the runtime exchange of data between process simulation models and also between models and other modelling tools such as databases and analytical and visualization applications. Its creation has been driven by the need to understand how processes interact and to predict the likely outcomes of those interactions under given conditions. A key design aim has been to bring about interoperability between independently developed modelling components, where those components may originate from any discipline or supplier. The ultimate aim is to transform integrated modelling into an operational tool accessible to all and so open up the potential opportunities created by integrated modelling for innovation and wealth creation.

This interface standard provides BNSDI developers with a way to enable the runtime exchange of data between process simulation models.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/openmi

M-2.19 Ordering Services Framework for Earth Observation Products Interface Standard

This OGC® standard specifies the interfaces, bindings, requirements, conformance classes, and a framework for implementing extensions that enable complete workflows for ordering of Earth Observation (EO) data products.

This interface standard provides BNSDI developers with a way to enable complete workflows for ordering of Earth Observation (EO) data products.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/oseo

M-2.20 OGC Sensor Web Enablement (SWE)

The OGC's Sensor Web Enablement (SWE) standards enable developers to make all types of sensors, transducers and sensor data repositories discoverable, accessible and useable via the Web.

SWE standards are developed and maintained by OGC members who participate the OGC Technical Committee's Sensor Web Enablement Working Group .

SWE offers integrators:

- Open interfaces for sensor web applications
- "Hooks" for IEEE 1451, TML, CAP, WS-N, ASAP
- Imaging device interface support
- Opportunity to participate in an open process to shape standards
- Sensor location tied to geospatial standards
- Fusion of sensor data with other spatial data
- Ties to IEEE and other standards organizations

Sensor technology, computer technology and network technology are advancing together while demand grows for ways to connect information systems with the real world. Linking diverse technologies in this fertile market environment, integrators are offering new solutions for plant security, industrial controls, meteorology, geophysical survey, flood monitoring, risk assessment, tracking, environmental monitoring, defense, logistics and many other applications.

The SWE effort involves OGC members in developing the global framework of standards and best practices that make linking of diverse sensor related technologies fast and practical. Standards make it possible to put the pieces together in an efficient way that protects earlier investments, prevents lock-in to specific products and approaches, and allows for future expansion. Standards also influence the design of new component products. Business needs

drive the process. Technology providers and solutions providers need to stay abreast of these evolving standards if they are to stay competitive.

This suite of standards provide BNSDI developers with a common framework for the collection, management, communications and utilization of sensor data.

This suite of standards can be referenced at the following link:
http://www.opengeospatial.org/ogc/markets-technologies/swe

M-2.21 OGC WaterML

WaterML 2.0 is a standard information model for the representation of water observations data, with the intent of allowing the exchange of such data sets across information systems. Through the use of existing OGC standards, it aims at being an interoperable exchange format that may be re-used to address a range of exchange requirements, some of which are described later in this document.

This standard provides the BNSDI community with a common model for the representation of water observations data.

This suite of standards can be referenced at the following link:
http://www.opengeospatial.org/standards/waterml

M-3 U.S. FEDERAL GEOGRAPHIC DATA COMMITTEE (FGDC)

The United States Federal Geographic Data Committee (FGDC) is an organized structure of Federal geospatial professionals and constituents that provide executive, managerial, and advisory direction and oversight for geospatial decisions and initiatives across the U.S. Federal government. In accordance with Office of Management and Budget (OMB) Circular A-16, the FGDC is chaired by the Secretary of the Interior with the Deputy Director for Management, OMB as Vice-Chair.

FGDC has since its inception facilitated the development or adoption of existing geospatial standards and guidelines. This has involved a structured process involving a broad spectrum of stakeholder organizations and individuals.

Standards from the FGDC are included here only if they are not redundant with other sources, are directly applicable to Belize, or represent a model that could reasonably be adapted in the future to align with the needs of the BNSDI community.

M-3.1 Geospatial Positioning Accuracy Standards, Part 4: Architecture, Engineering, Construction and Facilities Management

This standard defines accuracy criteria, accuracy testing methodology, and accuracy reporting criteria for object features depicted on A/E/C spatial data products and related control surveys. It references established voluntary standards that may be used for some smaller-scale A/E/C mapping applications. In addition, an Appendix A contains general guidance for specifying accuracy criteria for selected types of A/E/C features or control surveys. Using the standards and guidance contained in this section, end users of A/E/C products (e.g., planners, designers, constructors) can specify surveying and mapping accuracy requirements needed for their projects or specific CADD/GIS layers, levels, or entities. From these specifications, data producers (e.g., surveyors, mappers, photogrammetrists) can determine the instrumentation, procedures, and quality control processes required to obtain and verify the defined accuracies.

This standard can provide the BNSDI community with a useful reference in the development of A/E/C data accuracy standards for Belize.

This standard can be referenced at the following link:
https://www.fgdc.gov/standards/projects/accuracy/part4/index_html

M-3.2 Geospatial Positioning Accuracy Standards, Part 5: Standards for Nautical Charting Hydrographic Surveys

For the purposes of this Standard, hydrographic surveys are defined as those surveys conducted to determine the configuration of the bottom of water bodies and to identify and locate all features, natural and man-made, that may affect navigation. Nautical charts are compilations of data from numerous sources, principally hydrographic surveys, designed specifically to meet the requirements of marine navigation. This standard provides minimum standards for the horizontal and vertical accuracy of features associated with hydrographic surveys that support nautical charting. Such features include, but are not limited to, water depths, objects on the seafloor, navigational aids, and shoreline. The scope of these standards includes the coastal waters of the U.S. and its territories, and would need to be adapted for the Belize context.

This standard can provide the BNSDI community with a useful reference in the development of hydrographic and nautical chart data accuracy standards for Belize.

This standard can be referenced at the following link:
https://www.fgdc.gov/standards/projects/accuracy/part5/index_html

M-3.3 Content Standards for Digital Orthoimagery

The objective of this standard is to define the orthoimage theme of the digital geospatial data framework and envisioned by the FGDC . It is the intent of this standard to set a common baseline that will ensure the widest utility of digital orthoimagery for the user and producer communities through enhanced data sharing and the reduction of redundant data production. The standard describes the processing, accuracy, reporting, and applications considerations for digital orthoimagery.

This standard can provide the BNSDI community with a useful reference in the development of a common orthoimagery specification for Belize.

This standard can be referenced at the following link:
https://www.fgdc.gov/standards/projects/orthoimagery/index_html

M-3.4 Utilities Data Content Standard, FGDC-STD-010-2000

The purpose of this Utilities Geospatial Data Content Standard (hereafter abbreviated as Utilities Standard) is to standardize geospatial information for utility systems. This standard specifies the names, definitions, and domains for utility system components that can be geospatially depicted as feature types and their non-graphical attributes. This Utilities Standard is classified as a Data Content Standard in the Federal Geographic Data Committee (FGDC) Standards Reference Model.

This Utilities Standard supports large-scale, intra-city applications such as engineering and life cycle maintenance of utility systems. The components of each utility system described in this Utilities Standard are considered to represnent features located outside the foundation of an enclosed structure. This Utilities Standard describes eleven feature classes: compressed air, electrical distribution, electrical monitoring/control, fuel distribution, heating/cooling systems, industrial waste, natural gas distribution, saltwater, storm drainage collection, wastewater collection, and water distribution. This standard does not contain all features necessary to describe or model communications, alarm systems, or long distance utilities networks that stretch between cities. As with the Spatial Data Transfer Standard (SDTS), this standard uses a logical data model.

This standard can provide the BNSDI community with a useful reference in the development of a common utilities data content specification for Belize.

This standard can be referenced at the following link:
https://www.fgdc.gov/standards/projects/utilities/index_html

M-4 INSPIRE

INSPIRE is "an EU initiative to establish an infrastructure for spatial information in Europe that is geared to help to make spatial or geographical information more accessible and interoperable for a wide range of purposes supporting sustainable development".

The INSPIRE directive lays down a general framework for a Spatial Data Infrastructure (SDI) for the purposes of European Community environmental policies and policies or activities which may affect the environment. The INSPIRE Directive entered into force on 15 May 2007.

INSPIRE is based on the infrastructures for spatial information established and operated by the member states of the European Union. The directive addresses 34 spatial data themes needed for environmental applications.

To ensure that the spatial data infrastructures of the member states are compatible and usable in a community and transboundary context, the INSPIRE Directive requires that additional legislation or common Implementing Rules (IR) are adopted for a number of specific areas (metadata, interoperability of spatial data sets and services, network services, data and service sharing and monitoring and reporting). These are published either as Commission Regulations or as Decisions.[6]

The INSPIRE initiative has facilitated the development of a series of standards and guidelines that have some relevance to Belize. The following summarizes those that are most relevant and provide material that will be a useful reference in the formulation of detailed standards within the BNSDI programme.

M-4.1 Data Specification on Addresses – Technical Guidelines

The data specification defines an address as: “An identification of the fixed location of a property, e.g. plot of land, building, part of building, way of access or other construction, by means of a structured composition of geographic names and identifiers.”

A number of different object types can be related to property. The most commonly recognised types that have addresses are land parcels and buildings (including flats or apartments). In some countries additional objects have an address, such as street furniture, water pumping stations, mooring places, car parks and agricultural barns. Collectively, objects which can have addresses are referred to as addressable objects.

The spatial data theme Addresses is not isolated from other spatial data themes and it has a useful property where it can be used to link and join information from other data sets. The data specification is concerned with the structure of an address and does not attempt to define the structure of the addressable object to which it relates. The data specification does though include associations from the address to the two INSPIRE themes Cadastral Parcels and Buildings.

This standard can provide the BNSDI community with a useful reference in the development of a common address data content specification for Belize.

[6] https://en.wikipedia.org/wiki/Infrastructure_for_Spatial_Information_in_the_European_Community

This standard can be referenced at the following link:
http://inspire.ec.europa.eu/id/document/tg/ad

M-4.2 Data Specification on Administrative Units – Technical Guidelines

According to the definition of the Directive, administrative units are ―units of administration dividing areas where Member States have and/or exercise jurisdictional rights for local, regional and national governance, separated by administrative boundaries‖. Based on the reference materials and the user requirements, the Thematic Working Group has added some other fundamental aspects like the hierarchical structure of administrative units and the relations with statistical units that have already been defined and in use within the EU-administration.

Administrative units in INSPIRE play the role of generic information locators. Their main uses include:

- Searching / filtering other spatial data based on a name or code.
- Linking / publishing thematic information in a rapid and comparable way.
- Finding competent authorities e.g. in case of disasters, for environmental protection, etc. In addition administrative units may provide the frame for a boundary-based analysis of consistency of spatial objects (similar classification, geometrical matching) as required in Art. 8(4) and 10(2) of the Directive.

The administrative units data theme model is divided in two application schemas:

The core element of the Administrative Units application schema is the administrative unit represented by a surface geometry. In accordance with the Directive, each administrative unit carries a unique identifier. Administrative units are further described by their geographical name, the country of location, the national administrative code, and the hierarchical level within the administrative structure of the country. This information is completed, if available, with the life cycle information (when the administrative unit has been inserted or changed in the dataset, and when it has been (if ever) superseded or retired in the spatial data set), the name of the corresponding national level and the residence of the administrative authority.

The administrative division of the Members States follows a hierarchical structure where the lowest level units (often communes) are united in higher level units (like provinces, counties, etc) that compose other units at a higher level. It must be ensured that an administrative unit of an upper level is composed of one or more administrative units of a lower level. Lowest level administrative

13 Statistical units, such as NUTS (Nomenclature of Territorial Statistical Units) regions, are defined in the Statistical units data theme, which is part of INSPIRE Annex III. units are further characterised by their geometry and, where available, by the corresponding local administrative unit code. A special spatial object type called condominium has been introduced for describing independent administrative areas that are administered by two or more countries.

Administrative units are separated by administrative boundaries that are specified as lines. As mandatory properties they carry a unique identifier, information on the country, the

administrative hierarchic level and their own geometry. These are complemented, when available, with the legal and technical status of the boundary and the life cycle information.

The MaritimeUnits application schema models the existing maritime zones. These are stripes or belts of sea defined according international treaties and conventions, where the coastal States execute their jurisdictional rights. Depending on the zone type property, they may concern an area of seabed, ocean floor, subsoil, resources, or even the air space over the sea, for cadastral, administrative, economic, security or safety purposes. These rights are established by the United Nations Convention on the Law of the Sea (UNCLOS). The baseline, the line from which the outer limits of the territorial sea is measured, serves as reference to calculate the breath of territorial sea, while determines the outer limits of other maritime zones by establishing respectively different distances measured from it.

In contrast to the AdministrativeUnits model, no hierarchical structure is established between different maritime zones. However, they share common properties with administrative units, like the unique identifier and the country the maritime zone belongs to. All this information is again complemented, if available, with the life cycle information and the geographical name.

Following a common modelling approach with administrative units, maritime zones are separated by maritime boundaries that are specified as lines. As mandatory properties they carry a unique identifier, information on the country, and their own geometry. These are complemented, when available, with the legal and technical status of the boundary and the life cycle information.

This standard can provide the BNSDI community with a useful reference in the development of a common administrative area data content specifications for Belize.

This standard can be referenced at the following link:
http://inspire.ec.europa.eu/id/document/tg/au

M-4.3 Data Specification on Cadastral Parcels – Technical Guidelines

The cornerstone of the specification development was the definition of the Directive on the cadastral parcels: “areas defined by cadastral parcels or equivalent”. In accordance with the particular legal system each Member State runs a related register under the responsibility of the government. Such registers are often called cadastre, sometimes land or other type of registry. Regardless of the name of the system, the basic unit of area is the parcel. Cadastral parcels usually form a continuous partition of the national territory by the exception where some land owned by the governments13 is not subject of registration. The generic definition of cadastral parcels has been complemented by the Thematic Working Group to fit better with user requirements in the following way: the cadastral parcels should be, as much as possible, single areas of Earth surface (land and/or water) under homogenous real property rights and unique ownership, where real property rights and ownership are defined by national laws.

INSPIRE does not aim at harmonising the concepts of ownership and rights related to the parcels, but focuses on the geometrical aspects as presented in the national systems of the Member States.

Cadastral parcels in INSPIRE should serve the purpose of generic information locators. Having included the reference to the national registers as a property (attribute) of the INSPIRE parcels national data sources can be reached. Using this two-step approach other information, like rights and owners can be accessed fully respecting the national legislation on data protection. The data model for INSPIRE cadastral parcels has been prepared in a way that supports compatibility with the upcoming international standard on Land Administration Domain Model14. The Land Administration Domain Model (LADM) provides a wider context for the INSPIRE cadastral parcels because LADM includes additional information on rights (bound to national legislation) and owners, which are outside the direct scope of INSPIRE.

This standard can provide the BNSDI community with a useful reference in the development of a common cadastral data content specifications for Belize.

This standard can be referenced at the following link:
http://inspire.ec.europa.eu/id/document/tg/cp

M-4.4 Data Specification on Coordinate Reference Systems – Technical Guidelines

The scope of the theme Coordinate reference systems covers the Geodetic Coordinate Reference Systems (CRS) required for uniquely referencing spatial information in space as a set of coordinates (X, Y, Z) and/or latitude (φ), longitude (λ) and either ellipsoidal (h) or gravity-related height (H).

This specification establishes:

a. The geodetic datums and coordinate reference systems to be used when making spatial data sets available for INSPIRE, unless otherwise required for data of a specific theme.
   Particularly, the following ones are adopted:

   - The European Terrestrial Reference System 1989 (ETRS89), as geodetic datum within its scope.
   - The European Vertical Reference System (EVRS), to express gravity-related heights on land within its scope.
   - Barometric pressure, converted to height using ISO 2533:1975 International Standard Atmosphere, to express heights in the free atmosphere.
   - The Lowest Astronomical Tide (LAT), as reference surface to express depth values representing the sea floor in marine areas with an appreciable tidal range.
   - The Mean Sea Level (MSL), or a well-defined reference level close to the MSL, as reference surface to express depth values representing the sea floor in marine areas without an appreciable tidal range, in open oceans and effectively in waters deeper than 200 metres.

b. Plane coordinates reference systems (map projections) adopted and recommended for different purposes, covering the requirements of the INSPIRE transformation services and view services as well. Particularly, at least the coordinate reference systems for

two-dimensional geodetic coordinates (latitude, longitude) shall be available for the display of spatial data sets with the view network service (Regulation No 976/200915).

c. The identifiers for the different types of coordinates that shall be used.

The document also provides rules and guidance on geodetic coordinate reference systems, vertical reference systems and map projections for their use outside of continental Europe (e.g. overseas territories).

This standard can provide the BNSDI community with a useful reference in the development of a common Coordinate Reference System specification for Belize.

This standard can be referenced at the following link:
http://inspire.ec.europa.eu/id/document/tg/rs

M-4.5 Data Specification on Geographical Names – Technical Guidelines

Names of areas, regions, localities, cities, suburbs, towns or settlements, or any geographical or topographical feature of public or historical interest. [Directive 2007/2/EC].

This data specification describes concepts related with geographical names, i.e. proper nouns applied to a natural, man-made or cultural real world entity. The data specification is guided by the multi- language and multi-scriptual situation in Europe: a geographic entity can have different names in one or several languages, and each name can have different spellings, i.e. spellings in different scripts.

Because of this multi-language and multi-scriptual context, this specification defines a product that is feature oriented in order to enable to express which different names are used to designate one given place. In other words, the spatial objects defined in this specification are the ‘named places’, and the ‘geographical names’ are seen as information related to a named place. However, the product focuses on the description of names rather than the description of spatial objects: it particularly describes characteristics of names like their language and spellings in different scripts.

In some cases names can be applied as attributes of appropriately modelled spatial objects in other themes defined by INSPIRE. However, often the definition, classification, geometry and other attributes of these objects do not necessary correspond with the respective named places as defined by this data specification, which focuses on the names aspects. Besides, commonly named geographic entities such as elevations, islands or coastal land formations are seldom modelled as spatial objects in other themes, while they are modelled as named places in this specification.

This standard can provide the BNSDI community with a useful reference in the development of a common Geographic Names System specification for Belize.

This standard can be referenced at the following link:
http://inspire.ec.europa.eu/id/document/tg/gn

M-4.6 Data Specification on Hydrography – Technical Guidelines 3.1

The theme ―Hydrography is a basic reference component and, therefore, of interest for many users and uses. Hydrography in the context of this data specification is involved with the description of the sea, lakes, rivers and other waters, with their phenomena and all hydrographic-related elements.

For mapping purposes (to provide a map background for orientation and to understand place relationships), it includes the representation of all main hydrographic elements – both natural and artificial. To fulfill reporting requirements of EC water-related directives it includes the river and channel network; surface water bodies within river basin districts are categorised as rivers, lakes, transitional waters or coastal waters, or as artificial surface water bodies or heavily modified surface water bodies. Furthermore, a topologically-sound river network is necessary for GIS-based spatial analysis and modelling.

Geographically, the theme ―Hydrography‖ covers all inland water and marine areas covered by river basin districts as defined by WFD.

This standard can provide the BNSDI community with a useful reference in the development of a common Hydrographic data specification for Belize.

This standard can be referenced at the following link:
http://inspire.ec.europa.eu/id/document/tg/hy

M-4.7 Data Specification on Protected Sites – Technical Guidelines

According to the International Union for the Conservation of Nature (IUCN) a Protected Site is an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means.

Within the INSPIRE context, Protected Sites may be located in terrestrial, aquatic and/or marine environments, and may be under either public or private ownership. They may include localities with protection targets defined by different sectors and based on different objectives. Objectives for protection may include: the conservation of nature; the protection and maintenance of biological diversity and of natural resources and the protection of person-made objects including buildings, pre- historic and historic archaeological sites, other cultural objects, or sites with specific geological, hydrogeological or geomorphological value. Protected Sites may receive protection due to more than one type of objective, and may have a double or multifarious designation status.

Protected Sites may differ greatly in their reasons for protection, their designation and their management. Examples of legislation under which Protected Sites included in this INSPIRE theme are designated, managed and regulated include:

- the Habitats Directive (1992) (Directive 92/43/EC);

- the Birds Directive (1979) (Directive 79/409/EC);
- the Water Framework Directive (2000) (Directive 2000/60/EEC)
- the World Heritage Convention (1975);
- the Ramsar Convention (1971);
- the Barcelona Convention (1976);
- the Helsinki Convention (1974);
- the OSPAR Convention (1992) and
- the national laws of each European country and EU and international sector policies (for example, relating to forests or fisheries).

This standard can provide the BNSDI community with a useful reference in the development of a common Protected Sites data specification for Belize.

This standard can be referenced at the following link:
http://inspire.ec.europa.eu/id/document/tg/ps

M-4.8 Data Specification on Transport Networks – Technical Guidelines

The transport component should comprise of an integrated transport network, and related features, that are seamless within each national border. In accordance with Article 10(2) of the INSPIRE Directive, national transport networks may also be seamless at European level, i.e. connected at national borders. Transportation data includes topographic features that are related to transport by road, rail, water, and air. It is important that the features form networks where appropriate, and that links between different networks are established, i.e. multi-modal nodes, especially at the local level, in order to satisfy the requirements for intelligent transport systems such as location based services (LBS) and telematics. The transport network should also support the referencing of transport flows to enable the navigation services.

The data specification is extensive, covering major transport networks types that are defined in the five distinct transport themes (sub-themes): Road, Rail, Water, Air transport and Cableways15, including the connections between those types. The sub-themes are defined in a way that they can be used together to support an integrated approach to transport and they may be used with other spatial data themes. It is evident that there are a very large number of applications that can potentially use the Transport networks.

Taking into account the variety of responsibilities in collecting, managing and using the data and different approaches in the data base management practice, from simple models to complex data arrangements, this data specification is provided as basic framework and with the purpose to maximize the reuse and sharing of the data about a network. It is mainly focused on the “widely reused – widely referenced” segments of spatial objects, supporting the loose linkage between the diverse organizational data with these spatial objects and allowing the extensibility to fit into diverse applications and users needs.

This approach provides a framework for users to configure and associate their own information (from surface condition surveys, to journey planning, to trans-European transport policy making etc.) using existing transport networks information in each Member State.

The datasets in scope are used extensively at the “local level” and extended to regional, national and European levels. This data specification provides a coherent approach to the forms of the representation (physical topographic area objects or centreline representations) and consistency between data sets, the latest as different types of coherence (between spatial objects of the same theme at different levels of detail, between different spatial objects within a same area or coherence at state boundaries).

All the spatial data sub-themes are based on the INSPIRE Generic Conceptual Model (GCM) that relies on several ISO 19100 series of geographic information standards to provide the foundations for specific aspects of interoperability.

Within the GCM, the Generic Network Model (GNM) is defined to be shared by any network spatial data theme (e.g. Hydrography) to ensure a consistent approach across all network themes.

Specific mechanisms, used in the data specification and defined in the GNM, include:

- Network connection mechanism to establish the cross-border connectivity (a simple cross- referencing system to establish cross-border connections between the transport networks) or to establish intermodal connectivity (by linking two transport network elements from different transport networks which use a different mode of transport);
- Object referencing to support the reuse of information (for example to avoid the duplication of the geometry and to link complementary feature types from different organistaions);
- Linear referencing to support and link the different transport properties to the transport elements – it is used to position phenomena along a linear object, using a distance from the beginning of the linear object and
- The mechanism to combine the network elements into high-level semantic meanings.

The elements in the network are handled as nodes, links, aggregated links, areas and points. In addition, the individual transport links can be combined to form transport link sequences or further – the combination of both can be used to form the transport link sets.

The data specification includes three types of geometry: (a) (topographic) area objects, (b) centreline objects and (c) point objects. The types (a) and (b) may be alternative representations of the same real world phenomena about which the user can associate their own information (objects). The type (c) is, apart from network nodes, only included in the specification for marker posts. The basic spatial representation type is 2D vector.

This standard can provide the BNSDI community with a useful reference in the development of a common Transportation data specification for Belize.

This standard can be referenced at the following link:
http://inspire.ec.europa.eu/id/document/tg/tn

M-5 OTHER COMMUNITY MAINTAINED STANDARDS.

Some de facto standards have emerged through various research and development efforts and are now in common usage in the industry. This section includes those that have some direct relevance to the BNSDI programme.

M-5.1 GeoTIFF

GeoTIFF represents an effort by over 160 different remote sensing, GIS, cartographic, and surveying related companies and organizations to establish a TIFF based interchange format for georeferenced raster imagery. GeoTIFF has become an international standard that is periodically updated through broad professional consultation. It is recommended that the BNSDI adopt this standard and continue to follow and apply the refinements to the standard over time.

GeoTIFF is a public domain specification which allows georeferencing information to be embedded within a TIFF file. The potential additional information includes projections, coordinate systems, ellipsoids, datums, and other information needed to establish the spatial reference for the imagery or gridded data contained in the file. The GeoTIFF format augments the TIFF format, so TIFF-enabled software incapable of reading and interpreting the specialized georeferencing metadata should still be able to open a GeoTIFF file sufficiently to at least view the image or scanned map data. The GeoTIFF specification defines a set of TIFF tags provided to describe geographic and cartographic information associated with TIFF imagery that originates from such sources as satellite imaging systems, scanned aerial photography, scanned maps, digital elevation models, or as a result of geographic analyses. Its aim is to allow the means for tying a raster image to a known model space or map projection, and for describing those projections. The tags documented in the GeoTIFF specification are to be considered completely orthogonal to the raster-data descriptions of the TIFF specification, and impose no restrictions on how the standard TIFF tags are to be interpreted, which color spaces or compression types are to be used, etc.

This standard is maintained and used by a large number of organizations involved in geospatial technologies. It is suggested that the BNSDI community adopt the standard and monitor the evolution of the standard in the future.

The standard is freely available and can be accessed online at http://trac.osgeo.org/geotiff/.

M-5.2 Network Common Data Form (NetCDF)

NetCDF (Network Common Data Form) is a set of software libraries and self-describing, machine-independent data formats that support the creation, access, and sharing of array-oriented scientific data.
NetCDF is product of the Unidata community. Unidata is a diverse community of education and research institutions with the common goal of sharing geoscience data and the tools to access and visualize that data. For more than 30 years, Unidata has been providing data, software tools, and support to enhance Earth-system education and research. Funded primarily by the National Science Foundation (NSF), Unidata is one of the University Corporation for Atmospheric Research (UCAR)'s Community Programs (UCP).

This standard is maintained and used by a large number of scientific organizations involved in scientific research and data collection. It is suggested that the BNSDI community adopt the standard and monitor the evolution of the standard in the future.

The standard can be accessed online at http://www.unidata.ucar.edu/software/netcdf/