

EN-MSIOA GIS Platform

Final Report



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Abbreviations/Acronyms

AB	Abay Basin
ABN	Abay-Blue Nile
BA	Baro-Akobo
BAS	Baro-Akobo-Sobat
BASWN	Baro-Akobo-Sobat-White Nile
BGS	British Geological Survey
BN	Blue Nile
CGIAR-CSI	Consultative Group for International Agriculture Research - Consortium for Spatial Information.
CRA	Cooperative Regional Assessment
CSA	Central Statistics Agency, Ethiopia
DEM	Digital Elevation Model
EEP	Ethiopian Electric Power
EEPCO	Ethiopian Electric Power Corporation
EGY	Egypt
EN	Eastern Nile
ENFPEW	Eastern Nile Flood Preparedness and Early Warning
ENID	Eastern Nile Irrigation and Drainage
EN-MSIOA	Eastern Nile Multi-Sectoral Investment Opportunity Analysis
ENPM	Eastern Nile Planning Model
ENPT	Eastern Nile Power Trade
ENSAP	Eastern Nile Subsidiary Action Program
ENTRO	Eastern Nile Technical Regional Office
ENTROKBASE	ENTRO Knowledge-Base
ENWM	Eastern Nile Watershed Management
ESA	European Space Agency
ESPSI	Ethiopia-Sudan Power System Interconnection
ESRI	Environmental Systems Research Institute
ETH	Ethiopia
FAO	Food and Agriculture Organization, United Nations
GERD	Grand Ethiopian Renaissance Dam
GCS	Geographic Coordinate System

GIS	Geographic Information System
GLWD	Global Lakes & Wetlands Database
ISO	International Organization for Standardization
IT	Information Technology
IUCN	International Union for Conservation of Nature
JMP	Joint Multipurpose Program
lat/long	Latitude/Longitude
MN	Main Nile
MW	Mega Watt
MWIE	Ministry of Water, Irrigation and Energy, Ethiopia
masl	meter above sea level
NB	Nile Basin
NBI	Nile Basin Initiative
NCORE	Nile Cooperation for Result
NEC	National Electricity Corporation, Sudan
MS-Publisher	Microsoft Publisher
MODIS	Moderate Resolution Imaging Spectroradiometer
OSI	One System Inventory
PDFs	Portable Document Files
SDN	Sudan
SRTM	Shuttle Radar Terrain Mission
SSD	South Sudan
TSA	Tekeze-Setit-Atbara
UK	United Kingdom
UNESCO	United Nations Educational, Science and Culture Organization
USBR	United States Bureau of Reclamation
USGS	United States Geological Survey
WB	World Bank
WDPA	World Database on Protected Areas
WGS 84	World Geodetic System, 1984 datum
WLD	World

1. Introduction

1.1. General

The Nile Basin Initiative (NBI) is a partnership between the riparian states of the Nile River: Burundi, Democratic Republic of Congo, Egypt, Ethiopia, Kenya, Rwanda, South Sudan, Sudan, Tanzania, Uganda and Eritrea (as an observer). NBI's shared vision is to achieve sustainable socio-economic development through the equitable utilization of, and benefit from, the common Nile Basin water resources.

The Eastern Nile Subsidiary Action Program (ENSAP) strives to realize this vision in Eastern Nile (EN) region. The Eastern Nile includes the countries Ethiopia, Egypt, South Sudan and Sudan, and encompasses four main sub-basins: Abay-Blue Nile (ABN), Baro-Akobo-Sobat-White Nile (BASWN), Tekeze-Setit-Atbara (TSA) and Main Nile (MN). The institution established for planning and implementing ENSAP in the EN is the Eastern Nile Technical Regional Office (ENTRO).

ENSAP has been supporting the EN countries for over a decade now in cooperatively identifying and preparing water resources investment projects while at the same time promoting sustainability issues, both in the environment and social senses. Managing a trust fund dedicated to the Nile Basin Initiative, the World Bank (WB) has been supporting ENSAP and its executive arm ENTRO both financially and technically. Currently, as part of NCORE (Nile Cooperation for Result), the WB is supporting ENTRO in developing a range of knowledge and analytical products with support of ENTRO staff, consultants and interns/young professionals drawn from academia and EN Government institutions. This will include the development of an EN Multi-Sectoral Investment Opportunity Analysis (EN-MSIOA), EN Value of Cooperation, EN Climate Risk Assessment, and other knowledge products.

The Eastern Nile Multi-Sectoral Investment Opportunity Analysis (EN-MSIOA) study is one of several specific studies that are being undertaken to achieve the general objective of the NCORE from the Eastern Nile perspective. The overall objective is to develop a regional water investment strategy for the EN region that broadly supports socio-economic development, poverty reduction, and the reversal of environmental degradation.

1.2. The Consultancy Service

This refers to a contract agreement entered between ENTRO and a GIS Consultant to undertake GIS and information/knowledge management works of the EN-MSIOA with a total level of input of 45 days over a period of two and half months, commencing 16th of October 2014 and continuing through 31st December 2014.

The main GIS and related tasks/activities can be summarized as:

- Production/Preparation of Maps;
- Providing general GIS Support for the EN-MSIOA Study;

- Creation of Spatial Knowledge Products;
- Development of GIS Platform with a Geodatabase (spatial database).

The key deliverables of the current GIS consultancy include: various sectoral-thematic GIS maps, spatial knowledge products, a Geodatabase, map slider, products catalogue, online published maps, interim & final reports, and a GIS Platform encompassing all these resources.

This final report has been prepared as per the Terms and Conditions stipulated in the contract to briefly report the activities carried out and progress made so far, and provide essential descriptions for the key deliverables.

The final deliverable of the project has been provided as a package comprising the EN-MSIOA_GIS Platform database with a web-interface linking all resources with documentation (see the following Chapters).

2. The EN-MSIOA GIS Platform

The GIS platform developed for the Eastern Nile Multi-Sector Investment Analysis (EN-MSIOA) comprises the following essential resources:

- EN-MSIOA Atlas of Maps, Report Maps & Posters
- EN-MSIOA Map Slider
- EN-MSIOA Geodatabase/Geospatial Datasets
- EN-MSIOA Spatial Knowledge Products
- EN-MSIOA Online Published Maps
- EN-MSIOA ArcMap Documents
- EN-MSIOA Documentation
- EN-MSIOA Study Documents
- A Web-Interface Linking EN-MSIOA Resources

Figure 1 shows the EN-MSIOA GIS Platform database including the spatial knowledge products currently uploaded on ENTROKBASE (ENTRO's server) to further strengthen ENTRO's existing Knowledge-Base system. For practical purposes, the geospatial datasets have been thematically organized in a Geodatabase (using ArcGIS) as well as in file folders. Several technical study reports/documents prepared as part of the present EN-MSIOA have also been incorporated in the platform.

The web-interface developed to link relevant EN-MSIOA resources is shown in Figure 2. This EN-MSIOA GIS Platform provided with a side navigation pane and links to required maps, spatial products & data and related documentations, help users to navigate through and easily access the available EN-MSIOA spatial knowledge base. The spatial documentation is basically composed of chapters/sections of the present final report, spatial product catalogues and related descriptions.

Figure 1 EN-MSIOA GIS Platform Database

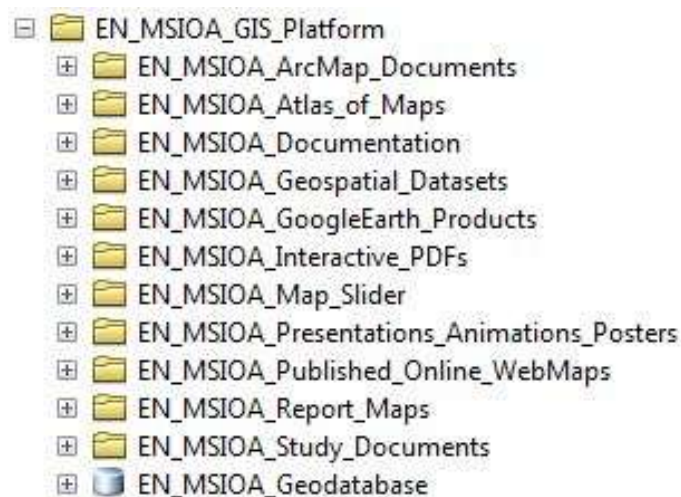


Figure 2 EN-MSIOA GIS Platform Web-Interface



The proceeding chapters provide brief accounts on some important EN-MSIOA resources including EN-MSIOA Atlas of Maps, report maps, map slider, Geodatabase, other spatial knowledge products, online published maps and deliverables.

Annexes 1-3 provide essential notes on map production and related tasks/activities, certain GIS support provided to various EN-MSIOA study components, list of main maps included in the Atlas, and selected EN-MSIOA Geodatabase datasets.

3. EN-MSIOA Atlas of Maps & Report Maps

As part of the Eastern Nile Multi-Sector Investment Opportunity Analysis (EN-MSIOA), more than 55 maps have so far been produced. These comprise: the various Maps in the Atlas, maps included in EN-MSIOA Situational Analysis report, and others kept as working, presentation or reference maps.

The Atlas of Maps (Figure 3) incorporates A3-sized maps, mostly prepared with background base-maps like satellite images, DEM (digital elevation model) and other derived products. As much as possible, the maps have been prepared to be self-explanatory with essential map layers suitably composed, and a separate block on the right side provided for locator/index map, detailed legend, scale bar, north arrow, ENTRO logo, and bars for title and other necessary details.

The report maps are generally A4-sized and prepared deliberately with limited but pertinent details. They have been mostly produced without background basemaps like satellite imageries and show only relevant main-theme legend. The report maps prepared as part of EN-MSIOA study have been compiled in MS-Publisher (Figure 4 shows cover-page and back-cover of the report maps published as double-column A3-sized pdf document).

The Contents of the Atlas Maps include: general location maps, administrative area maps, surficial geology, relief & drainage, soils, climate, hydrology, irrigation, hydro-power and environmental hot-spots, among other maps. (Annex 1 provides the list of main maps).

Figure 3 Atlas of Maps (cover-page)

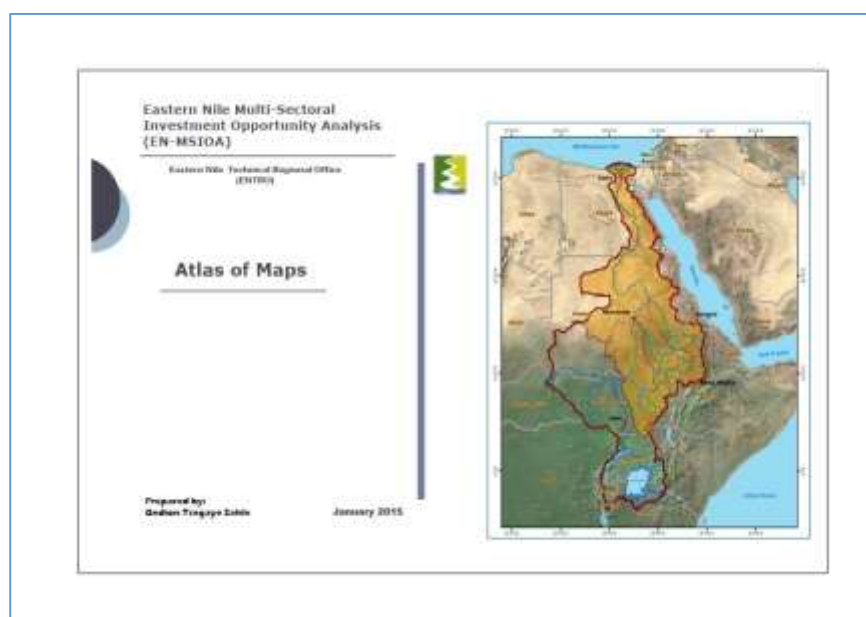


Figure 4 Report maps (compiled in MS-Publisher)



Note included in the Atlas of Maps:

This Atlas of Maps has been prepared as part of the Eastern Nile Multi-Sectorial Investment Opportunity Analysis (EN-MSIOA) Study. The designations employed and the presentation of materials in this Atlas do not imply the expression of any opinion whatsoever on the part of the Nile Basin Initiative (NBI) nor the Eastern Nile Technical Regional Office (ENTRO) concerning the legal or development status or aspiration of any country, administrative area, city or its authorities, or concerning the delimitation of its frontiers or boundaries.

4. Data Organization & Geo-database Development

All the necessary geospatial data have been initially organized thematically in folders. Quite a lot of spatial data were acquired from previously developed ENTRO project databases although some datasets required serious updating and data/information re-arrangement. Numerous new datasets have also been created since the work involved multi-sectorial analysis with additional development project sites (see Annex 1).

For the current study, a spatial database called EN_MSIOA_Geodatabase.gdb has been created using ArcGIS. The main bio-physical environment, socio-economic and infrastructure geospatial datasets used for the preparation of the EN-MSIOA Atlas and report maps have been thematically organized in three raster catalogs and seven feature datasets as shown in Figure 5. Most of the datasets have been subjected to limited but necessary quality inspection including geographic location checking of certain features, limited attribute table cleaning, metadata development and other appropriate sorting and re-arrangement, before they were incorporated in the Geodatabase.

Figure 5 The EN-MSIOA Geo-database



Feature Datasets and Raster Catalogs Description:

Admin (also known as administration): includes comparable admin areas of the EN countries organized by sub-basins (Admin Zones of Ethiopia, States of Sudan, States of South Sudan, Regions of Eritrea and Governorates of Egypt), protected areas (like national parks and nature reserves), towns & cities, and demographic (population & population density) feature classes.

Climate: includes precipitation, temperature, potential evapotranspiration and aridity index raster datasets.

DEM & Relief: includes Digital Elevation Model (DEM), hillshade (derived from the DEM) and color shaded relief imagery raster datasets.

Geology: includes Eastern Nile surficial geology and groundwater storage/potential feature classes.

Hydrography: incorporates feature classes of river/stream networks, lakes & reservoirs, seas and Eastern Nile and Nile sub-basin boundaries feature classes.

Hydropower: includes feature classes of existing and proposed/planned/potential hydropower sites, regional power-systems interconnection transmission lines and substations.

Irrigation: includes feature classes of existing irrigation schemes, potential irrigation projects and main irrigation canals, organized by country and sub-basin.

Landcover/Landuse: includes Eastern Nile landcover-landuse raster datasets from different sources.

Soils: includes Eastern Nile soils feature class.

Transportation: incorporates feature classes of roads, railways and navigation canal like Suez Canal.

Annex 3 provides thumbnail images of some of main feature classes and raster datasets contained in their respective raster catalogs and feature datasets of the EN_MSIOA_Geodatabase. Naming of the datasets has been carried out by using geo-prefixes denoting the geographic extent of the dataset, followed by the type of data/information (see Table 1). It is similar to naming systems employed in existing project-based ENTRO spatial databases developed by the present consultant and colleagues (see references).

Table 1 Geo-Prefixes used in Naming Raster Datasets & Feature Classes

a) Sub-basins/Basins Geo-Prefixes	
AB	Abay Basin
ABN	Abay-Blue Nile
BA	Baro-Akobo
BAS	Baro-Akobo-Sobat
BASWN	Baro-Akobo-Sobat-White Nile
EN	Eastern Nile (sub-basin)
NB	Nile Basin
TSA	Tekeze-Setit-Atbara
MN	Main Nile
WN	White Nile
Atb	Atbara
Tkz	Tekeze

b) Country/World Geo-Prefixes	
ETH	Ethiopia
SDN	Sudan
SSD	South Sudan
EGY	Egypt
EN	Eastern Nile (countries)
WLD	World

Examples of named Geodatabase Feature Classes & Raster Datasets:

- ABN_hydropower_project_sites
- ETH_AB_potential_irrigation_projects
- EN_surficial_geology
- WLD_shaded_relief_imagery
- NB_main_rivers
- EGY_main_irrigation_canals
- EN_rainfall_july
- WLD_countires
- EN_capital_cities
- SSD_potential_irrigable_areas
- MN_admin_areas
- SDN_Atb_exiting_irrigation_projects

It has been mentioned earlier that, for practical purposes, the geospatial datasets thematically organized in a Geodatabase (using ArcGIS) have also been provided in file folders. Additional essential layers like online basemap layers and symbology layers (containing map legend color schemes) have also been kept separately in these file folders.

5. Spatial Knowledge Products

The main spatial knowledge products created as part of the EN-MSIOA include maps, interactive pdfs, interactive Google Earth products, map slider, animated spatial products and other derived products. The report maps and Atlas of Maps have been discussed in Chapter 3. This section provides brief descriptions of some of the spatial knowledge products produced for the current study.

Simple interactive products catalogues linking available spatial knowledge products have been prepared using MS-Publisher and converted to pdfs, and incorporated in the GIS platform.

5.1. Interactive PDFs

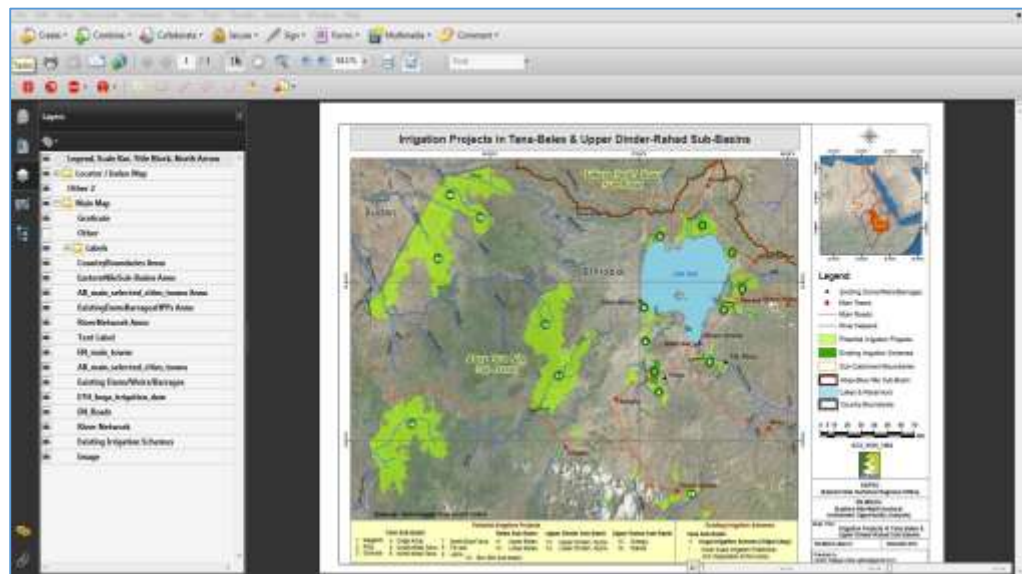
In view of the fact that the main development sectors need to be dealt with properly, irrigation and hydropower project and environmental interactive pdf maps prepared for the current study have been separately organized.

The interactive pdfs have been produced in such a way that the map objects that make-up the maps are exported as layers while still keeping their geographic coordinates. The map layers, annotations, labels and title block details have been carefully labeled. Adobe Reader is a widely-used software for reading pdfs; recent/latest versions can be freely downloaded from the net (www.adobe.com). Also commercially available is Adobe Acrobat with advanced functionalities.

Depending on the user's desires, the eyes on left side of the interactive pdfs allow certain layers/labels/objects either to appear on the map or be turned off. For example, turning on and off basemaps can help view hydropower projects, irrigation canals or other selected features alone or accompanied with other few limited layers.

Another interesting thing about these interactive pdfs is that one can point at any feature (like a dam, a city/town, etc.) or move along certain features (rivers, canals, farm blocks, etc.) and be able to check or monitor geographic coordinates displayed on the right bottom side of the map (Figure 6). The coordinate system used for the Atlas and report maps is GCS_WGS 84 (Geographic Coordinate System; World Geodetic System 1984 datum), so are the displayed lat/long coordinates in degree-minute-seconds or decimal-degrees.

Figure 6 Interactive PDFs (irrigation map example)

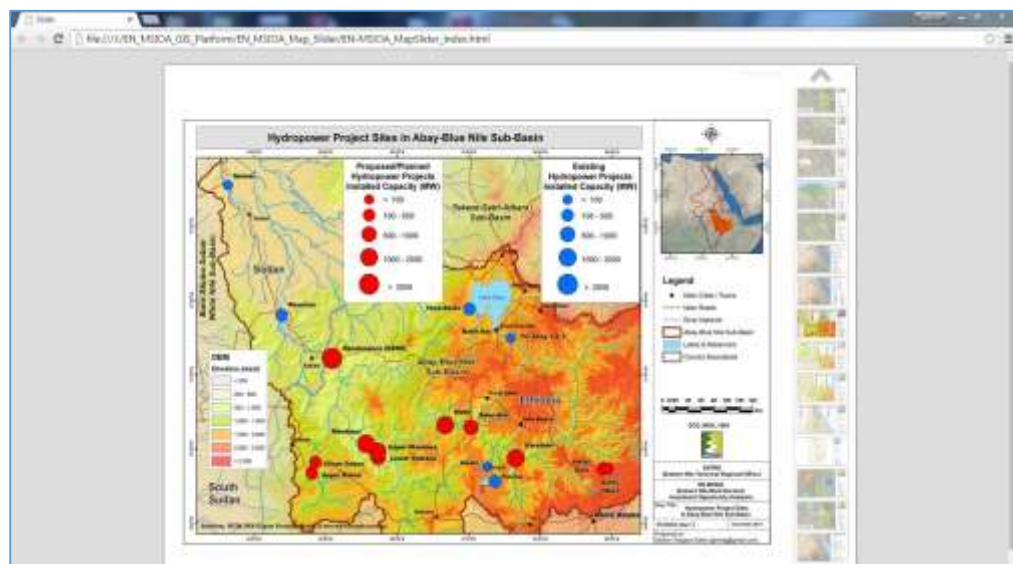


5.2. EN-MSIOA Map Slider

As discussed earlier, various maps have been produced for the EN-MSIOA study project. For wider audiences or broader users, web-based map sliders / catalogues are however preferable since they only require commonly available web-browsers such as Internet Explorer, Google Chrome, Mozilla Firefox, Opera or other free web-browsers that can be downloaded from the net. Simple map sliders can make presentations even handier and easy to use with better on-screen visualization and professional look.

Figure 7 shows a map slider with published EN-MSIOA Atlas of Maps developed for the current EN-MSIOA Study. It is provided with a main map slider and a thumbnail slider on the side.

Figure 7 Map Slider developed for EN-MSIOA Maps

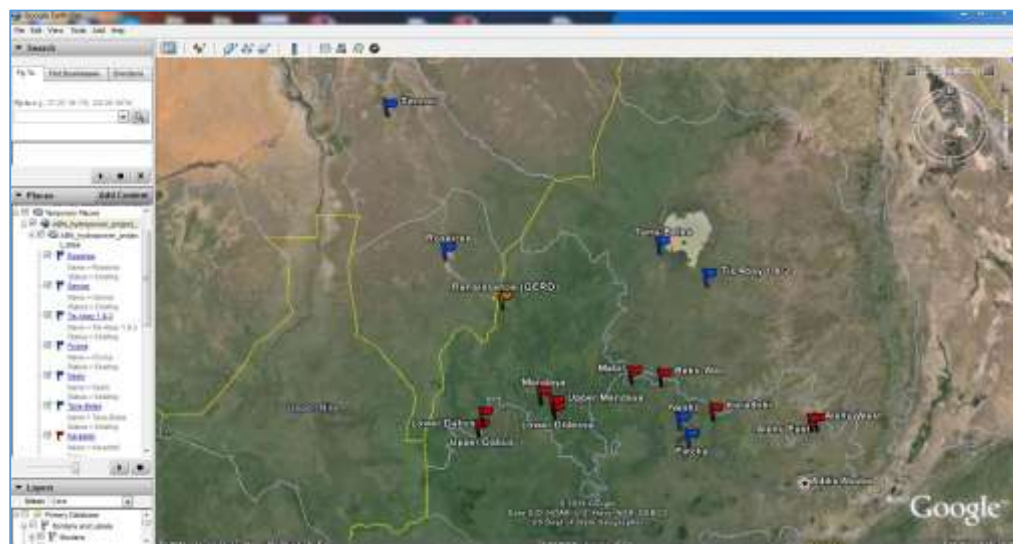


5.3. Interactive Google Earth Products

Google Earth is one of the widely-used software for displaying spatial datasets on a 3D-globe viewer, carrying out simple spatial analysis (measurement, overlay, mapping, etc.) and preparing presentations, among others. Selected geospatial hydro-power datasets used to prepare the Atlas of Maps have been organized by sub-basin, processed and presented in kmz format for use in Google Earth or other compatible applications. EN sub-basins boundary file has also been provided together with these files. Also included is Eastern Nile's proposed regional power transmission route from Eastern Nile Power Trade Study.

- ABN_hydropower_project_sites.kmz
- BASWN_hydropower_projec_sites.kmz
- TSA_hydropower_projects_sites.kmz
- MN_hydropower_projects_sites.kmz
- EN_proposed_regional_power_transmission_route.kmz
- EN_sub-basins.kmz

Figure 8 Hydropower Projects Sites in Abay-Blue Nile Sub-Basin



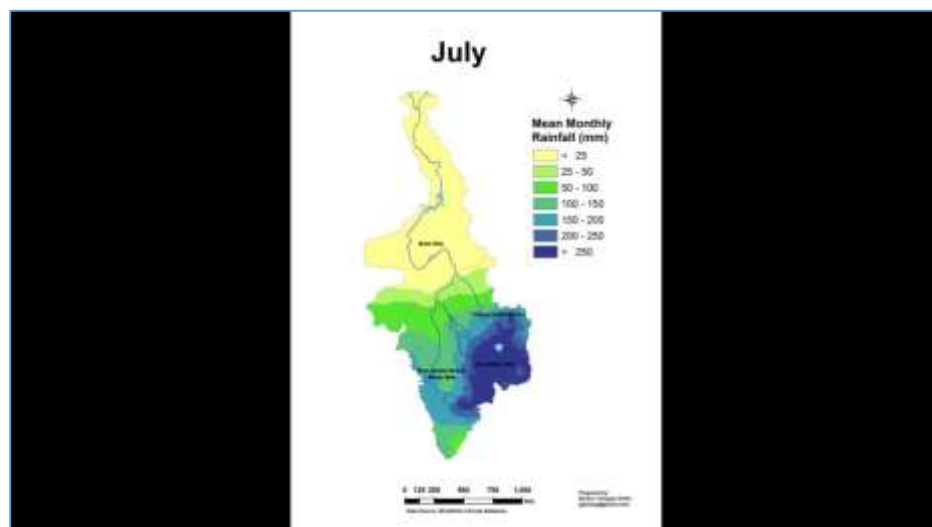
These spatial hydropower products are interactive in that pointing on any required hydropower site provides you necessary attributes like name, status (potential/planned/proposed; existing; construction stage) and installed capacity (MW).

5.4. Animated Products, Presentations & Posters

Animated products and presentations prepared so far for the current study include:

- EN Spatio-Temporal_Rainfall_Variation.pptx
This spatial product shows the temporal and spatial rainfall variation in the Eastern Nile sub-basin. Under slideshow mode, the Power Point presentation routinely plays twelve mean monthly rainfall maps in intervals giving audiences time to clearly view the seasonality of rainfall and spatial extents of rainfall classes (amount).
- EN-MSIOA GIS Platform.pptx
Presentation prepared to report the EN-MSIOA GIS platform development.

Figure 9 EN Spatio-Temporal Rainfall Variation Presentation



- Posters
 - EN Sub-Basins (showing relief & drainage)
 - EN WRM Schematics (Eastern Nile water resources modeling schematics)

5.5. ArcMap Documents

The ArcMap documents here refer to the map layouts (mxd files) of the EN-MSIOA Atlas of Maps, Report Maps and other presentation/poster maps. ArcCatalog can be used to directly view the map layouts, provided that ArcGIS desktop is installed on the user's machine.

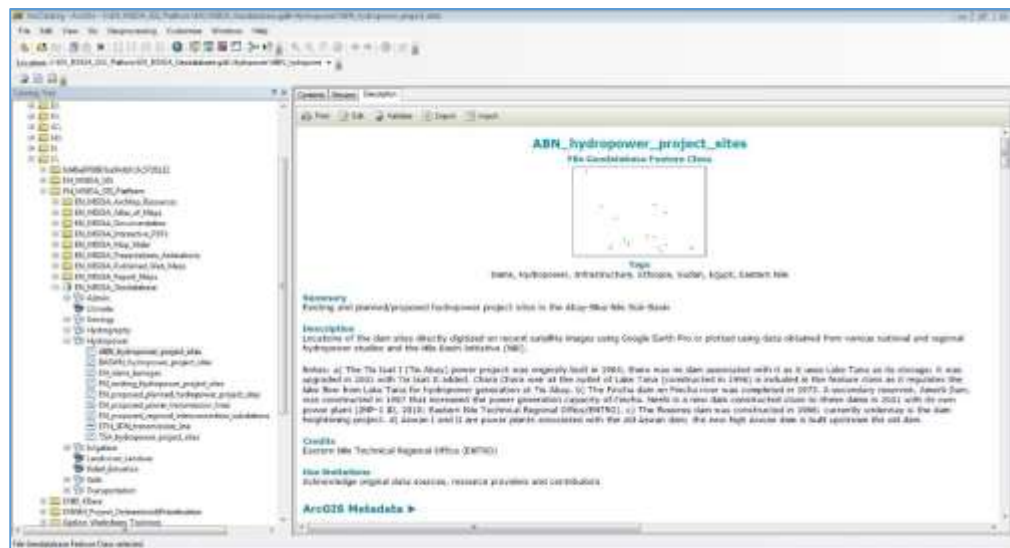
The map document properties (title, summary, description, author, etc.) have been filled out, thumbnails created and relative pathnames to data sources stored. The later helps to repair data sources (map layers' links) automatically when moving the mxds and the accompanying spatial databases to different drivers or machines.

5.6. Metadata

Metadata refers here to descriptions prepared for specific geospatial resources of the EN-MSIOA study. For most of the newly created Geodatabase resources (feature datasets, raster catalogs, feature classes, raster datasets and file Geodatabase) metadata has been created using ArcCatalog 10 Metadata editor (ISO 19139 metadata implementation specification). For some datasets, it was required only to update or modify the metadata.

These Metadata can be converted to formats like xml and html as required (some xml/html metadata are provided in the main database for reference).

Figure 12 Metadata for selected hydropower feature class from EN_MSIOA Geodatabase



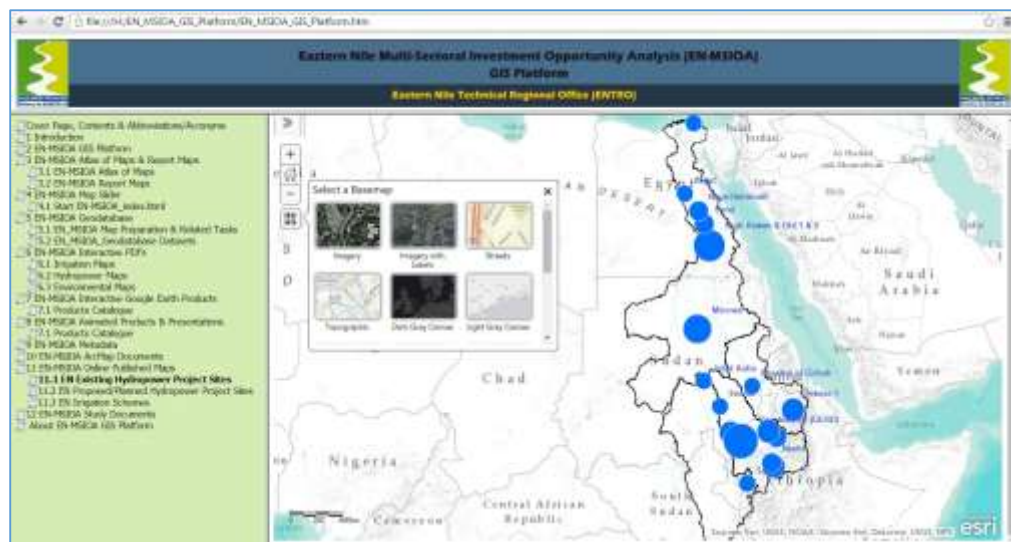
6. Publishing Maps Online

Publishing maps online has been carried out using ArcGIS resources. For practical reasons, it has been found suitable to use online basemaps and overlay the EN-MSIOA updated geospatial layers to publish maps. For the current study, the existing and potential/planned/proposed irrigation and hydropower project maps have been published online. The published maps can be viewed in a browser, ArcGIS desktop or mobile device, shared via email or embedded in a website.

- EN Existing Hydropower Project Sites
- EN Proposed/Planned Hydropower Project Sites
- EN Existing and Potential Irrigation Projects

The html of the online published maps have been copied and embedded in webpages. These web-maps have been integrated with the EN-MSIOA GIS Platform and made available together with other knowledge products and spatial resources.

Figure 13 Published Hydropower Map (html)



7. References

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Ethiopian Electric Power Corporation.
- Sources of certain geospatial datasets given in EN-MSIOA Atlas of Maps, January 2015 (part of the present EN-MSIOA GIS Platform).
- Hi Slider, image/map slider software used for EN-MSIOA GIS Platform: <http://www.hislider.com/>.
- Numerous other thematic geospatial datasets and hydropower/irrigation studies (most of them noted in ENTRO's project-based Knowledge-Base documentations listed above; also provided in metadata prepared for geospatial/GIS datasets).

Annex 1: Preparation of Maps & Related Tasks

Notable tasks/activities carried out in relation to GIS map preparations for the EN-MSIOA Study:

- The EN-MSIOA team members, ENTRO staff members and other professionals have been consulted to define data requirements; the main geospatial datasets required have been noted; essential datasets have been collected from existing ENTRO databases and online resources; and various methods/approaches used to fill the data/information/knowledge gaps:
 - Recent publicly available remote-sensing and GIS data required to fill data-gaps and map preparation have been compiled and utilized. As recent satellite imageries covering the Eastern Nile basin is not available in ENTRO, online imageries have been used as a basemap for seven A3-sized irrigation maps included in the Atlas of Maps. The landcover-landuse maps have also been prepared from raster datasets in public domain; some admin (for Eastern Nile countries at different levels) and demographic datasets (Ethiopia, Egypt, Sudan and South Sudan) have also been downloaded from pertinent sites; datasets previously downloaded from the net have also been compiled.
 - A number of documents, maps and information have been collected from different institutions and professionals: Demographic data from Central Statistics Agency (CSA) of Ethiopia and hydropower & irrigation studies from Ministry of Water, Irrigation and Energy (MWIE) of Ethiopia and Ethiopian Electric Power (EEP).
 - In addition to these, several maps have been geo-referenced and important hydropower project sites and irrigation schemes digitized (for example: Geba 1 & 2; Chemoga Yeda dams and power plants; South Sudan potential irrigation schemes; Wolkayit potential irrigation project; Negesso/Anger irrigation feasibility studies; and few Ethiopian national parks).
- The Eastern Nile development areas were considered in relation to environmental hot spots. Essential geospatial datasets like National parks, flood-prone areas, wetlands and seasonally flooded areas were used together to quickly assess potential environmental constrains in irrigation development areas. Essential maps for the Baro-Akobo-Sobat and Abay-Blue Nile have also been prepared. In addition to these, considering the relatively high erosion rate on the highlands and its effect on downstream reservoir and irrigation reservoir sedimentation, available reference maps and documents have been extracted from Eastern Nile Watershed Management (ENWM) project documents for workshop presentation purposes.

- Support has been given to the water resources modeling activity by providing necessary geospatial hydrologic and water resources management related maps, datasets and reference materials;
- Necessary socio-economic admin and transport layers such as main towns, main roads, railways, navigation canals like Suez, have also been included in some of the hydropower and irrigation maps to help spatially locate and assess current economic activity and growth potential/development areas.

The report and Atlas maps produced necessarily support the EN-MSIOA to spatially identify priorities in terms of water resource development and investment projects.

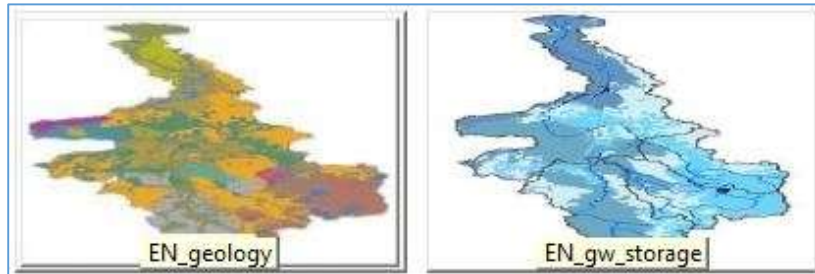
Other than these, posters/maps showing water resources modeling schematics of the EN sub-systems and regionally significant potential hydropower and irrigation projects were prepared for the final workshop.

Annex 2: List of EN-MSIOA Atlas of Maps

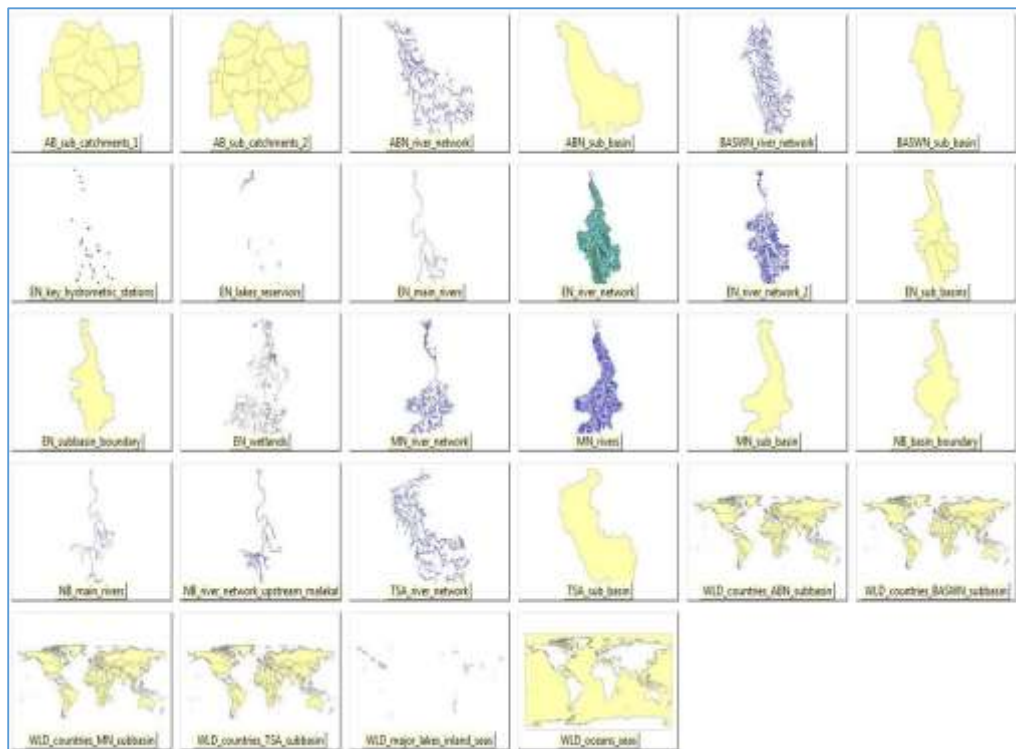
Theme/Category	Title of Map
General	Eastern Nile Sub-Basin within the overall Nile Basin Eastern Nile Sub-Basins
Eastern Nile Admin Areas & Demography	Abay-Blue Nile Sub-Basin: Admin Areas Baro-Akobo-Sobat-White Nile Sub-Basin: Admin Areas Tekeze-Setit-Atbara Sub-Basin: Admin Areas Main Nile Sub-Basin: Admin Areas Eastern Nile Population Density
Physical Setting	Eastern Nile Surficial Geology Eastern Nile Soils Abay-Blue Nile Sub-Basin: Relief & Drainage Baro-Akobo-Sobat-White Nile Sub-Basin: Relief & Drainage Tekeze-Setit-Atbara Sub-Basin: Relief & Drainage Main Nile Sub-Basin: Relief & Drainage
Climate & Hydrology	EN Mean Annual Rainfall EN Mean Monthly Rainfall EN Mean Annual Temperature EN Mean Annual Potential Evapotranspiration EN Aridity Index EN Groundwater Potential EN Key Hydrometric Stations Schematics for Water Resources Modeling (EN Sub-Systems)
Landcover-Landuse	EN Landcover-Landuse (MODIS Product) EN Landcover-Landuse (Globcover; ESA's product)
Irrigation	Irrigation Projects in Tana-Beles and Upper Dinder & Rahad Sub-Basins Irrigation Projects in Didessa, Fincha & Guder Sub-Basins Irrigation Projects in Blue Nile & Lower White Nile Sub-Basin Irrigation Projects in Baro-Akobo-Sobat Sub-Basin Irrigation Projects in Tekeze-Setit-Atbara Sub-Basin Main Nile Irrigation Projects (immediately d/s Aswan) Nile Delta Irrigation Projects Potential Irrigation Projects in South Sudan
Hydropower	Existing Hydropower Sites in Eastern Nile Sub-Basin Proposed/planned Hydropower Project Sites in Eastern Nile Sub-Basin Hydropower Projects in Abay-Blue Nile Sub-Basin Hydropower Projects in Baro-Akobo-Sobat-White Nile Sub-Basin Hydropower Projects in Tekeze-Setit-Atbara Sub-Basin Hydropower Projects in Main Nile Sub-Basin EN Regional Power-Systems Interconnection Systems
Development Areas / Environmental Hot Spots	Abay-Upper Blue Nile Irrigation Projects / Environmental Hot Spots Baro-Akobo-Sobat Irrigation Projects / Environmental Hot Spots Eastern Nile Protected Areas (Parks, Wetlands & Conservation Areas)

Annex 3: Selected EN-MSIOA Geodatabase Datasets

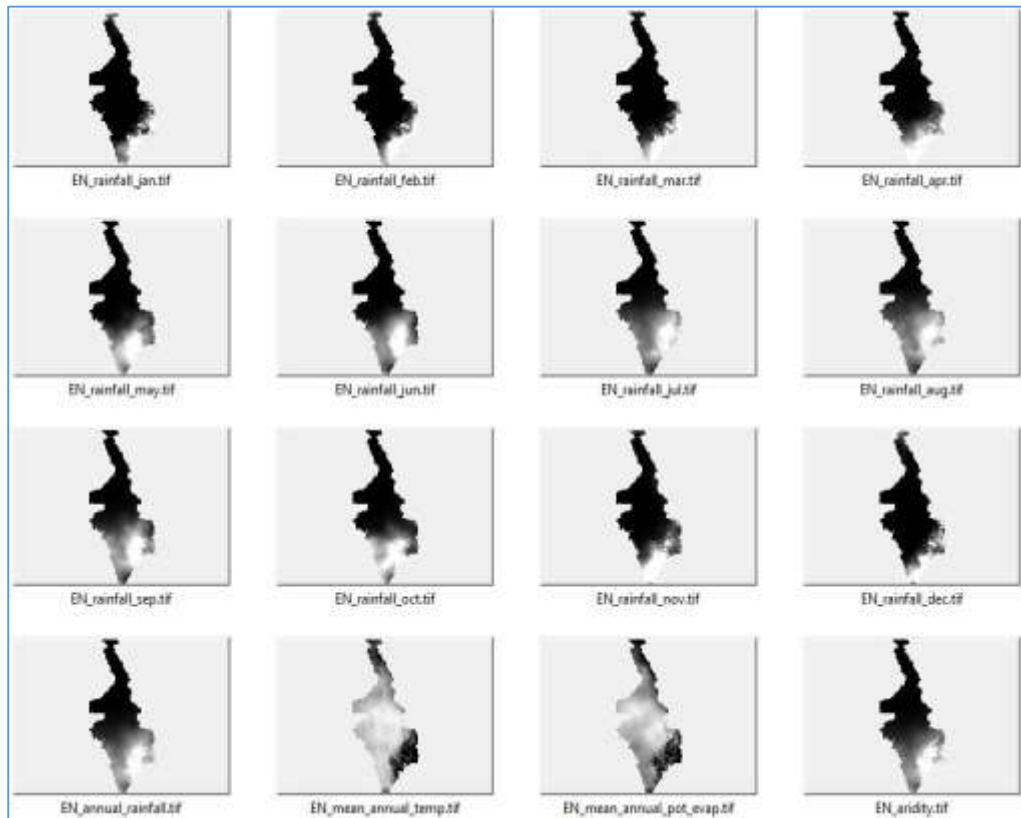
Geology Feature Class



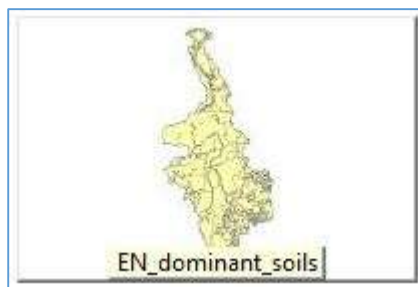
Hydrography Feature Classes



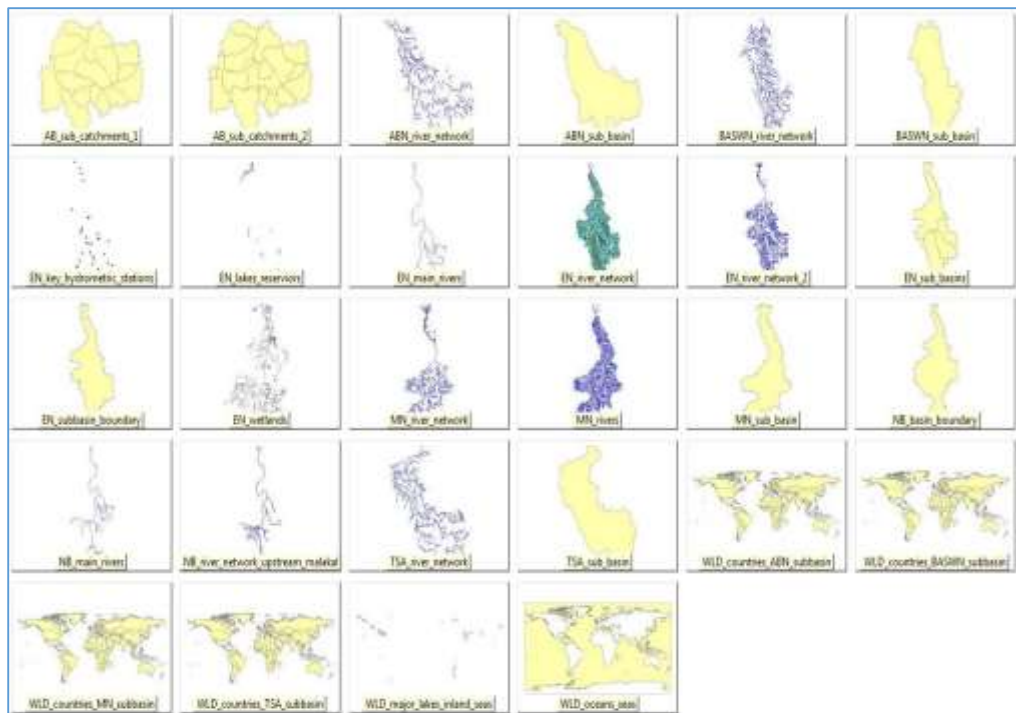
Climate Raster Datasets



Soils Feature Class



Hydropower Feature Classes



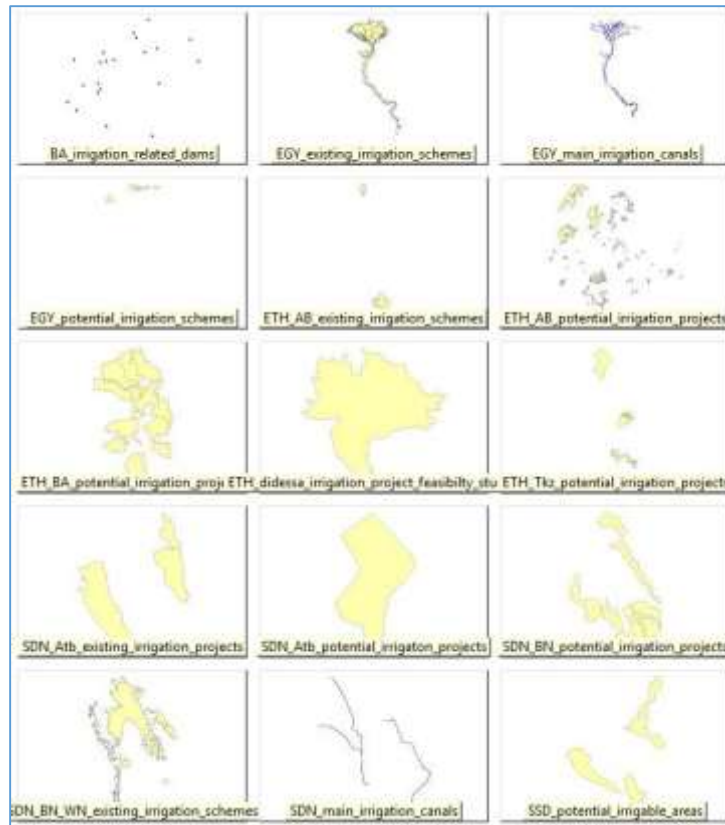
DEM_Relief Raster Datasets



Landuse/Landcover Raster Datasets



Irrigation Feature Classes



Admin Feature Classes

