Software

PHOTOMOD

Module

PHOTOMOD VectOr

USER MANUAL

Racurs, Moscow, 2009

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1. Overview

1.1. What is VectOr

The **VectOr** software is a powerful desktop cartography and GIS system, developed for digital maps creating, editing and printing out. You can create digital map based on separate digital map sheets of different scales, types and nomenclatures. **VectOr** aggregates complete list of tools for visualization, creating, editing and searching map objects. You can add different types of objects including non-cartographic ones to the map, display fragments of the map, using different scales, select objects and process groups of objects based on semantics and metrics parameters.
VectOr is running under Windows 95 or Windows NT operation systems.
VectOr supports MDI interface and drag and drop mode to make the system user-friendly and simple. You can use True Type fonts while map creation and make high quality hardcopies, using a comprehensive list of output devices, supported by MS Windows.
The system kernel is implemented as a set of Dynamic Loading Libraries (DLLs) that allows to add any map-handling functions easily. Applications can be created using different C++ compilers as well as MS Visual Basic and databases such as FoxPro or Paradox.

The main features of **VectOr** system are as follows:

- creation and using hierarchical structure of database, including following levels: work region, map sheets, layer, objects;
- editing digital maps using GUI: creating new level, updating, deleting, copying and restoring map objects
- displaying map objects, using standard geographic, topographic, cadastral and other map symbols
- supporting standard Russian map classifiers (object coding)
- supporting user-created map symbols
- measurements on the map: distances, areas, perimeters, buffer zones, statistical parameters
- colorful and grayscale hardcopies, changing map contents and scale when output
- WYSIWYG mode;
- C++, C, Pascal, Delphi, Visual Basic, Builder C++ and other programming interfaces.

1.2. Hardware and software requirements

- Pentium;
- 16 mb RAM;
- Windows 95,98,2000,NT.

1.3. General software structure

VectOr is implemented as module-separated multitasking system. All modules may be called from the main shell. **VectOr** includes:

- digital maps manager;
- command shell;
- service modules.

VECTOR.EXE file is used as a command shell. It is responsible for user-interface. Digital maps manager is a DLL used for digital maps creating, editing, etc. Service modules are data converters, printing modules, modules of calculations and analysis and others. All of them are also implemented as DLLs.
Such a structure allows users to create their own applications and easily integrate them to the system.
See also \DOC\MAPAPI.DOC file.

1.4. Data types

The digital map may contain following cartographic datasets:

- vector maps,
- raster images,
- matrix datasets

Different types of datasets can be processed separately or as a whole. They can be converted to a number of formats or from one type to another, displayed, printed out, edited, etc.

1.4.1. Vector maps structure

VectOr processes vector maps, stored in open SXF format. Datasets from F1, F20V, MIF / MID, DXF and other vector formats can be converted to/from SXF.
For SXF description see \DOC\SXF3-30.TXT и DOC\SXF4TXT.DOC files.

1.4.1.1.Vector map sheet

Digital vector map dataset includes:

- Passport data corresponding to map sheet (nomenclature, scale, projection, coordinate system, rectangular and geodetic coordinates of corners etc);
- Metrics data(coordinates of vector elements);
- Object attributes (semantics data)

Object of a digital map is a collection of digital data (metrics, semantics, reference data) corresponding to real world object (bridge, river, etc.) or a group of real world objects (block of buildings) or a part of object if it is a complex one (some part of a building).
Vector objects can be separated to different layers on the map based on their thematic properties (rivers, roads, etc). According to thematic layer each vector object can be represented by symbol or pattern included to the map legend. These symbols (patterns) are stored in the digital map classifier.
Following are the limitations of **VectOr** digital map:

- up to 65536 types of objects
- up to 255 layers
- up to 65536 types of characteristics for each type of objects

Standard topographic digital map uses about 2000 types of objects, 16 layers and 200 characteristics.

1.4.1.2. Map nomenclature – sheet title

To make it easier and faster to look for map sheets of different scales and ground location, every map sheet is assigned unique name, called **Nomenclature**. Nomenclature (map sheet title) is placed on the top (north) part of sheet either in the middle or right side. Usually Nomenclature is following by a name of largest town located on the map.
Structure of Nomenclatures depends on map type (topographic, geographic, aerial navigation, city plans, etc), scale and coordinate system.
Russian Nomenclature structure based on 1:1 000 000 map sheets. Any of them covers ground area of 6 degrees of longitude and 4 degrees of latitude. Nomenclature of 1:1 000 000 map sheet includes number of “Latitude zone” (Latin capital character starting from equator (A-zone) to the north) and number of “Longitude zone” (integer number starting from 180 degrees longitude (0-zone) to the east). Thus, for example 1:1 000 000 map sheet of area around city of Smolensk is named N-36 (Smolensk).

1.4.1.2.1. Nomenclature of topographic maps

Nomenclature (map sheet title) of topographic maps depends on their scales. There is a list of standard scales of topographic maps below:

- 1: 1 000 000,

- 1: 500 000,
- 1: 200 000,
- 1: 100 000,
- 1: 50 000,
- 1: 25 000,
- 1: 10 000.
- 1: 5 000.

Template of Nomenclature of 1:10 000 map looks like:

9. Z - 99 - 999 - 9 - 9 - 9. Z
1 2 34 567 8 9 10 11

Dot or dash may be used as delimiter.

Character number	Meaning
1	Hemisphere (0 - north, 1 - south)
2	“Latitude zone” (Latin character from A to U). Numbering is starting from equator
3, 4	“Longitude zone” (Integer from 1 to 60). Numbering is starting from meridian of 180 degrees to the east
5, 6, 7	Number of 1:100 000 map sheet (1-144) or number of 1:200 000 map sheet (1-36) or number of 1:500 000 map sheet (1-4)
8	Number of 1:50 000 map sheet (1-4) on 1:100 000 map sheet
9	Number of 1:25 000 map sheet (1-4) on 1:50 000 map sheet
10	Number of 1:10 000 map sheet (1-4) on 1:25 000 map sheet
11	Sheet type (Latin characters A - D) can be one of following: • single (A, B, C, D) • double (A, C) • four sheets in one (A) Sheet type depends on latitude zones: • zones A - O – single sheet • zones P - S – double sheets • zones T - U – sheets “four in one”

Characters 8, 9, 10 depending on sheet type assigned following values:

- 1,2,3,4 if single sheet
- 1,3 if double sheet
- 1 if “four in one” sheet

Character 8 is optional

Samples of nomenclatures:

Scale 1: 1 000 000:

0. A-01,
0. A-60

Scale 1: 500 000:

0. A-01-001,
0. A-01-004,
1. A-60-001,
1. A-60-004

Scale 1: 200 000:

0. A-01-001,
0. A-01-036,
1. A-60-001,
1. A-60-036

Scale 1: 100 000:

0. A-01-001,
0. A-01-144,
1. A-60-001,
1. A-60-144

Scale 1: 50 000:

0. A-01-001-1,

0. P-01-144-3,
0. T-60-144-1,
1. A-60-144-2

Scale 1: 25 000:

0. A-01-001-1-1,
0. A-01-144-1-4,
0. A-60-144-4-1,
0. A-60-144-4-3

Scale 1: 10 000:

0. A-60-001-1-1-1
0. A-60-001-1-2-3
0. A-60-144-4-1-1
0. A-60-144-4-3-1

The template of Nomenclature of 1:5 000 map sheet looks like:

9. Z - 99 - 999 - 999
1 2 34 567 89 10

The symbols 1,2,3,4,5,6,7 correspond to 1:100 000 map sheet.

Symbols 8,9,10 (integers 1 - 256) - number of 1:5 000 map sheet on 1:100 000 map sheet.
Sample of 1:5 000 nomenclature: 0. A-60-144-256.

1.4.1.2.2. Nomenclature of geographic maps

Standard scale range for geographic maps includes following scale values: 1 : 500 000, 1 : 1 000 000, 1 : 2 500 000, 1 : 5 000 000, 1 : 10 000 000.
Geographic maps are created in 4 subsystems (zones) that cover the entire globe.

- Midlatitude (main) in conformal conic projection (standard parallels are 30 and 60 degrees (north))
- North (polar) - central meridians are 90 degrees (east and west). Conformal azimuthal (stereographic) projection (standard parallel is 60 degrees (north)).
- South (polar) - central meridians are 90 degrees (east and west). Conformal azimuthal (stereographic) projection (standard parallel is 60 degrees (south)).
- Equatorial - conformal cylindrical Mercator projection (standard parallels are 26 deg 08.4 min south and north).

Midlatitude subsystem used for mapping of north hemisphere in 1:500 000 - 1:10 000 000 scale range. Subsystem includes following 5 blocks:

- Europe (central meridian is 20 deg east), code 1
- Asia (central meridian is 90 deg east), code 2
- Pacific ocean (central meridian is 170 deg west), code 3
- North America (central meridian is 40 deg west), code 4
- Atlantic ocean (central meridian is 40 deg west), code 5

Blocks of midlatidude subsystem are composed as follows.

Europe, Asia, North America, Atlantic Ocean

10	11
00	01

Pacific ocean

00	01

Composing polar subsystems

20	21	22
10	11	12
00	01	02

Composing equatorial subsystem

20	21	22	23	24
10	11	12	13	14
00	01	02	03	04

Map sheet of 1 : 10 000 000 scale divided into:

4 sheets 1 : 5 000 000;
16 sheets 1 : 2 500 000;
100 sheets 1 : 1 000 000.

Map sheet of 1 : 1 000 000 divided into 4 sheets of 1: 500 000 scale.

Dividing sheet of 1 : 10 000 000 into sheets of 1 : 5 000 000.

10	11
00	01

Dividing sheet of 1 : 10 000 000 into sheets of 1 : 2 500 000.

30	31	32	33
20	21	22	23
10	11	12	13
00	01	02	03

Dividing sheet of 1 : 10 000 000 into sheets of 1 : 1 000 000.

90	91	92	93	94	95	96	97	98	99
80	81	82	83	84	85	86	87	88	89
70	71	72	73	74	75	76	77	78	79
60	61	62	63	64	65	66	67	68	69
50	51	52	53	54	55	56	57	58	59
40	41	42	43	44	45	46	47	48	49
30	31	32	33	34	35	36	37	38	39
20	21	22	23	24	25	26	27	28	29
10	11	12	13	14	15	16	17	18	19
00	01	02	03	04	05	06	07	08	09

Dividing sheet of 1 : 1 000 000 into sheets of 1: 500 000.

10	11
00	01

Standard nomenclature of geographic map includes **subsystem code** or Midlatitude **block code**, **scale code** and **sheet number**.

Codes of subsystems, Midlatitude blocks and scales are as follows:

Subsystem (block) name	Subsystem code	Scale	Scale code
Blocks of a Midlatitude		1:10 000 000	01
subsystem:	1	1: 5 000 000	02
Europe	2		
Asia	3	1: 2 500 000	03
Pacific ocean	4	1: 1 000 000	04
North America	5	1: 500 000	05
Atlantic ocean	6	For the summary	
North pole subsystem		enlarged sheets	
South pole subsystem	7	1:10 000 000	10
Equatorial subsystem	8	1: 5 000 000	55

Sheet number includes number of Longitude and Latitude zones, which intersection it is located on. Numbering of both zones starts at 0 and rises from bottom to top (Latitude) and from left to right (Longitude)
Nomenclature template looks like:

99 - 99 - 99 - 99
12 34 56 78

Character number	Meaning
1	Block or subsystem (1-9)
2	Scale (1-5)
3,4	Number of Latitude zone, Longitude zone of subsystem (00 - 24)
5,6	Number of Latitude zone, Longitude zone of 1:10 000 000, 1:5 000 000, 1:2 500 000, 1:1 000 000 maps (00 - 99)
7,8	Number of Latitude zone, Longitude zone of 1:1 000 000, 1:500 000, (00 - 11)

Nomenclature samples:

Subsystem Europe:
Scale 1: 10 000 000: 11-01
Scale 1: 5 000 000: 12-01-10
Scale 1: 2 500 000: 13-01-21
Scale 1: 1 000 000: 14-01-53
Scale 1: 500 000: 15-01-53-10

1.4.1.2.3. Nomenclature of aerial navigation maps

Nomenclature template looks like

9 - 9 - 99 - 99
1 2 34 56

Character number	Meaning
1	Block (1 - main block, 2 - north pole block, 3 - south pole block)
2	Scale (1 - 1:2 000 000, 2 - 4 000 000)
3,4	“Longitude zone” (01 - 12)
5,6	“Latitude zone” (01 - 20)

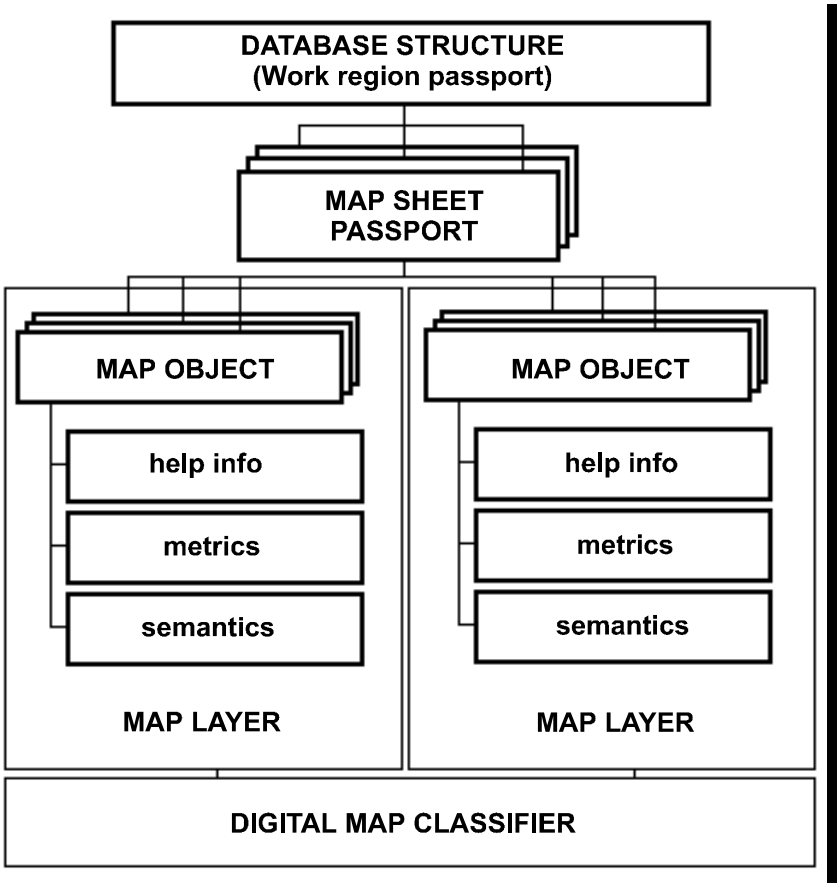
Sample of nomenclature
The main block of a scale 1: 2 000 000: 1-2-10-05.

1.4.1.3.Work region

Usually, nomenclature sheets divide the source cartographic data used for maps of different types and scales. Each sheet corresponds to exact area of the ground. It is necessary to merge somehow several paper sheets to work with them as a whole.

The merging procedure is very simple in **VectOr** software. You can correctly display as many as needed digital map sheets on the screen all together if they have the same scale and map projection. At the same time each of them is still stored in separate file.
The collection of map sheets to be processed all together is called **Work region**.

Digital maps database structure



All map sheets (nomenclature sheets), included to Work region, must have the same scale, projection and coordinate system.
The data related to Nomenclature sheets is located in the following files:

- Metrics (coordinates of objects, *.DAT),
- Semantics (attributes of objects, *.SEM),
- Reference data (indices for fast searching object or its description, *.HDR).

There is one passport file (*.MAP) for the entire Work region that consists of records related to each map sheet. All information related to object attributes and characteristics is stored in digital classifier of work region (*.RCS file).
Work region is created when loading data form SXF file using DIR file (see Appendix A).
Any map sheet, included to work region can be edited, updated and passed from one user to another separately of other work region map sheets. Data files, corresponding to one Work region should be stored in one directory.

1.4.1.4.Structure of vector user maps

The structure of vector maps allows storing digital representation of real objects of region, as well as user-related datasets that can be rapidly varied in time. The samples of such kind of data are information about transportation network, weather forecast, etc.
To store these datasets you just have to add them to additional layers, object types, including attributes in the map classifier. However there are some disadvantages in this way:

- user defined objects located on different map sheets are separated when saving and its further processing is not convenient in most cases
- there is no way to view data, put on one map, on the other one for the same region
- it is necessary to expand and keep up-to date several map classifiers for the maps of different types and scales

So **VectOr** allows to store “user” datasets separately of the “main” maps in special “user maps”.
User map consists of just one map sheet of unlimited size. The size gets changed as some objects are added / removed to/from map. The User map can be displayed along with Vector map and Raster or Matrix maps. The same instance of User map can be visualized on different Vector maps and edited by different users.
User map has its own classifier not equal to the classifier of the “main” map. The number of displaying user maps along with the main Vector map is unlimited.
User map objects can not be linked to the user classifier. Objects of User map can be easily imported from popular GIS systems via DXF or MIF/MID formats.
User map is rescaling appropriately when “moving” from one vector map to another.
Data, related to user map is stored in following files:

- metrics (object coordinates, *.SDA),
- semantics (object attributes, *.SSE),
- information (index records, *.SHD),
- map symbols (*.SGR).

Passport file for user map has *.SIT extension.

1.4.1.5. Group objects

Digital information associated with ground area is stored in separate map sheets. Real ground objects and map symbols (map grid, contours, etc) can be located on different map sheets.
For convenient work with such objects there are two ways:

- Using user maps, which contain one sheet of variable size depending on its contents
- Using group objects

Group object is a map object (real or conditional) which divided into map sheets but gets combined every time it is opening (common object metrics is composed by single ones)
Once Group object is edited, it is automatically cut by map sheet borders. Map frames may have arbitrary configuration.
You can create group objects automatically (in **Sheets adjustment** mode) or manually - using **Add objects to group, Remove objects from group** options of **Map editor** icon panel. Group objects are supported just in case when VECTOR.INI file contains string Group=ON.

1.4.1.6.Graphic map object

Most of digital map objects are described in map classifier. Object description includes object code, layer number, map symbol and other parameters. However when you need to put on a map additional information (some comments, auxiliary lines, polygons) it is more convenient to use simple graphic objects that are not attached to classifier.
So **Graphic map object** is an object that is not linked to classifier but has metrics, semantics, unique ID and map symbol. Map symbol (pattern for lines and polygons) is stored in object description.
When data is transferring in exchange SXF format map symbol is transferring along with other object parameters (coordinates, ID, etc). Instead of external code there is a layer number.
To put Graphic object on a map you should open appropriate user map or create a new one. After this modes of map editor becomes available (creation of line, polygon, point, etc). Map symbol parameters (line pattern, color, thickness, etc) are available in the dialog opened according to current map editor mode.

1.4.2. Raster map structure

Digital raster map is a raster image of exploring ground area in defined scale, projection, coordinate system. In fact raster image is 2D array of brightness values that can be acquired in some spectral interval. Brightness can be represented by different number of “colors” depending on raster type.
VectOr stores raster images in open RST format and supports import of raster objects from

PCX, TIFF, BMP and other popular formats.
The structure of raster **VectOr** file is as follows:

- passport data related to image (image size, raster type, color definition, etc)
- color map description
- raster image (raster map)

Working with raster images along with vector maps, you can easily update and edit any digital information corresponding to exploring ground area.
RST file structure described in \DOC\SXF3-30.TXT.

1.4.3. Matrix map structure

VectOr handles matrix datasets (basically DEMs or feature maps) for the exploring region in the open MTR format. MTR files contain additional data for the main **VectOr** SXF format to represent different characteristics of the map region.
Matrix format has following structure

- passport data for the region
- feature matrix of region

There are two main types of the feature matrix:

- elevation matrix (DEM)
- feature matrix (thematic map)

Matrix can be built based on **VectOr** digital map vector objects. DEMs may contain absolute heights of surface points, relative elevations or its summarized values (called attributes).
The feature matrix is created by searching vector objects based on user defined parameters. The values of feature matrix are weight coefficients calculated by appropriate vector objects parameters.
MTR file structure is described in \DOC\SXF3-30.TXT file.

1.5. Scale range

One of advantages of digital maps versus paper ones is their displaying flexibility. You can display and print digital maps in different scales, using different map legends and so on. However, when using zoomed in map legend symbols or if the image is compressed when scaling, some objects can cover other ones, causing problems in visual map perception. There is a technology called **Map generalization** to make your digital map nice-looking and more informative. One of the main generalization rules is to set visibility of every object according to the current scale of displaying map. **Scale range** can be set for class of objects (forest, lake, sidewalk, etc) when digital classifier is creating, it also can be redefined for any single object by digital map editor tools. Besides user-defined scale range **VectOr** provides automatic generalization procedure for different object categories. Starting at some scale relative to the basic one, **VectOr** changes size of labels, removes relatively small objects, changes thickness of polygon boundaries etc.

1.6. VectOr installation

To start working you should install **PHOTOMOD** system or **VectOr** itself (in case of separate **VectOr** purchasing). See also manual for **PHOTOMOD** system.

2. VectOr interface

2.1. Basic info

2.1.1. Start and exit

VectOr can be started from **PHOTOMOD Montage Desktop** module as well as separately (VECTOR.EXE).

System is handling by mouse and keyboard. Screen is divided into work area, panels, menus and messages area.
Once you have finished **VectOr** session, all maps get closed. All displaying parameters including relative windows placement are saved in service INI files.
To exit **VectOr**, make one of following operations

- Double click on exit button of control menu;
- Select File/Exit option;
- Push F10 on keyboard.

2.1.2. Moving map image

To move an image in view window you can press “Pan” icon at the top menu and “grab” and move window contents. In all other modes (editing, measurements...) you can just press left mouse button and move cursor outside window to get image scrolling in corresponding opposite direction. Another way is to press Shift key and move mouse cursor as needed. You can also scroll a map, using keyboard: Ctrl and PgUp, PgDn, Home, End keys.

2.1.3. Moving cursor

You can move cursor using mouse or arrow keys along with Shift and Ctrl keys when cursor is located over the map image.

2.1.4. Getting object description

To select object, click left mouse button or press Enter when mouse cursor is placed over the object .The dialog **Object selection** is opened. Press **Select** button to select object (it will be highlighted by red color). In case when there are several objects “under” mouse cursor you can switch between them by **Prev** and **Next** buttons. The opened dialog allows viewing and editing semantics, metrics, scale range and displaying style of the object. You can get detailed information about the object by pressing **Info** button.
Once object is selected it can be edited, used in measurements, deleted, etc.
In case if some main panel dialogs is active when you select object, **Object select** dialog is not opening and selected object starts blinking. You can see brief information related to selected object in the top of map window. You can open **Select object** dialog by pressing **Spacebar** when object is blinking.
To cancel object selection, press **Esc** key.
For fast object selection use **Ctrl+left mouse button**. In this case object will be selected without opening the dialog.
The object metrics-related information includes:

- number of subobjects
- ID of displaying subobject
- number of points in object (subobject)
- distance between current and following point of object (subobject)
- azimuth angle between current and following point of object (subobject)

Metrics can be set using different units:

- meters in rectangular coordinate systems
- map units in rectangular coordinate system
- pixels in rectangular coordinate system
- radians in geodetic (geographic) coordinate system
- degrees in values range 1E-6 - 1E-7 in geodetic (geographic) coordinate system
- degrees, minutes, seconds in geodetic (geographic) coordinate system

If you edit object by changing distance and angle, coordinates of vertex that follows current one are changed. You can not correct coordinates of the first object vertex this way.
To edit elevation values in object metrics first you have to open **Full information** window by mouse double click over the dialog title or select **Full info** from pop-up menu that appears by right mouse click over the dialog.

Using popup menu options you can also:
- revert object vertices numbering (including subobjects)
- revert vertices numbering for current subobject
- select current subobject
- set metrics accuracy.

2.1.5. Hot keys

You can use following hot keys while working with **VectOr**:

- View scale:
  > - Zoom in;
  < - Zoom out;
  = - Initial scale.
- Moving view window over the map:
  PgUp - Move up at window size;
  PgDn - Move down at window size;
  Home, Shift +Tab - Move left at window size;
  End, Tab - Move right at window size;
  Ctrl+PgUp - Move to the upper map border;
  Ctrl+PgDn - Move to the lower map border;
  Ctrl+Home - Move to the left map border;
  Ctrl+End - Move to the right map border;
  Ctrl + up arrow - Move up at 16 pixels;
  Ctrl + down arrow - Move down at 16 pixels;
  Ctrl + left arrow - Move left at 16 pixels;
  Ctrl + right arrow - Move right at 16 pixels;
  Shift + mouse moving - Move view window corresponding to mouse cursor position.

- Cursor moving:
  Arrows - Moving by 1 screen pixel;
  Shift + Arrow - Moving by 8 screen pixels.
- Map operation. To start operations of editing, searching, measuring, etc., you should click on corresponding icon.
  Once operation is selected following hot keys become available:
  Ctrl+C - To cancel current operation;
  Ctrl + left button of the mouse - To complete operation.
- Map object selection:
  Enter - To select nearest object to cursor (opens **Object selection** dialog).
  If some operation is active when object selection selected object is blinking. Press Enter again to go to the next object. Press Shift+Enter to go to previous object. Press Ctrl+Enter to complete operation.

  Space - opens Object selection dialog when object is blinking;
  Ctrl+Enter - fast selection of closest to cursor object (without blinking and opening dialog).
- Searching map objects:
  Ctrl+F - Opens object Searching/Marking dialog;
  Ctrl+L - Continues object searching starting at the last found one.

2.2. "File" menu options

Menu **File** used to access to digital data in different formats.

Table 2.1 File menu options

Option	Meaning
New	Create map, user map, plan, matrix, etc.
Open	Open existing vector map, raster image or matrix
Map tree	Select a map from list
Add	Add to active map raster, matrix or user map
Close	Close map, raster or matrix
Update	Add and update data in active map
Save as...	Save map in selected format (BMP, DIR, MTW, SXF, TXT, EMF)
Print	Print a map or its fragment
Printer Setup	Select printer parameters
Exit	Exit VectOr

2.2.1. Creating digital map

2.2.1.1.Creating new map

To create a new map, select **New/Map** option of **File** menu. Dialog window consists of two main parts (see below) appears:

- Area data
- Map sheet data

First fill area-related fields and press **Add** button. Obligatory parameters of map creation are the name of resource (classifier) file (.RSC) and scale value greater than 0. Once **Add** button is pressed **Nomenclature** dialog opens up. After entering Nomenclature (possibly using special template) all map sheet related text fields become available.
Obligatory data for map sheet is coordinates (rectangular or geodetic). For topographic maps of standard Nomenclature this fields get filled automatically. Otherwise coordinates must be entered manually. For geographic maps there also should be filled fields of region passport (standard parallels values, central meridian and origin latitude). Once all necessary fields are filled out, you can close dialog or continue entering data for other map sheets.
You can also use **Copy** button for map creating. In this case you select existing map and copy it to the created one for further editing.
Note that digital map passport can be edited any time using menu **Tools/View Passport**.

2.2.1.2.Creating plan

Plan in **VectOr** terminology is simple version of a digital map. Map in **VectOr** is a set of digital information associated with some ground site and built by standard rules including information about projection, nomenclature, vertical datum etc. Samples of map are topographic, geographic or aerial navigation maps. Map passport must include all this information. So in many cases it is easier and faster to create Plan (for example it is tourist map of Lancaster county, NE). As a result you have digital map in which most of passport fields are filled automatically.
To create plan, select **New/Plan** option of **File** menu. It is important to define what coordinate system you are going to use for your plan. If it is large-scale cadastral scheme you can take coordinates from source paper material. If you want have no information about source coordinate system you should create your own one (local coordinate system). In this case before scanning your paper map you should:

- add a rectangular border to map
- assign 0.0 coordinates to the low-left (south west) map corner
- calculate map scale (approximately)

Measure map size by X and Y axes and convert this distances to meters using scale factor. If for example scale factor is 500 and rectangular X size = 25 cm and Y size = 50 cm you can set following coordinates for plan corners

X southwest = 0.0, Y southwest = 0.0,
X northwest = 125.0 Y northwest = 0.0,
X northeast = 125.0 Y northeast = 250.0,
X southeast = 0.0 Y southeast = 250.0.

Besides coordinate values you should set scale factor (500) and select classifier to be used for plan. If creating **Work region** includes several map sheets you should at first create all sheets separately and then combine them to **Work region**.

2.2.1.3.Creating user map

To create **User map** use **File/New/User map** menu.
You will need to enter its title, type and the name of used classifier (RSC file). Scale entering is optional. Once **User map** passport is created, user map is adding to the "main" map, which it will be used along with. First object can be added to **User map** just after it is included to real map. At this step it is georeferenced to real map coordinate system and can be opened as separate document (if needed) and get object added.

2.2.1.4.Creating matrix

There are several ways to open **Matrix creation** dialog:

- **File/New/Matrix** menu
-  icon in **Map computer** panel
- add non existing file to the matrix list

All information, related to current map and user map objects, is using when matrix creation.
Elevation matrix can be computed in fast mode
Elevation matrix can be computed for selected region or for selected map sheets.
To build matrix for the entire region set on **All region** option. To select some region portion press **Select** button in **Output area** panel and select area you need by two clicks of left mouse button.
Area borders can be also set by coordinate values in **North, South, West, East** text fields
Use **Relief type** menu to set a type of elevation calculations:

- **absolute** - matrix is calculated based on vector objects with **True altitude** attribute as well as vector objects having Z coordinate in metrics
- **summary** - when output elevation values are calculating as a sum of **absolute** elevation and elevation of vector objects with **relative elevation** attribute

In some cases there are several vector elements "under" creating matrix element. To define how to calculate output elevation value **Height if superposition** menu is used. There are two options in this menu:

- **Maximum** - maximum of "underlying" Z - coordinates is put to elevation matrix
- **Average** - average of "underlying" Z values is put to elevation matrix

There can be used auxiliary text file (MTRCREA.TXT) when matrix creation that contains information related to vector objects used for computing elevation values.
You can set output matrix cell size (resolution) in **Element size** text field.

2.2.1.4.1.Fast mode of matrix creation

Elevation matrix can be computed in **Fast** or **Normal** modes. All matrix cells can be separated to two groups:

- cells, which values are calculated at the first step of processing using information related to vector map objects
- cells which values are calculated based on values of neighboring cells

The difference between **Fast** and **Normal** modes is that in first case smaller area and less number of directions are used to calculate values of second group cells. So second group cell values calculated by **Fast** and **Normal** methods may be slightly different.

2.2.2. Opening digital map

To open existing digital map, use **File/Open** menu. Now it is available for viewing, editing, printing out, etc. You can open several maps at the same time and switch between them as needed. If you open map in exchange format (SXF, TXT, DIR, PCX, BMP, TIFF, etc) it is converting to internal **VectOr** format for further processing.

2.2.3. Map tree

Map tree (**File** menu option) is a hierarchical multilevel genealogy chart looking structure that can be created and edited by user for fast searching needed map by its name.
Originally (right after installation), map tree is setup based on sample data included to installation package. It is up to user to edit map tree or create new one. Map tree related information is stored in .TRE file. The Map tree information for every map includes map name and its location on your computer. Map location can be stored as full path or as partial path associated with “parent” branch.
Below are the samples of valid map trees:

- General map [E:\MAP\]
  - Europe [MAP1\EVR.MAP]
  - America [MAP2\US.MAP]
- Special maps [D:\DATA\MAP\]
  - A map of a site of the river [map1.map]
  - A soil map [terr.map]

And

- General map
  - Europe [E:\MAP\MAP1\EVR.MAP]
  - America [E:\MAP\MAP2\US.MAP]
- Special maps
  - A map of a site of the river [D:\DATA\MAP\map1.map]
  - A soil map [D:\DATA\MAP\terr.map]

To edit a map tree use **Add**, **Edit**, **Delete** options of map tree menu **Edit**.

2.2.4. Loading data from external formats

2.2.4.1.Loading vector data

To create a digital map it is necessary to convert data, stored in exchange format, to internal format of **VectOr**. To load dataset stored in the exchange format you have to select corresponding SXF file. As a result of conversion MAP, HDR, DAT and SEM files, associated with the map sheet, are created. You will also need RSC file to use it as a classifier. If you use text version of SXF file it has TXT extension. If you use “file of directions” (DIR extension) as a source it should load vector data according to its internal reference to RCS, MAP and SXF files to include them to creating Work region. The name of Work region will be set according to the name of the first SXF file or the name taken from DIR file. If you need to select some vector objects to include to the creating map use **Filter** button to open **Map structure** dialog. If loading map sheets are locating in adjacent zones of topographic maps all coordinates will be recalculated to the first sheet coordinate system.
If some records can not be read from file they are skipped. Information about “bad” records is put to the LOG file. When data loading, **VectOr** is verifying codes of source objects in the classifier and the validation of its semantics attributes. In case of source data errors, **VectOr**

generates error message in LOG protocol. Objects having invalid classification code are displaying by red outline. All attribute records associated with this objects will be started at "*"-character.

2.2.4.2.Loading raster data

Raster objects needed to be included to the raster map can be loaded from one of the following formats to **VectOr** raster format called RSW:

- BMP;
- PCX;
- TIFF.

To load raster image you should select appropriate raster file. Output RSW file will assign the same name and .rsw extension.
Set the **Scale** and **Resolution** (dots per inch) parameters for output RSW file. Note that these values can be changed during further processing.
To change all related to raster image parameters (Scale, Resolution, Color Map, Georeference) use options of Raster list dialog.

2.2.4.2.1.Loading BMP files

Source BMP file must be standard Windows uncompressed BMP file. No restrictions for image size and color map.

2.2.4.2.2.Loading PCX files

The source file should be standard PCX file. No restrictions for image size and color map.

2.2.4.2.3.Loading TIFF files

The source file should be standard TIFF file (version 6.0). No restrictions for image size and color map.

2.2.5. Saving data

2.2.5.1.Saving digital map

Saving digital map causes saving all types of data (vector, raster, matrix) to appropriate files. Saving procedure is also starting automatically according to time interval set in **Parameters** menu (**Redraw after**).
Editing objects get saved directly to files after finishing each editing operation. All intermediate situations are saved in auxiliary files in LOG directory. These files are cleaned up after sorting map procedure.

2.2.5.2.Saving data in exchange format

Digital map can be saved in following exchange formats: SXF, TXT, BMP, EMF.
It is needed to convert vector data to exchange SXF format if you want to make the data available for other applications or when you want to edit classifier (change object list, change relations between objects and corresponding attributes).
It is possible to convert whole dataset to exchange format as well as copy just selected layers, objects, object types, etc.
To filter (select) objects for conversion use **Filter** button which opens **Structure of a map** dialog. Conversion procedure automatically creates DIR file, containing names of resource file (RSC) and names of SXF files (in case of several map sheets) If program fails, all invalid records are missing and program tries to process rest of them. Errors related information is stored in LOG file.
To save vector map as a text file you should convert source data from internal **VectOr** format to text version of SXF file. To do this you should select output file name and nomenclature of saving map (if there are several map sheets included). Default output filename is equal to

input map file name.
You can save any fragment of digital map in BMP and EMF formats for further processing in external applications. Matrix and raster data are saved in EMF format as rasters. Vector data can also be saved either as raster (**normal** mode) or as vector (**printer** mode). See **View** menu options.

2.2.6. Map upgrading

Map upgrading procedure adds to current map new objects, retrieved from SXF file. The Map, taken from SXF file, should have the same scale, projection and nomenclature as the upgrading one. If object, derived from SXF file, has unique id, equal to id of some object on a map, this object will be replaced. All other objects just get added to the map.
SXF file can be either text (TXT) or binary (SXF) If current map does not contain a map sheet corresponded to SXF file, this sheet will be loaded to the map and the **Work region** is expanded. You can update raster dataset by loading new raster objects from BMP, PCX or TIFF format to current digital map.

2.2.7. Printing a map

To print a map (or its selected fragment) you need:

- turn on the printer;
- press **Print** button.

Once printing is over you get an appropriate message (press OK).

It may take from several seconds to tens of minutes to print a map, depending on map size, computer resources, printer type and printing quality.
Only objects selected by **View contents** dialog are sent to printer. There are several modes of printing used to print a map:

- **Normal** - creates hardcopy of variable filling intensity of polygons used to print on color and grayscale raster printers.
- **Transparent** - creates hardcopy without filling polygons, used to print to any (including vector) output printing devices
- **Outline** - printing vector elements by lines on any printers;

There is a possibility to print the whole map as well as its portion. To select print area press **Select** button and select map region by mouse.
VectOr supports changing the scale when printing. In **Fit to page** mode the output scale is calculated automatically to fit current paper size. Map is divided into pages according to page size, page orientation (Portrait or Landscape) and page margins. You can view output page layouts in **Print** dialog
To select printer and set its parameters use **Printer setup** option.
To print map border (by black color) set **Print border** option on.
There are three radio buttons below the view area located in the upper-left part of **Print** dialog:

- **Map** - shows map in details in view area
- **Scheme** - shows map border in view area to see its relative position when printing (fast visualization)
- **Information** - shows map related info in view area

Possible problems with printing often caused by:

- not enough space for print file that created on disk where MS Windows is installed
- using wrong printer driver (for example PostScript).

2.3. "Edit" menu options

Edit menu used to pass datasets to other applications via clipboard and graphic files.

Table 2.2. Edit menu options

Option	Meaning
Undo	Cancels last executed operation
Copy	Copies selected fragment to clipboard
Copy to	Copies selected fragment to EMF or BMP file
Copy Map window	Copies contents of current active window to clipboard
Copy Map window to	Copies contents of current active window to EMF or BMP file

2.4. "View" menu options

View menu used to set options for currently open map viewing.

Table 2.3. View menu options

Option	Meaning
View Contents	To select objects to be displayed
Map image	Type of visualization (normal, draft, printer, printer outline)
Matrix image	Type of matrix visualization (color or grayscale)
Raster list	Changing raster displaying parameters
Matrix list	Changing matrices displaying parameters
User Map	Changing user maps displaying parameters
Embedded Object	

2.4.1. View contents (Map structure)

The dialog box **Map structure** used to select objects for displaying by different criteria. Map object are structured as follows:

- Map layers and object types
- Object styles
- List of map sheets
- Range of object IDs
- Objects attributes (semantics)
- Spatial object parameters

Full list of map layers, object types, object attributes are defined by **Map classifier**.

To select layers to be displayed you should open **Map structure/Layers** dialog and select needed layers in the list by mouse.

To select map sheets to be displayed open **Map structure/Map sheets** dialog and select/unselect map sheets in the list by mouse.

To set range of displaying object IDs open **Map structure/IDs** dialog and set minimum and maximum ID of displaying objects.

To set criterion for object displaying based on its attributes open **Map structure/Semantics** dialog and set on **Selected semantics** option. If, for example, you want to display objects, that have absolute elevation > 100m you need to build an expression like this **Absolute elevation > 100**. To do it use dialog panel consists of three columns: **Semantics code name, Condition, Value**. Press **Selected semantics** to select attribute name (Absolute altitude). Double click on **Condition** to select **>** and type **100** in **Value** text field.

To set selection by spatial object parameters open **Map structure/Measurements** dialog. Press **Selected measurements** button. Set type of measurement (for example **length**). Set condition like **length < 100** in **Single** mode or **50 < length < 250** in **Range** mode. To set condition use **Expression** panel.

You can use **Model** dialog to create several models of object selection (set by dialogs listed above). To create model, press **Create** button to add model to **Model list** (up to 256 models). Selection models are saved once **VectOr** session is over and restored when system starts another time.

2.4.2. Map displaying mode (Map image)

The vector map can be displayed in several ways:

- Normal - all digital map objects are displaying in accelerated mode according to the map legend stored in the digital classifier.
- Draft - objects are displaying in draft simplified form
- Printer - map looks completely like its hardcopy using full library of output styles
- Printer outline – polygons look like not filled.

2.4.3. Raster displaying parameters (Raster list)

Used to add, remove, change properties of raster objects included to map:

- raster view modes (full, saturated, translucent, average, transparent, none)
- raster color map
- raster relative position on digital map. You can place raster relatively to current vector map using following methods:
  - place raster by one point,
  - place raster by two points with scaling,
  - place raster by two points with scaling and rotation,
  - move raster to southwest map corner

These modes are available in **Raster list/Properties** menu

- current raster position in view window;
- scale
- resolution
- optimization (optimization speeds up raster displaying and reduce required disk space for) raster storing.
- color view preferences

When adding rasters of BMP, PCX, TIFF formats, corresponding converter to internal RSW format is started. Multi-selection mode is also available.

2.4.4. Matrix displaying parameters (Matrix list)

Matrix map can be displayed using two modes:

- Color map
- Grayscale

In case of color map color range from deep-green (low elevations) to deep-brown (high elevation) is used. In case of grayscale low elevation pixels look dark and high elevation pixels look bright.

2.4.5. User map displaying parameters

User map list menu used to change a structure of the list of files of user maps, and properties of a user map selected in the list of files. To access user map parameters use right mouse button or **Properties** button. User has possibility to not display a user map and change a structure of displayed layers and objects.

2.5. "Search" menu options

Search menu used to select map objects based on different parameters.

Table 2.4. Search menu options

Option	Meaning
Search and mark	Searching and marking map objects, using query based on classifier

Option	Meaning
Search by query	Searching object by query
Search by area	Searching by selected area
Search again	Searching object based on conditions selected for previous searching session

2.5.1. Search and mark objects

Dialog **Search object** allows to use set of parameters for object searching:

- map layers and object classes
- object types
- map sheets (Nomenclatures)
- range of object IDs
- object attributes (semantics)
- spatial object parameters

Full list of map layers, object classes, object types, object attributes, is defined by **Map classifier**.

To select layers to be marked you should open **Map structure/Layers** dialog and selects needed layers in the list by mouse.

To select map sheets to be marked open **Map structure/Map sheets** dialog and select/unselect map sheets in the list by mouse.

To set range of marking object IDs open **Map structure/IDs** dialog and set minimum and maximum ID of marking objects. To set criterion for objects selection, based on their attributes, open **Map structure/Semantics** dialog and set on **Selected semantics** option. If for example you want to display objects that have absolute elevation > 100m you need to build an expression like this **Absolute elevation > 100.** To do it, use dialog panel consists of three columns: **Semantics code name, Condition, Value.** Press **Selected semantics** to select attribute name (Absolute altitude). Double click on **Condition** to select **>** and type **100** in **Value** text field. To set selection by spatial object parameters open **Map structure/Measurements** dialog. Press **Selected measurements** button. Set type of measurement (for example **length**). Set condition like **length < 100** in **Single** mode or **50 < length < 250** in **Range** mode. To set condition use **Expression** panel. You can use **Model** dialog to create several models of object selection (set by dialogs listed above). To create model, press **Create** button to add model to **Model list** (up to 256 models). Selection models are saved once **VectOr** session is over and restored when system starts another time.

2.5.2. Searching objects by query

When searching objects by query you should use following searching parameters:

- map layers and object classes
- object types
- map sheets (Nomenclatures)
- range of object IDs
- object attributes (semantics)
- spatial object parameters

Full list of map layers, object classes, object types, object attributes, is defined by **Map classifier**.

To select layers to be marked you should open **Map structure/Layers** dialog and selects needed layers in the list by mouse.

To select map sheets to be marked open **Map structure/Map sheets** dialog and

select/unselect map sheets in the list by mouse.
To set range of marking object IDs open **Map structure/IDs** dialog and set minimum and maximum ID of marking objects. To set criterion for objects selection, based on their attributes, open **Map structure/Semantics** dialog and set on **Selected semantics** option. If for example you want to display objects that have absolute elevation > 100m you need to build an expression like this **Absolute elevation > 100.** To do it, use dialog panel consists of three columns: **Semantics code name, Condition, Value.** Press **Selected semantics** to select attribute name (Absolute altitude). Double click on **Condition** to select **>** and type **100** in **Value** text field. To set selection by spatial object parameters open **Map structure/Measurements** dialog. Press **Selected measurements** button. Set type of measurement (for example **length**). Set condition like **length < 100** in **Single** mode or **50 < length < 250** in **Range** mode. To set condition use **Expression** panel. You can use **Model** dialog to create several models of object selection (set by dialogs listed above). To create model, press **Create** button to add model to **Model list** (up to 256 models). Selection models are saved once **VectOr** session is over and restored when system starts another time.

2.5.3. Searching objects by selected area

To search map objects by selected area you should select area and set searching parameters. Use mouse to select area on a map and complete operation (see 3.2.1.7 section).
Then you have to select searching parameters:

- search inside/outside area
- searching distance (used in «outside» mode)
- filter (object selection by layer, type, attributes, etc)

2.5.4. Searching objects by name

This mode is used to search objects by value of selected attribute. To set attribute (semantics) name used by searching operation press **Setup..** button and select semantics by double click or **OK** button. You can also manually enter semantics name (**By name** mode) or semantics code (**By number** mode) in **Search semantics** text field. You can type just first characters of attribute name (code) for speeding up (for example “Lancast” instead of “Lancaster” or «167» instead of «167523»). All dialog parameters (attribute values) are saved and restored for next Searching sessions.

2.6. “Tools” menu options

Table 2.5. Tools menu options

Option	Meaning
Map Editor	Editing vector map
Map Computer	Measurements over digital map
Map Navigator	Navigation through digital map
Map Sorting	Sorting (and compression) data
View Passport	Viewing and editing map passport
Map classifier	Editing and adding object attributes and map symbols
Run Application	Running application tasks

You can find a description of such programs as map editor, measurements on the map, map passport in **Basic application tasks** section.

Run application dialog consists of three main parts:

- task name
- path to corresponding DLL file
- control icons

Use **Add** and **Delete** buttons to add and remove tasks from list. To run application, press **Start** button. If some task is currently executing there is a checker near its name in the list. Some DLLs also additionally marked by icon.

2.7. "Scale" menu options

Used to scale a map on the screen.

Table 2.6. "Scale" menu options

Option	Meaning
Zoom In	Zooming in map by left mouse button
Zoom Out	Zooming out map by left mouse button
Full	Display full map
Zoom 1:1	Display map in 1:1 scale

There also two ways to change map scale:

- press **<** or **>** keys to zoom in, zoom out map respectively;
- select zooming mode by right mouse button.

2.8. "Options" menu options

Table 2.7. "Options" menu options

Option	Meaning
Coordinate System	Selecting coordinate system
Colors	Selecting palette for map displaying
Fonts	Selecting fonts used in map displaying and dialogs
Screen Options	Screen size and image scale
Language	Language, used in interface (English or Russian)
Redraw after (s)	Period of digital map updating

There are following coordinate systems available:

1. Rectangular in Meters.
2. Rectangular in Map units.
3. Rectangular in Pixels.
4. Geodetic (Radians).
5. Geodetic (Degrees).
6. Geodetic (Degrees, minutes, seconds).

2.8.1. Map palette

Used to set colors and brightness/contrast parameters of a map including vector and raster information.
Color palette dialog includes following panels:

- **Service** - used to set colors of map background, selected objects, marked objects and thickness of line for vector object displaying.
- **Map** - used to set colors for map displaying as well as brightness/contrast parameters. To change color in map palette click on the appropriate one in the color map and change it as needed.
- **Raster** - used to set raster color map as well as raster brightness/contrast parameters. To change color in color map click on appropriate one on the color map and change it as needed.
- **Matrix** - used to set matrix color map as well as matrix brightness/contrast parameters. To change color in color map click on appropriate one on the color map and change it as needed.

2.8.2. Setting fonts

You can set fonts for map labels as well as fonts, used by dialogs.
Screen fonts dialog allows you to set fonts used by map displaying and raster output devices. **Plotter fonts** dialog allows you to set fonts for printing to vector output devices (plotters).

2.8.3. Image size and scale

Digital map can be displayed in different scale. There is a current scale value at the bottom part of the main window. However visual object size, distance between objects on screen, height of label letters may not correspond to the paper samples. It also can depend on monitor type. It happens because MS Windows does not determine physical size of screen pixel but printer devices do. You can use **Screen options** dialog to set **Screen size** (default value (diagonal) is 1.5 inches less than passport one) and **Zoom factor.** Image increasing makes a map more viewable but changes its real scale. If diagonal value is set correctly and zoom factor is equal to 100%, the accuracy of image displaying is 0.5 pixel. Map symbols are displaying it its real size when displaying scale is equal to the map scale. Displaying scale changing causes appropriate changes in map symbol size.

MAP DISPLAYING PARAMETERS DO NOT CAUSE CHANGES IN CALCULATIONS OF COORDINATES, DISTANCES, AREAS, etc.

2.9. "Window" menu options

Window menu options used to handle user-interface elements on the screen.

Table 2.8. Window menu options

Option	Meaning
Cascade	To display windows as a cascade
Mosaic	To display windows as a mosaic
Arrange Icons	To put all icons to a row
Close All	To close all open documents

2.10. "Help" menu options

There are two choices under **Help** menu: **Information** (opens VectOr's help) and **About**, that opens panel containing following information:

- Program name;
- Program version;
- Hardware key ID;
- Mail address of software developing company;
- Web-site;
- E-mail address.

3. Basic application tasks

3.1. Editing passport of vector map

To edit passport of the map, select **View Passport** option from **Tools** menu.
Map passport consists of datasets related to **Work region** and **Map sheet**.
The Work region dataset includes:
1. Title of area;
2. Source data:
   - Type of a map;
   - Scale;
   - Name of resource file;
3. Projection data:
   - Ellipsoid;
   - Vertical datum;
   - Coordinate system;
   - Source projection;
   - 1st standard parallel;
   - 2nd standard parallel;
   - Central meridian;
   - Origin latitude;
4. Area extents;
5. Additional information:
   - Plane and elevation units
   - Digitizing rate;
   - Type of a framework;

Not editable records:

- Resource file name (since it is created only when passport creation)
- Scale;
- Area extents, since they are calculated automatically by map sheet extents

If map type gets changed you get a warning that data are in wrong projection. So it is not recommended to edit Map type.

Map sheet data set includes:

1. Nomenclature (sheet title);
2. Coordinate of the sheet (rectangular and geodetic);
3. Data related to a map document:
   - Sort and type of the initial map document;
   - Date of survey;
4. Declination data:
   - Magnetic declination;
   - Average meridian convergence;
   - Annual magnetic declination;
   - Date of measurement of the declination;
5. Data files name (the name is common for all data files with HDR, DAT, SEM, GRA

extensions.
All map sheet related data sets can be edited except Nomenclature since it is constant for standard map sheets. You also must not edit coordinates for this type of maps.
Once **Add** button is pressed new dialog window gets opened. You need to enter map sheet nomenclature using standard template (if needed). When dialog **Input of nomenclature** is closed input data fields appear on screen.
Coordinates data fields should be filled obligatorily. In case of standard map sheets (with known nomenclature) this fields are filled out automatically. In all other cases you should enter coordinate values manually. For geographic map, it is also necessary enter projection related data, including 1st and 2nd standard parallels, central meridian, origin point latitude. Once all necessary data is input you can either close the dialog or continue input adding new map sheets.

3.2. Vector map editor

To activate vector map editor select **Tools|Map Editor** option.
Vector map editor is an integrated part of **VectOr** system and used to creation and editing digital vector maps.
There is a panel of icons located along the left screen border. Each icon corresponds to option of vector map editor. You have to push the appropriate icon to activate editing mode you need. In case when you are working in one editing mode and do not finish the editing operation all other icons are not available.
Once editing is completed the vector object is saved to file automatically.
If program failures during the input and editing, data is not lost.
All displaying options (such as color, scale, background, view contents) are available when editing and can be changed any time you need.
Map editor functions are as follows:

- Select object type
- Create point object
- Create line object
- Create polygon object
- Create label
- Create object with existing code
- Create object group by coordinates from file
- Save conditional object
- Create object layouts
- Delete selected object
- Delete one subobject
- Delete all subobjects
- Move object
- Full copy (backup) of object
- Edit vertex
- Create node
- Delete vertex
- Close object
- Edit label
- Change object type
- One step undo
- Create subobject
- Copy portion
- Delete marked object
- Restore deleted objects
- Edit common vertices of adjacent objects
- Rotate object
- Copy object to user map

- Add vertex
- Intersect objects
- Merge objects
- Copy all subobjects
- Copy marked objects to user map
- Joining vertices
- Dissection of line object
- Joining line objects
- Delete panel
- Group panel
- Topology panel
- Restore edited objects
- Parameters of edit session
- Code conversion of marked objects
- Filtering objects
- Smoothing objects
- Point panel
- Creation panel
- Panel Processing semantics of marked of objects
- Add semantics to marked objects
- Delete semantics of marked objects
- Replace semantics of marked objects
- Text panel
- Selection panel
- Expand line object
- Classification.

3.2.1. General information

3.2.1.1.General information related to object editing

All editing operation can be executed for **selected** object. See detailed description of object selection in 3.8.1.3 section. Only one object can be selected at once. When editing (or creating) is done object is still selected so you can switch to another editing tool. If you want to begin editing another object just select it by standard way.
Some operations are implemented for object group (for example **Deleting marked objects**). In this case you should previously **mark** (do not confuse **Mark** mode with **Select** mode) objects using **Search** menu tools.
Although there is a **Save as** option in **File** menu, you should not save your map after editing. Edited object gets saved right after its editing is completed. It's possible to return to previous statuses of map unless it is **sorted**.

3.2.1.2.Map editor options

Map editor options are as follows:

- **Cut objects by map sheets:** objects that cover several map sheets in work region will be cut by every sheet border.
- **Cut objects by parent frame:** objects that cover several map sheets in work region will be cut by the frame where the first object vertex located.
- **Use semantics when object creating**. Adding semantics when object creating.
- **No frame editing**. Frame editing causes changes of map georeference and may have unexpected effect.
- **Tracing rate** parameter of smoothing vector line created by interactive vectorization (tracing) over raster image
- **Zone width** - Width of creating object - parallel line. Zone width can also be changed

by «+» and «-» keys

- **Joining tolerance** - tolerance of joining corresponding objects located on adjacent map sheets. If the distance between corresponding vertices is greater then tolerance value objects will not be combined.
- **Filtering level** - distance between object vertex and line segment connecting previous and next vertices. If this distance is less than Filtering level parameter this vertex is removed by line filtering operation (decreasing number of line vertices). Recommended value is 1.5.
- **Spline order** used for line smoothing operation.

3.2.1.3.Object selection

To select object, click left mouse button or press Enter when mouse cursor is placed over the object .The dialog **Object selection** is opened. Press **Select** button to select object (it will be highlighted by red color). In case when there are several objects «under» mouse cursor you can switch between them by **Prev** and **Next** buttons.
Once object is selected it can be edited, used in measurements, deleted, etc.
In case if some main panel dialogs is active when you select object, **Object select** dialog is not opening and selected object starts blinking. You can see brief information related to selected object in the top of map window. You can open **Select object** dialog by pressing **Spacebar** when object is blinking.
To cancel object selection, press **Esc** key.
For fast object selection use **Ctrl+left mouse button.** In this case object will be selected without opening the dialog.

3.2.1.4.Unselecting objects

To unselect an object you can

- Select new one
- Press **Cancel** button on **Select object** dialog
- Press **Ctrl** and right mouse button
- Press **Cancel** on pop-up menu opened by right mouse button.

3.2.1.5.Selecting object part

You can select a portion of object by selecting 2 (for non-closed line) or 3 (for closed line) metrics points using left mouse button. This mode can be used for editing or making measurements when message string is **Select part of object**.

3.2.1.6.Editing object part

Select object part by three points and edit object part point by point (move them to a new position). To complete editing – press **Ctrl** key and left mouse button. To go back use **Step back** or **Restoring edited object**.

3.2.1.7.Completing operation

To complete operation (for example calculate segment length or save line) you can:

- press **Ctrl+Enter**
- press **Ctrl+left mouse button**
- press **right** and **left mouse buttons**
- press **Yes** or **OK** in appropriate dialog

If you complete object creation by double click, additional vertex is created. Otherwise not.

3.2.1.8.Canceling operation

To cancel any operation you can:

- click again on the same icon to get it released
- select another operation
- close corresponding task in **Tools** menu
- press **Ctrl+right mouse** button (if currently some object is selected it is at first deselecting and you have to press **Ctrl+right mouse** button again to cancel operation)
- using pop-up menu opened by right mouse button.

3.2.1.9.One step Undo

Restores previously edited or deleted object.

3.2.2. Object creation

3.2.2.1.Object creation modes

Object creation menu includes following modes:

- Create object (object type is selected from map symbols library);
- Create object of type of existing object;
- Create subobject;
- Copy object;
- Copy object to another map (object type is selected from map symbols library);
- Copy marked objects to another map;
- Save object created by another application.
- Create graphic objects (line, polygon, raster symbol, label).

3.2.2.2.Creation of map object

To create map object you should define corresponding map symbol (object style), its spatial coordinates (metrics) and attributes (semantics). Object style is created in special dialog that also allows you to set method of object creation (manual or interactive vectorization, manual coordinates entering, loading coordinates from text file, etc). The sample of object is displaying in special view window. You can use fast object searching by its name or classification code. If object type and layer are selected you can use **Ctrl** and **Shift** keys to make group object selection. For example you can select all line and polygon objects from layers called **Road network** and **Road facilities**. Press **Select** button for final object style selection. Besides, you can select object style from **Map legend** panel. You can attach attributes (add semantics) when object selection if corresponding option of **Map editor** is on.

3.2.2.3.Point object creation

Point object of a digital map contains coordinates of one point. The point object can be spatially connected to other objects of a map (see **Supplementary creation modes** section) To put point object on the map press left mouse button. Its location can be changed unless left mouse button is released.

3.2.2.4.Line object creation

The line object of a digital map contains coordinates of two or more points.
Line object can be closed or non-closed, it can include several subobjects and spatially connected to other objects of the map
Depending onto its type line object can be created as one of following:

- object of arbitrary configuration
- simple, rotated or complex rectangle
- circle of known diameter
- result of interactive vectorization (tracing) over underlying raster
- entering coordinates from keyboard
- loading from text file

Line object points (vertices) are creating when pressing left mouse button or **Enter**. To close

line object press **L** button. Supplementary modes of creation are also available
To save line object use standard save operation (see 3.2.1.7 section).
Pressing **Backspace** key deletes last added vertex.
To create a **rectangle** you should “draw” it on the map using left mouse button.
To create a **rotated rectangle** you should “draw” it on the map using left mouse button.
To create a **complex rectangle** you should add its vertices one by one by left mouse button (all line segments are intersected at the right angle).
To save any line objects, use standard save operation (see 3.2.1.7 section).
To create a **circle of fixed radius** you need to set its radius and center point. You can use previously created point object as a center for circle as well as any line vertex. (Refer to **Supplementary modes of creation** section for details)
To create **an arbitrary circle** you need to draw it by left mouse button. You can use previously created point object as a center for circle as well as any line vertex. (Refer to **Supplementary modes of creation** section for details)
Vectorization (tracing) is a process of interactive following line features of raster image to convert them to vector format. To start **vectorization** you need to set first line vertex by left mouse button or copy it from existing object. To start automatic procedure you should set the direction by mouse cursor and press **O** key. To save vector line use standard save operation (see 3.2.1.7 section).

3.2.2.5.Polygon object creation

Polygon object of a digital map is a closed polyline. Displaying style of polygon is defined in map classifier. Besides main (exterior) boundary, polygon can include «islands» - subobjects. Polygon can be spatially connected to other map objects.
Depending onto its type polygon can be created as one of following:

- object of arbitrary configuration
- simple, rotated or complex rectangle
- circle of known diameter
- result of interactive vectorization over underlying raster
- entering coordinates from keyboard
- loading from text file

Polygon object points (vertices) are creating when pressing left mouse button or **Enter**. Polygon object is closed automatically. Supplementary modes of creation are also available
To save line object use standard save operation (see 3.2.1.7 section).
Pressing **Backspace** key deletes last added vertex.
To create a **rectangle** you should «draw» it on the map using left mouse button.
To create a **rotated rectangle** you should «draw» it on the map using left mouse button.
To create a **complex rectangle** you should add its vertices one by one by left mouse button (all polygon segments are intersected at the right angle)
To save any polygon objects, use standard save operation (see 3.2.1.7 section).
To create a **circle of fixed radius** you need to set its radius and center point. You can use previously created point object as a center for circle as well as any polygon vertex. (Refer to **Supplementary modes of creation** section for details)
To create **an arbitrary circle** you need to draw it by left mouse button. You can use previously created point object as a center for circle as well as any polygon vertex. (Refer to **Supplementary modes of creation** section for details)
Vectorization (tracing) is a process of interactive following line features of raster image to convert them into vector format. To start **vectorization** you need to set first polygon vertex by left mouse button or copy it from existing object. To start automatic procedure you should set the direction by mouse cursor and press **O** key. To save vector line use standard save operation (see 3.2.1.7 section).

3.2.2.6.Creating object with the code of existing object

To create object with the code of existing object you should select existing object first and

then create a new one.

3.2.2.7.Creating object group by coordinates, retrieved from file

You can create object (or group of objects of common type) which described in text file as a set of coordinates of vector elements. First you have to prepare text file appropriately:

- text file has to have .MET extension
- text file must not to have empty strings
- text file may have service fields

Field	Function	Note
MET	File beginning keyword	a mandatory field
BEGIN	Information beginning keyword	a mandatory field
#	Object beginning keyword	a mandatory field
END	end information keyword	a mandatory field
XY	Rectangular coordinates (m.)	
RAD	Radians	
GRAD	Degrees in decimal form	
GMS	Degree, minute, second	
/	Comment string	

Service fields must start at the first string position
- **MET, BEGIN, END** are mandatory keywords, the description of object description is delimited by **#**.
- Strings located between «#» symbols must contain only coordinate values or comments strings.
- By default (or if coordinate section marked as **XY**) coordinate values are in rectangular coordinate system (after «#» symbol there are strings containing coordinate pairs corresponding to object points (m))
- After **RAD** keyword there are pairs of vector point geodetic coordinates (B, L) in radians
- After **GRAD** keyword there are pairs of vector point geodetic coordinates (B, L) in decimal degrees
- After **GMS** keyword there are pairs of vector point geodetic coordinates in Deg Min Sec format.

Note that the range of possible latitude values is from -90(south) to 90(north) degrees and the range of possible longitude values is 0 - 360 degrees.

Sample of a text file:

```
MET
BEGIN
// Point objects (radians)
RAD
 #
0.97065938 0.65882652
 #
0.97058971 0.65838004
// Point objects (Decimal degrees)
GRAD
 #
55.65802244 37.54409293
// Point objects (meters)
XY
 #
6171257.20 7408038.50
 #
6169977.20 7407298.50
```

```
// Point objects (Degrees Minutes Seconds)
GMS
 #
55 39 28.88 37 32 38.73
 #
55 39 18.96 37 32 20.51
END
```

To add object to map use **By coordinates from text file** mode of **Object creation** dialog.

3.2.2.8.Creating subobject

To create subobject (island of polygon or part of line) select parent object and create subobject line or polygon by standard way.

3.2.2.9.Creating vector object from conditional object

This mode is used to reassigning attributes to the object created by some **VectOr** application. For example when buffer zone is built around selected vector object. To save conditional object you have to select object type by the same way as when creating new vector object.

3.2.2.10.Supplementary modes of object creation

The supplementary object creation modes are used to provide spatial topological relationships between objects that can belong to one or different map layers. Using supplementary object creation modes you can copy existing point or object portion to creating object with or without node creation. To activate supplementary object creation mode use corresponding option of pop-up menu or appropriate keyboard key.
Supplementary object creation modes include:

- **I** - **copying real point**. This mode is useful if you want to create object that exactly goes through already existing ones. For example you «draw» electric power line connecting existing piers (point objects). To activate **Copying real point** mode, press **I** key. Then select object, used for snapping to, and start drawing. Press **I** for each vertex should be snapped to existing point. You can use any objects to be snapped to (in case of lines and polygons their vertices are used for snapping).
- **T** - **copying pseudo-point with node creation**. This mode is pretty much similar to previous one, but now you use not existing vertex for snapping to, it can be located anywhere on selected line. In other words this mode works like snapping to object and previous one provides snapping to object vertices. Node is created in every snapped vertex in this mode.
- **D** - **copying pseudo-point without node creation**. Mode is just like the previous one, but without node creation. It can be useful when created object is snapping to the map border and there should not be nodes on it.
- **K** - **copying fragment of object bounded by pseudo-points**. This mode is useful if created and existing objects should have common part (fragment). Fragment selection is making by 3 points - (start, middle, end of fragment). Second point can be equal to the first or third one. So in this case only 2 points are used for fragment selection. However if source object is a polygon always use 3 points. Once copying is done nodes are created at the first and third snapping points.
- **P** - **copying fragment of object bounded by real points**. Mode is similar to previous one, except that, only vertices can be used for fragment selection.
- **H** - **creating horizontal line**. Mode of horizontal line drawing (X=const).
- **V** - **creating vertical line.** Mode of vertical line drawing (Y=const).
- **F** - **cancellation of modes H and V.**
- **R** - **current raster selection** (for interactive vectorization(tracing)). While tracing, it is possible to create an object over several opened rasters.
- **M** - **memorizing cursor position on a map**.
- **N** - **go to the previous (saved by M) point**.

- **O** - **starting interactive vectorization (tracing)**.

3.2.2.11.Map legend

You can create map legend including most usable map objects for fast and convenient access to them. **VectOr** map legend located at the bottom of screen and looks like rows of pictograms (up to 255 lines) with map symbols associated with map objects. Every row of map symbols has unique name for convenience of object searching. Once legend is created you don't need to open complicated **Classifier** dialog to search and select map object. Just click on corresponding pictogram in map legend row.
To show map legend click on corresponding icon of **Map editor** panel.
When map legend is opened first time, all pictograms have gray cross on them, which will be replaced by appropriate map symbol when created. To add map symbol to legend press any pictogram and select map symbol.
Note that map legend is linked to map classifier, so if classifier is edited you should recreate map legend (you will get appropriate system warning).

3.2.3. Deleting objects

3.2.3.1.Deleting selected object

Once an object to be deleted is selected, you get warning message to confirm delete operation. Press OK to delete object. You can restore it using **Undo** operation.

3.2.3.2."Delete" panel

Delete panel includes following modes:
- deleting one subobject;
- deleting all subobjects;
- deleting marked objects.

3.2.3.3.Deleting one subobject

This mode is used to delete an island (subobject of polygon). To execute operation you should select polygon and its subobject.

3.2.3.4.Deleting all subobjects

This mode is used to delete all islands (subobjects of polygon). To execute operation you should select parent polygon.

3.2.4. Map objects editing

3.2.4.1.Changing code of marked objects

Changing code of marked objects used to access new map symbol to the group of objects. When reassigning map symbol all object parameters (name, attributes, etc) may be changed except its coordinates.

3.2.4.2.Copying object to user map

To copy object to user map you should select object to be copied and select destination map and output object type (since source and output maps can be linked to different classifiers).

3.2.4.3.Copying all subobjects

Used to copy all subobjects (islands) on one polygon to another polygon. To copy you should select source and destination polygons and complete operation (see 3.2.1.7 section). To cancel operation, use **1 step undo** or **Cancel** button of **Edit** menu.

3.2.4.4.Full copy of object

To copy object, select it and set a new object position in drag-and-drop mode. Use arrow keys along with left mouse button pressed for precise object positioning. Object is saving by standard save operation (see 3.2.1.7 section).

3.2.4.5.Moving object

To move object, select it and set a new object position in drag and drop mode. Use arrow keys along with left mouse button pressed for precise object positioning. Object is saving by standard save operation (see 3.2.1.7 section).

3.2.4.6.Changing object type

To change object type you should select object and set its new type.

3.2.4.7.Expanding vector line

To expand (continue digitizing vector line) select it. As a result the cursor is located at the last object vertex (defined by vertices numbering order). If you need to add vertices in the opposite direction press **R** key. Then «draw» vector line in standard way. All additional object creation modes are available.

3.2.4.8.Marking (grouping)

Used to mark objects on the map manually. Every marked object is added to object group for further possible group processing (delete group, copy group, decode group, move group to another map and so on).

3.2.4.9.Viewing map control information

Used to view control information related to created digital map. Listing error list, you can analyze spatial objects current error is associated with.
Note that previously you should execute one of map control procedures.

3.2.4.10. Changing scale range of marked objects

Used to set lower and upper values of scale to display / not display an object.

3.2.4.11.“Mark” panel

Used to work with objects, marked by queries (Search) or by tools of Marking (Grouping) panel.

3.2.4.11.1. Restoring previously deleted objects

All objects deleted after last **Sorting** procedure can be restored. Using **Restore deleted objects** dialog you can select which deleted objects are to be restored or press **All** button to restore all of them.

3.2.4.11.2.Intersection of marked objects

Puts nodes on each intersection point of marked objects to build spatial topology.

3.2.4.11.3.Smoothing marked objects

Used to smooth marked object using splines. Note that as a result of smoothing operation object changes its shape and may cause changes in topology relationships between objects.

3.2.4.11.4.Filtering marked objects

Filtering operation decrease number of object vertices and makes object shape «simpler».

3.2.4.11.5.Copying marked objects to user map

To copy group of objects (for example all highways of width > 10 meters) to user map you should mark them using **Search menu** options or mark them manually. In case of selection by query program will ask you to confirm copying of each marked object. If you are going to copy objects to several map sheets they will be cut on sheet borders automatically. For example you can copy all objects from 1:200 000 map, create Work region consists of four sheets of 1:100 000 and finally get your objects on all of them. Note that you can copy objects only to the map with border. It is also preferable to use common classifier for both source and destination maps.

3.2.4.11.6.Deleting marked objects

Used to delete marked (highlighted by magenta color) object(s). You should confirm each object deleting after appropriate system warning.

3.2.4.12."Text" panel

Used to create and edit compound and single map labels.
Compound label creation mode used basically for editing map sheets created before «text along curve» mode was implemented. On such lists some labels were divided by segments like Mud - dy Cre - ak . To combine segments of such a label select them one by one working in **Creating compound label** mode. To complete combining press **Ctrl-Enter** if you need to edit text while combining press **Space** key and press **OK** once text is edited. When compound test is created you can select and edit its base curve (See **Editing vertex** section).

3.2.4.13."Group" panel

Group panel includes following options:

- add object to group;
- delete object from group;
- delete all links in the group;
- combine group to object.

3.2.4.14."Topology" panel

Used to build spatial topology relationships between map objects:

- Merging objects;
- Copy object fragment;
- Create subobject based on map object;
- Creating objects intersections;
- Dissection of line object;
- Dissection of area object;
- Joining objects vertices;
- Joining line objects;
- Creating a node;
- Object smoothing;
- Filtering objects;
- Joining objects.

3.2.4.14.1.Merging objects

Used to merge objects of **common** type. To merge objects select them one by one and complete operation (3.2.1.7 section). To cancel operation, use **1 step undo** or **Cancel** button of **Edit** menu.

3.2.4.14.2.Copying object part

Used for topology adjustment of objects that must have common border. To create common border of objects you should:

- Select source object (object, which part should be copied to destination object)
- Select source object part to be copied
- Select destination object
- Select destination object part to be replaced
- Complete operation

You should select object part by 3 points.
Operation is available for line and polygon objects only.

3.2.4.14.3.Creating subobject by existing object

This mode used to create subobject of polygon (island) as full copy of existing object. For example you want to draw forest glade that has exactly the same border as already digitized lake in this forest. To execute operation select source object (lake) and parent object (forest).

3.2.4.14.4.Creating object intersections

Used for lines and polygons only. To intersect objects, select them one by one. In case when a point already exists in intersection it is not duplicated.

3.2.4.14.5.Dissection of line object

To cut a line, select line object and select dissection point.

3.2.4.14.6.Dissection of polygon object

Polygon object can be dissected by line object or another polygon object. To dissect (cut) vector polygon select it, then select line or polygon vector object used to cut the source one.

3.2.4.14.7.Joining object vertices

Used to join vertices of different map objects. To join vertices you should select source object, select vertex on source object (to join vertices of editing objects to). Then select editing object and its vertices to be combined. To select another source object, you should turn off and turn on **Join vertices** mode (just press corresponding icon twice).

3.2.4.14.8.Joining line objects

Used to join line objects by moving vertex of source object to selected vertex position of destination object. For example you want to connect line vertex on one map sheet to corresponding line vertex to another map sheet (both of them located on the map frames). To join lines select source line and source vertex, then select destination line and destination vertex.

3.2.4.14.9.Creating a node

This mode is used to build topology relationships between objects that can belong either to one or to several layers. Select source object, select editing object and select vertex on editing object. Editing vertex snaps to source object by shortest distance to create a node.

3.2.4.14.10.Smoothing object

Used to smooth object shape.

3.2.4.14.11.Filtering objects

Object filtering operation used to decrease number of object vertices. Filtering level is set in **Map editor parameters** dialog.

3.2.4.14.12.Joining objects

To join 2 objects select them on by one and complete operation. Use **Join tolerance** parameter in **Editor options** window to set a maximum distance between objects to be joined.

3.2.4.15.Restoring edited objects

VectOr «memorizes» all map states unless you start **Sort** procedure. So you can restore previously deleted objects. While objects restoring **VectOr** asks you to confirm restoring of each deleted object. To go to the next object to be restored use **Next** button.

3.2.5. Processing semantics of marked objects

Map editor provides following operations for semantics of marked objects:

- Adding semantics to all marked objects
- Deleting semantics from all marked objects
- Replacing semantics of all marked objects.

3.2.5.1.Adding semantics

To attach semantics (attribute) to marked objects:

- Search and mark objects (**Search** mode)
- Activate Semantics mode (**Semantics** panel in **Map editor**)
- If there are several maps open select needed one.
- Select name and value of adding attribute. Note that attribute can be repeatable and non-repeatable. If you selected attribute that can has several values (for example Trees: birch, oak), you should «tell» the program whether to add new attribute value or replace previous one.
- Press **OK**.

3.2.5.2.Deleting semantics

To delete semantics (attribute) of marked objects:

- Search and mark objects (**Search** mode)
- Activate Semantics mode (**Semantics** panel in **Map editor**)
- If there are several maps open, select one you need.
- Select name and value of attributes to be deleted.
- Press **OK**.

3.2.5.3.Replacing semantics

To replace semantics (attribute) of marked objects:

- Search and mark objects (**Search** mode)
- Activate Semantics mode (**Semantics** panel in **Map editor**)
- If there are several maps open, select one you need.
- Select old and new name and value of attribute.
- Press **OK**.

3.2.6. Vertex operations

Vertex operations panel includes:

- edit marked vertex;
- edit common vertices of adjacent objects;
- delete vertex;
- add new vertex;
- close object;
- rotate object.

3.2.6.1.Editing marked vertex

To edit a vertex you need to select line place cursor near line which causes selection of the closest vertex.(You will see a rubber line connecting cursor position and nearest line vertex). You can edit selected vertex in drag and drop mode. Use arrow keys for precise positioning. Object is saving by standard complete operation (3.2.1.7 section).

3.2.6.2.Editing common vertices of adjacent objects

Used to edit spatially connected objects.
Process is similar to **Editing marked vertex**, except that in this mode after editing (moving) a vertex all corresponding vertices (vertices with the same coordinates) of adjacent objects also move to the same position.

3.2.6.3.Deleting vertex

To delete a vertex you need to select line and place cursor near line vertex to be deleted. (You will see a rubber line connecting cursor position and nearest line vertex). Vertex is deleted by standard complete operation (3.2.1.7).

3.2.6.4.Adding vertex

To add a vertex to line or polygon select source object and add vertex by left mouse button. Insert position is defined by cursor. To save object use standard save operation.

3.2.6.5.Closing object

This mode used to close line object that should be previously selected.

3.2.6.6.Object rotating.

To rotate an object, select it and rotate by left mouse button around current cursor position or selected object vertex. Use standard complete operation (3.2.1.7) to finish rotation.

3.2.6.7.Renumbering vertices

Select corresponding vector object to renumber its vertices (revert numbering order of vertices).

3.2.7. Labels on the digital map

3.2.7.1.Creating labels

All digital map labels may be divided on three main groups:

- raster labels – horizontal, non-scalable labels. When such a label creation you should set its starting point on a map.
- vector non-scalable labels. When such a label creation you should set its starting point and direction on a map.
- vector scalable labels. When such a label creation you should set its location on a map by two points.

3.2.7.2.Editing labels

To edit label, select it and edit label text.

3.3. Data sorting (compression)

After any changes made on coordinates or semantics information corresponded to map objects, it is recommended to start data sorting procedure to speed up further processing.

This procedure also causes data compression. Note that there is no way to restore previously deleted objects after sorting procedure is done.

3.4. Measurements on a map

VectOr contains a complete set of tools necessary for spatial measurements over the vector map including calculations of distances, areas, perimeters and so on. There is a special icon bar available at the left side of screen when you are in measurements mode. Each icon in the column relates to some measurement mode. Tool tips corresponded to each icon are also helpful when measurement mode selection. All options related to objects visualization are available in measurements mode, thus you can change styles of objects displaying, show or hide chosen objects, change map background, etc. Following are the measurement modes supported.

3.4.1. Length of drawn line

This mode allows to calculate length of a polyline drawn by user.
Polyline vertices are entered by left mouse button and connected by straight segments. Use **Backspace** to remove last selected vertex
You can also use portions of existing objects to calculate length. For this purpose press right mouse button and select option named **Copy part object.** Then select an object and mark by 3 points fragment to be included to line.
To finish line adding, use standard save operation (3.2.1.7). You can also set a displaying style for saved object, using options of **Saving conditional object** dialog.
If the map includes elevation matrix final line length will be calculated on surface (as 3D).
To cancel started processing press **Ctrl+Right mouse button**.

3.4.2. Object length

Used to calculate selected line/polygon length/perimeter.

3.4.3. Length of segment

This mode is available just for line and polygon objects. Once object is selected you should select its fragment by 3 points in case of polygon and by 2 points in case of line. After third point of segment is selected, measuring fragment is highlighted and its length is displaying in the results window.
To cancel processing press **Ctrl+Right mouse button**.

3.4.4. Area of drawn polygon

This mode allows to calculate area of a polygon, drawn by user.
Polygon vertices are entered by left mouse button and connected by straight segments. Use **Backspace** to remove last selected vertex
You can also use portions of existing objects to calculate length. For this purpose press right mouse button and select option named **Copy part object.** Then select an object and mark (by 3 points) fragment to be included to line.
To finish line use standard save operation. You can also set a displaying style for saved object, using options of **Saving conditional object** dialog according to classifier.
To cancel processing press **Ctrl+Right mouse button**.

3.4.5. Object area

This mode works for polygon objects only. Select polygon and press right mouse button and left mouse button to display its area. Note that area value is calculated excluding area of subobjects (islands).

3.4.6. Coordinates calculations

Used to calculate coordinates of a set point on a map. Rectangular coordinates (XYZ) can be calculated in two coordinate systems (Pulkovo 1942 (Gauss-Kruger)) and UTM. Geodetic coordinates (BLH) can be calculated using following datums: Pulkovo 1942, WGS-84 and PZ-90. Geodetic coordinates can be displayed as degrees or radians.

Coordinate values in **VectOr** view windows correspond to current point on map (cursor position). Entering data in any dialog text fields cause recalculation of coordinates in all systems.

Use **Show current point** button to display coordinate values of current point when it is changed its position on a map. Use **Show** button to redraw a map when new coordinates of point are entered.

3.4.7. Distance from point to object

To measure distance between point and object, select the object first and set a point position by left mouse button. The distance is displaying in the Results window. To cancel processing press **Ctrl+Right mouse button**.

3.4.8. Distance between map objects

Used to display shortest distance between map objects. To display distance, select «source» and «destination» objects. Distance is computed between existing vertex of first object and closest point of destination object (there may not be a vertex in this point).

3.4.9. Building buffer zone

Used to calculate a buffer zone around marked point, line or polygon object. To build buffer zone:

- Mark objects using **Search/Mark** mode
- Enter zone radius in meters
- Select a map to add created object to

As a result of processing:

- new user map is created with resource file ZONE.RSC.
- **User object** layer is added to resource file of current or new map.
- **Buffer zone** object is created in this layer with attribute **Zone radius**.

There is a possibility to change process parameters. Open file INI located in LOG directory associated with current map. Find section named [ZONE] and needed parameters, such as code, name of zone objects, code and name of semantics, layer name and RSC file name.

3.4.10. Crossing marked objects

Used to view a list of marked objects that cross drawn line or selected object.
To make following modes available you should mark needed objects using **Search / Mark** dialog.

- **Crossing by selected object**. Select object to view list of marked objects crossed by selected objects
- **Crossing by drawn line**. Draw a line on a map to get a list of marked object crossed by this line.
- **Crossing and surrounding**. Select polygon or closed line object to view list of marked objects crossed or surrounded by selected object.

You can save object list, you got, to the text file.

3.4.11. Intersection of marked and selected objects

You can create a new object by intersection of marked and selected objects.

- Mark needed objects using **Search / Mark** mode
- Select map object - closed line or polygon to be used for new object creation
- Set new object parameters (layer, type, name) in **Create object** dialog.

3.4.12. Defining map “empty” spaces (no object areas)

To define map empty spaces:

- Mark a group of objects using **Search/Mark** mode or manually
- Activate **Empty areas** mode
- Set output «empty» object parameters in **Create object** dialog (layer, map, name, etc)

As a result empty areas are added to the digital map.

3.4.13. Marked objects operations

Panel of marked objects operation includes:

- Crossing by selected object;
- Crossing by drawn line;
- Crossing and surrounding;
- Intersection of marked and selected objects;
- Marked objects info.

3.4.14. Objects statistical info

Used for polygons only. Statistical window shows following information for common code objects:

- total area
- number of objects
- minimum area value and corresponding object ID
- maximum area value and corresponding object ID.

3.4.15. Marked objects statistical info

Used to get information (see previous section) corresponding to marked objects.

3.4.16. Building loxodrome

To calculate loxodrome (a curve that crosses meridians at equal angles) set control points by left mouse button, which will be connected by smooth curve. The length of curve is computed and displayed.

3.4.17. Building orthodrome

To calculate orthodrome (arc of great circle) line set control points by left mouse button, which will be connected by smooth curve. The length of curve is computed and displayed.

3.4.18. “Matrix” panel

There are following operations with matrix available in the matrix panel:

- Matrix creation, based on vector map
- Matrix 3D displaying
- Viewshed building (drawing sector on screen)
- Viewshed building (entering sector coordinates from keyboard)

- Profile building along drawn line
- Profile building along map object
- Z coordinate viewing.

3.4.19.Calculating absolute elevation

Used to calculate absolute elevation in map point marked by cursor in case when corresponding elevation matrix is available.

3.4.20.Building profile along drawn line

This mode used to build 3D profile along a line drawn over elevation matrix. Use left mouse button to draw a line.
Resulted profile is displaying as a color diagram in which Z coordinate value represented by Y-axis value and line length by X-axis value. You can view following values while moving cursor over profile:

- **elevation** - elevation values of starting, current and ending points of profile
- **distance** - distance between start and current profile points
- **profile height** - distance from Earth surface to line, connecting starting and ending profile points

You can move start, end and current points to chosen altitude. For this purpose you should set appropriate values in **Z offset** text field
You can save profile (**Save As** button) as WMF, EMF formats for further using in MS Windows applications.
Parameters panel allows to set options of profile visualization, such as line and profile color.
Profile can be also calculated, taken Earth curvature into account, if corresponding option is on.

3.4.21.Building profile along existing object

This mode used to build 3D profile along a selected line or polygon object using «underlying» elevation matrix. Select object to build profile along it.
Resulted profile is displaying as a color diagram, in which Z coordinate value represented by Y-axis value and line length by X-axis value. You can view following values while moving cursor over the profile:

- **elevation** - elevation values of start, current and end points of profile
- **distance** - distance between start and current profile points
- **Profile height** - distance from Earth surface to line, connecting start and end profile points

You can move start, end and current points to chosen altitude. For this purpose you should set appropriate values in **Z offset** text field
You can save profile (**Save As** button) as WMF, EMF formats for further using in MS Windows applications.
Parameters panel allows to set options of profile visualization, such as line and profile color.
Profile can be also calculated, taken Earth curvature into account, if corresponding option is on.

3.4.22.Building viewshed

VectOr is computing Viewshed model based on elevation matrix (if any).
To calculate viewshed you need to set one or few visibility sectors, including view point and sector boundary drawn by mouse or entered from keyboard as coordinate values.
Viewshed control window options includes:

- text field for output raster file name selection
- view point parameters (coordinates, elevation, shear angle, etc)
- output raster view parameters (transparency, color of non visible areas, etc)
- viewshed building modes (cell is visible from all view points or at least from one view point)

All viewshed dialog parameters are saved in **VectOr**.ini file and restored for every viewshed session.

3.4.23.Building buffer zones

Used to calculate a buffer zone around marked object. To build buffer zone:

- Mark objects using **Search/Mark** mode
- Enter zone radius in meters
- Select a map to add created object to

As a result of processing:

- new user map is created with resource file ZONE.RSC.
- **User object** layer is added to resource file of current or new map.
- **Buffer zone** object is created in this layer with attribute **Zone radius.**

There is a possibility to change process parameters. Open file INI located in LOG directory associated with current map. Find section named [ZONE] and needed parameters, such as code, name of zone objects, code and name of semantics, layer name and RSC file name.

3.4.24. 3D terrain displaying

Opens window containing 3D image of elevation matrix (if any). To open control panel of 3D view mode press left mouse button over displaying elevation matrix. Set orientation and view angle by mouse. Control panel also allows to view elevation matrix parameters, to change rotation angle and view angle, to show/hide grid and change its interval.

3.4.25.Results displaying

Allows to show/hide window with calculation results and make more calculations using screen buttons or keyboard. Buttons **M+, M-, MC, MR** used to work with memory as follows

- add to memory
- subtract from memory
- clear memory
- extract from memory.

3.5. Editing classifier

3.5.1. Creating and editing classifier

The digital classifier is a description of vector map layers included object types, map symbols (patterns), attributes, etc.
Description of layers, objects, attributes should contain digital code.
Map symbols can be represented in two forms - for displaying and printing.
Digital classifier creation begins with preparation works that include defining type, base scale and nomenclature (title) of digital map, which is classifier created for, list of using map symbols, layers definition, method of coding and so on.
There are standard classifiers of topographic information for maps and plans of 1:500 and 1:10 000 scales and maps of 1:25 000 - 1:1 000 000 scales. These classifiers may be used as a base for defining object types included, coding method and object attributes. During special map creation (navigation, thematic, tourist maps) it is recommended to use corresponding paper maps to create map symbol library to be included to classifier.
Preparation works includes:

1. Layers description
    - layer name (up to 30 characters)
    - unique layer number
    - layer displaying order (0-255).
2. Map objects description

- object name (up to 30 characters)
- classification code (8 characters)
- object type (line, polygon, point, label, vector, template)
- layer number
- digitizing direction
- scale range (which scales are used to display/not display object)
- list of obligatory attributes (semantics)
- list of optional attributes (semantics)
- list of characteristics used to set object's displaying style
- map symbols, corresponding to object

3. Semantics characteristic description
   - Attribute name (up to 30 symbols)
   - Attribute classification code (1 - 65535)
   - Attribute type (string, numeric, bit, classification code, etc)
   - Minimum, maximum, default values common for all objects
   - Minimum, maximum, default values common for single objects
   - «Repeat» check box. Set it on in case when attribute may have several values for one object (Many to one mode)
4. Classifier of values of semantics characteristics
   - classification code of attribute (1 - 65535)
   - classification code of attribute value (1 - 65535)
   - attribute value (up to 30 characters)

To input collected information you can use resource editor RSCEDIT.EXE under MS DOS.
It is recommended to input data as follows:

- layers description
- description of all possible characteristics of objects
- description of used color map (if not standard)
- map objects description

Layers descriptions can de entered by filling corresponding table in layers editing mode (one record for one layer).
Description of characteristics is entering in semantics editing mode by filling corresponding tables (one table for one characteristic). There can be created classifier of values for each table. Note that for numeric attributes every code corresponds to the range of values (for example width of the river: 1 - 5m; 2 - 10 m; etc). For point attributes one code corresponds to one value (for example, material: 1 - wood, 2 - concrete, etc).
In case if attribute has corresponding classifier of values, this attribute is numeric in input description table, since physically it is number, but it is displaying as logical value corresponded to current code). If there is no classifier of values for described attribute this attribute can be defined either as numeric or as string.
Object description is entering by filling several tables from different lists. It is recommended to input data as follows:

- main object parameters (layer, type, classification code, object name)
- additional parameters (numbering direction, scale range)
- semantics parameters (values range, default values, etc)
- object type/description
- map object

In many cases it is useful to have several displaying styles for one object. Current style is depending on object attribute. The simplest way is add new objects to be displayed by new style (for example object **Building** that has attribute **Material**) can be separated on two objects **Wood buildings** and **Concrete buildings**. Another way is to create set of objects separated by range of attribute values and displaying style. In this case you should select source object and switch to set of objects creation mode. Set of objects creation begins with selecting one or two attributes that define object displaying style (if number of such attributes is greater than 2 you should combine two methods described above). All displaying styles are entering to object view table. At the beginning of object set creation, this table contains

just style for source object. For each attribute the range of possible values should be defined. These ranges are entering to the first line of link table for 1st attribute and to the 1st column for 2nd attribute. You can set displaying style for each attribute.
You can also change displaying style of map objects from dialog **Object selection**. Once object is selected press **Info** button and set object displaying style (**Style** tabbed page on **Info** dialog). You can use following parameters for style editing and creating.

1. Line objects:
   - new line style;
   - color, thickness and dashes parameters for existing line;
   - style of vector objects, located along the line
2. Polygon objects:
   - style of vector objects, located along the polygon perimeter;
   - background color;
   - fill color;
   - map symbol used for the polygon filling.
3. Point objects:
   - style, color and origin coordinate;
   - symbol size;
   - multicolor map symbol.
4. Labels:
   - font;
   - color, size, angle;
   - background, shadow, alignment.
5. Vector objects:
   - vector object style.

There is a **Scale** check box, which may be used for any vector object. If this option is on object becomes “scalable”. Scalable line objects’ thickness is scaling depending onto view scale. The size of scalable vector objects and labels corresponds to object metrics. Scalable point objects are displaying in accordance with their **scale range**, non-scalable objects are not displaying when current view scale is greater than original map scale.
You can use special map symbols for printing out to high quality printers. The size of such symbols is set in micrometers and the color map is expanded. To edit printer map symbol select **Printer** tabbed page.
Note that object style changing causes equal style changes for all objects with the same classification code.

3.5.2. Editing classifier objects

Used to create or edit object code, layer, displaying style, attributes as well as create and delete objects themselves.

There is an objects table at the right part of panel. This table may contain all objects or objects selected by **Filter** of classifier objects. Current object is highlighted by magenta box. Edited objects are highlighted by white box. There are tool tips that show code, name and layer of objects, mouse cursor is located over. To edit object parameters click on it by left mouse button. Once object is edited you can save it after appropriate system warning.

There is a tool bar above objects table that includes following tools:

- Create new object;
- Copy object;
- Copy group of objects;
- Delete object;
- Delete group of objects.

Below the table **Filter, Group, Find** buttons are located. Use **Filter** button to select objects

by query **Filter**. Use **Search** button to find object (s) with selected classification code for further processing

At the left part of panel there are following buttons used to edit main object parameters (such as code, type, name and layer) as well as following buttons

- Type;
- Semantic;
- Scale;
- Print.

To save editing press **Save** button.

If **Group of objects** option is on, all changes made for selected object (**Code, Layer, Semantics**) will cause equal changes for all objects in the group. Some parameters, such as **Type** or **Semantics** that define object displaying style can be changed only when working with object group as a whole.

To enter or edit object code push **Code** button. In case of zero code or when object code is equal to another object code object can not be saved and user has to correct code value after appropriate system warning or just cancel operation.

To change object type press **Type** button. Note that type changing cause view and printing object style.

To change object layer press **Layer** button.

To change object name (up to 30 characters) press **Name** button.
To cancel editing, press **Cancel** button.

3.5.2.1.New object creation

Default settings for new object are as follows:

- standard code
- line object
- service layer
- default displaying style
- no attributes (semantics)
- visible for map of any scale

To change default parameters you need to edit corresponding text fields.

Note that new object, created when some filter is set on, will get corresponding layer and type assigned. Change or reset filter if needed.

Use **Save** button to save new object. In case of zero code or when object code is equal to another object code object can not be saved and user has to correct code value after appropriate system warning or just cancel operation. New object is appended to objects table.

3.5.2.2.Copying object

Used to copy object and all its parameters (except **Code**) to new one. Note that unique **Code** of output object must be entered.

Use **Save** button to save new object. In case of zero code or when object code is equal to another object code object can not be saved and user has to correct code value after appropriate system warning or just cancel operation. New object is appended to objects table.

3.5.2.3.Copying group of objects

Used to copy group of objects. Note that unique **Code** of output group must be entered.

3.5.2.4.Deleting object

Used to delete marked (highlighted by magenta color) object(s). You should confirm object deleting after appropriate system warning.

3.5.2.5. Deleting object group

Used to delete all objects from group, currently marked object is belonged to. Marked object is highlighted by magenta color. You should confirm group deleting after appropriate system warning.

3.5.2.6.Filtering classifier objects

Used to select layers and object types you currently need. Note that new object, created when some filter is set on, will get corresponding layer and type assigned. Change or reset filter if needed.

3.5.2.7.Searching for classifier objects

Used to search classifier objects by classification code. List of objects with selected code is displayed in the main dialog window. Use **Next** and **Previous** buttons to scroll object list. Use **Select** button to select corresponding object on a map.

3.5.2.8.Displaying style of classifier object

Displaying style panel used to set how to display map objects. All measurements (line thickness, dash length...) are in pixels except otherwise specified.

- Displaying style of line objects;
- Displaying style of polygon objects;
- Displaying style of point objects;
- Displaying style of labels;
- Displaying style of vector objects;
- Displaying style of templates.

3.5.2.9.Semantics of classifier objects

You can add semantics (attribute) to object of classifier. There are three columns at the **Semantics** panel: **Code, Type, Name**. **Code** field contains codes of attributes. **Name** field contains names of attributes. These two fields are not editable. **Type** field used to define attribute type: **Optional** (attribute may not be assigned) or **Obligatory** (attribute must be assigned when object is added to map). Use **View** panel to view corresponding map symbol. Map symbol can be edited just when working with **Object group**.

Press **Add** button to add semantics. Press **ESC** to cancel semantics selection. Press **Delete** button to remove semantics from the list. Press **Cancel** to restore original semantics attached to object when it was selected.

3.5.2.10.Scale range of classifier objects

To make a map more «viewable» some object should be visible only when map scale is

large enough. Use **Scale** panel to set minimum and maximum map scale values to display object. Press **All** button to make object always visible. Press **Cancel** button to cancel scale range selection.

3.5.2.11.Printing style of classifier objects

Use **Print** panel to set printing style of classifier object. Printing style generally depends on object type (point, line, polygon). Press **Color** button to set object color. All measurements (line thickness, dash length, etc) are in mm. Printing style use a set of primitives (for selected object type). Primitives are printing according to the metrics (first primitive is printing «below» second one and so on). Thus when printing polygon you should enter its fill primitive first and then its outline primitive.

At the left part of **Print** window map symbol corresponding to the object is displaying. You can set output units (pixels or mm). Use **Restore** button to restore original object view.

To add primitive, press **Add** button. To delete primitive, press **Delete** button. Use **Reset** button to reset editing. Use **Parameters** button to set primitive's parameters. To change order of primitives use following options: **Up, Top, Down, Bottom**.

There are following options used to set printing style to different object types

- Printing style of line objects;
- Printing style of polygon objects;
- Printing style of point objects;
- Printing style of labels;
- Printing style of vector objects;
- Printing style of templates.

3.5.3. Editing general classifier data

Used to:

- select classifier to edit
- change map name, map type, map scale, code of classifier
- change color map

You can edit a classifier of «main» map or any of classifiers of user maps. To switch between classifiers use **Select classifier** button. To edit classifier name (up to 19 characters) click on **Name** text field. To edit map type click on **Map type** text field. To change map scale click on **Scale** text field (use also **Large scale** and **Small scale** to activate appropriate scale range (up to 1:10 000 and less than 1:10 000 respectively)). Click on **Classifier code** field to edit code of classifier (up to 4 characters).

There is a classifier color map at the left part of panel. Click on color to be edited by left mouse button and change color appropriately. Press **Reset** button to restore color map. Press **Standard** to replace current color map by standard one.

To save changes made for classifier press **Save** button at the right part of panel. Use **Reset** buttons for «undo» changes of corresponding fields.

3.5.4. Layers editing

Layers editor allows to:

- add layers to classifier
- delete layers from classifier and move objects to another layer
- change layers names and displaying order

- sort layers by name, number, displaying order

Layers editing dialog contains list of layers as a table of 4 columns: layer number, name, displaying order, number of objects.

To add new layer press **Add** button and enter layer name, layer number and layer displaying order in appropriate table fields.

To delete layer select it and press **Delete** button. To copy all objects from deleting layer press **Copy objects** button and select destination layer. Press **OK** button.

To edit layer's name, displaying order, etc select appropriate table field and enter new values.

To sort layers by different parameters use corresponding options in **Sort** menu.

3.5.5. Semantics editing

Semantics editing dialog contains list of attributes included to classifier as two non- editable columns: attribute name and attribute code. Use **Sort** button to sort attributes by name or code. Right part of dialog includes semantics related fields, such as name, code, units, type, default value. You can edit attributes directly in the table, add new attributes (**Add**), delete attribute (**Delete**). Use **Info** button to view attribute-related information. To work with attributes from Classifier use **List** button. Now you can edit classifier or create new one (**Add**). Use **Save** button to save changes, use **OK** button to save changes and close classifier.

4. Linked application tasks

4.1. General information

This icon opens dialog of application task selection. There are three main parts of the dialog window:

- task name
- path to corresponding DLL file
- control icons

Use **Add** and **Delete** buttons to add and remove tasks from list. To run application, press **Start** button.

If some task is currently executing there is a checker near its name in the list. Some DLLs also additionally marked by icon.

There are two basic types of application tasks:

- tasks, which don't need operator's work. For example – converting formats, transformation, sorting, upgrading and others.
- interactive tasks: editing, analysis, reports building, etc.

Applications should be implemented as 32-bit DLLs for Windows 95 or Windows NT.

To call applications from modules there should be two standard functions. All tasks have to include function as follows:

```
extern "C"
{
long int _ export WINAPI GetInterfaceVersion()
 {
  return MAPACCESSVERSION;
 }
}
```

If application is written in Visual C++ you should use "__declspec(dllexport)" instead of "_export".

If you work in Delphi following statement can be used:

```
procedure GetInterfaceVersion; stdcall; export;
```

This function should be always called before the application running for comparing version of MAPACCESS library, used when application writing in corresponding library installed with the system. If the versions are different, applications can not be executed and you have to recompile application. The variable MAPACCESSVERSION is declared in mapapi.h.
If the application is using only functions, included to **MAPAPI** interface (C++ classes from **mapacces** library are not used), returned value can be equal to 0.
Second function should look like follows:

```
extern "C"
{
 long int _ export WINAPI CallMapFunction(long int hmap, TASKPARM * parm);
  {
   ...
  }
}
```

Variable hmap contains identifier of open map. For C++ modules this variable should be cast to TmapAccess type. TASKPARM structure is described in mapapi.h.

```
typedef struct TASKPARM    // APPLICATION PARAMETERS
 {
   long int   Language;              // Language code (1 -ENGLISH,
                                     // 2 - RUSSIAN, ...)
   HINSTANCE  Resource;             // Module of application resources
   const char * HelpName;            // Full ".hlp" file name
   const char * IniName;             // Full ".ini" file name
   const char * PathShell;           // Path to the application (exe,dll,...)
   const char * ApplicationName; // Application name
   HWND       Handle;                // ID of main application window
 }
   TASKPARM;
```

Second type applications should be written in Borland C++ (version is upper than 5.02), since they use mechanic of C++ classes export. Nevertheless they may use components, written in other programming languages.
Besides "GetInterfaceVersion()", second type applications should include following function:

```
extern "C"
{
 TMapTask * WINAPI_export GreateMapTask(TMapWindow * mapwindow)
  {
   TMapTask * task
   try
     {
      task = new UserClass(mapWindow);
     }
   catch
    {
     task=0;
    }
   return task;
  }
}
```

TMapTask and TMapWindow classes are described in MTmaptask.h и MWmapwin.h. Class UserClass must be inherited from TMapTask.
You have to use **PANAPI** interface to develop second type applications in Delphi, Visual C++, etc.

4.2. Loading matrix map from GRD format

Elevation matrix can be represented as GRD text file of following structure:
DSAA - file label
i, j - number of columns
- number of lines
Ymin Ymax - matrix extents
Xmin Xmax in rectangular coordinate system
Hmin Hmax - minimum and maximum elevation values
H11 H12 H13... H1n - elevation values
H21 H22 H23... H2n - elevations relative to minimum value
Hm1 Hm2 Hm3... Hmn

For example:
DSAA
237 151
1770.000 4130.000
4190.000 5690.000
35.079 110.054
0.000 37.637 38.589 etc.

4.3. Combining Work region to one map sheet

This application is used to combine source **Work region** to output vector map, consisted of one map sheet.
Source work region can include any number of sheets.
Output vector map is created based on all corresponding Work region's parameters. Thus output scale, digitizing rate, map projection, are equal to source ones.
There are following options of this application:

- Remove borders of source map sheets
- Create border of output region
- Automatic merging output objects

Press **Run** button to start combining. Previously you must name output map sheet. It is recommended to enter region name and nomenclature for combined sheet. Otherwise output sheet assigns name of source work region and nomenclature of its first map sheet.
You can include to output map just a part of objects or their attributes (**Filter** button).
You can view errors, occurred during processing in LOG file, stored in output map directory.

4.3.1. Removing borders of source map sheets

If this option is on, output map does not contain source map borders. If it is off, source borders are exported to output map with a code **Marked lines**.
Once combining is done user can use **Map editor** tools to merge output vector object and delete objects referred to as **Marked lines**.

4.3.2. Creating border of output region

If this option is on, the border of output sheet is built based on passport of output region. If it is off, output border is not created. You can create or edit output sheet border using standard **Map editor** tools.

4.4. Vector map transformation

Used to convert source vector map to destination vector map with different characteristics. Process modes are listed below:

- Map transformation to control coordinates by map border
- Map transformation to control coordinates by map corners
- Map transformation using control points by map border
- Map transformation using control points by map corners
- Map transformation to selected zone of Gauss-Kruger coordinate system

- Map transformation to conic conformal projection for the block Europe
- Map transformation to conic conformal projection for the block Asia
- Map transformation to conic conformal projection for map of scale 1:4 000 000
- Map transformation to conic conformal projection for 1:4 000 000 map (Russia)
- Map transformation to Transverse Mercator projection
- Map transformation to cylindrical projection for Russia's latitudes

There is a possibility to include to output map just selected objects, sheets, layers, attributes and so on. To create a query for source objects selection, press **Filter** button.
Transformation is done when all source map sheets get transformed.
You can view errors (if any), occurred during processing in LOG file, stored in output map directory.

4.4.1. Map transformation to control coordinates by map border

To start transformation set **Transformation** to **To control coordinates**, **Method** to **By map border** and push **Run** button.

4.4.2. Map transformation to control coordinates by map corners

To start transformation set **Transformation** to **To control coordinates**, **Method** to **By map corners** and push **Run** button.

4.4.3. Map transformation using control points by map border

Set **Transformation** to **By control points** and **Method** to **By map border**. Afterwards you should enter coordinates of map corners and arch points (if any). Once last point is selected push **Run** button at the appeared dialog.

4.4.4. Map transformation using control points by map border

Set **Transformation** to **By control points** and **Method** to **By map border**. Afterwards you should enter coordinates of map corners. Once last point is selected push **Run** button at the appeared dialog.

4.4.5. Map transformation to selected zone of Gauss-Kruger coordinate system

Set **Transformation** to **To Gauss-Kruger coordinate system**, and set following **Method** parameters: **Zone XX** and **Column XX**. Push **Run** button to start transformation.

4.4.6. Map transformation to conic conformal projection for the block Europe

Set **Transformation** to **To conic conformal projection** and **Method** to **Block Europe** (30,60,20). Push **Run** button to start transformation.

4.4.7. Map transformation to conic conformal projection for the block Asia

Set **Transformation** to **To conic conformal projection** and **Method** to **Block Europe** (30,60,90). Push **Run** button to start transformation.

4.4.8. Map transformation to conic conformal projection for 1:4 000 000 map (Russia)

Set **Transformation** to **To conic conformal projection** and **Method** to **Block Russia**

(45,62,93). Push **Run** button to start transformation.

4.4.9. Map transformation to Transverse Mercator projection

Set **Transformation** to **To cylindrical projection** and **Method** to **Mercator** (26° 8' 24", -26° 8' 24", 0). Push **Run** button to start transformation.

4.4.10. Map transformation to cylindrical projection for Russia's latitudes

Set **Transformation** to **To cylindrical projection** and **Method** to **Russia** (60, -60, 0). Push **Run** button to start transformation.

4.5. Joining sheets of Work region

This application is used for joining objects located on different map sheets and combine them to a group.
Application works in three modes:

- Control of joining objects on the sheet borders in the Work region
- Expanding objects to the map border (remove border "undershoots")
- Automatic combining joined objects to a group

To execute application you should set **undershoot tolerance** and **joining tolerance** for map objects. If you want to select some layers, objects, etc to be included to processing, use **Filter** button. Once operation is complete, LOG file with full information about joined and not joined objects is created. To start joining, press **Run** button. You can cancel processing by **Cancel** button, in this case LOG file contains information related to only processed objects. Joining is done as soon as all sheets of work region are processed.

4.5.1. Control of joining objects on the sheet borders in the Work region

In this mode the system provides only control of objects joining without the metrics correction. Use this mode to control joining accuracy. Set tolerances to 0 in this mode.

4.5.2. Remove border "undershoots".

Used to expand map object to the map border in accordance with **undershoot tolerance** parameter. If **Expanding objects to the map border** option is off tolerance is equal to 0 and the process does not work. Set on **Control of joining objects on the sheet borders in the Work region** option when working in this mode.

4.5.3. Automatic combining joined objects to a group

Used to combine joined objects to a group. When working in this mode, set **Control of joining objects on the sheet borders in the Work region** off. **Expanding objects to the map border** option can be on or off, depending on your current needs. If objects are already joined you can set it off or set tolerances equal to 0. You also have to set GROUP=ON in VECTOR.INI file.

4.6. Vector map georeferencing

Used to transform **Work region** from arbitrary coordinate system to selected coordinate system based on catalog of control points coordinates.
You can transform single map sheet or work region that consists of several map sheets. It is necessary to have at least 5 control points equally spread over each transformation area. Digital classifier should have control point object with mandatory attribute: point ID. Code of control point and code of its semantics should be contained in digital catalog of control points coordinates.
While georeferencing (transformation) origin point of the coordinate system is transferring

automatically and vector map is georferenced to coordinate system of control points catalog. You can estimate transformation accuracy by relative position of equal points and borders on adjacent map sheets of the work region.

4.6.1. Creating catalog of control points

Catalog of control points coordinates should have following structure:

```
.CAT
.OBJ XXXXXXXX
.SEM XXX
// comment
N1 X1 Y1 H1
N2 X2 Y2 H2
  .....
Nm Xm Ym Hm ,
```

Where

.CAT	- file beginning (mandatory field),
.OBJ	- mark of control point code (mandatory field),
XXXXXXXX	- external code of control point (mandatory field),
.SEM	- mark of semantic code of control point's ID (mandatory field),
XXX	- semantics code of control point's ID (mandatory field),
//	- comments (optional field),
N1 - Nm	- control points Ids (mandatory field),
X1 - Xm	- real coordinates of control points in meters (mandatory field),
Y1 - Ym	- coordinates of control points in meters (mandatory field),
H1 - Hm	- absolute elevations of control points (optional).

4.6.2. Running process

To georeference vector map to selected coordinate system you should:

- Open Work region;
- Start **vecttrans.dll** in **Run application** mode

Program works interactively. While processing it may ask you about control points rejection. Besides, you can get some error, warning and information windows.
Main georeference dialog consists of following parts:

- Paths and file names for:
  Source region;
  Output region;
  Control points catalog;
  Elevation matrix;
- Status bars;
- Standard screen buttons.

4.6.2.1.Preparation

Before running georeferencing process you should:

- Select transformation mode using **Elevation data** menu:
  - **No data** - 2D transformation,
  - **Elevation matrix** - 3D transformation:
- Select source region
- Select output region (default mode replaces input region by output region);
- Select control points catalog;
- Select elevation matrix (in case of 3D transformation);
- Set maximum control data residual value (difference between real and calculated coordinates).

4.6.2.2.Control points rejection

Before processing of each sheet system provides rejection of "bad" control points (points with a gross error in coordinate values). There are following warnings used to help user to go through the processing:

- **There is minimum number of control points on the sheet. Gross error in coordinates of …… point may cause serious deformations. Do you want to cancel processing?**
- **Gross error in coordinates of …… control point. Do you want to reject it?**
- **Maximum number of control points rejected. Gross error in coordinates of …… point may cause serious deformations. Do you want to cancel processing?**

Afterwards you can reject points those do not meet general criteria. Corresponding warning looks like this:

- **Do you want to reject …..point (RMS = …..m)**

If very big residuals occur, you should stop processing and figure out the reason. Most possible reasons are as follows:

- Wrong point coordinates in the catalog
- Control point is not digitized properly
- Wrong point ID in corresponding object semantics
- Wrong point ID in the source material

After necessary corrections start process another time.

4.6.2.3.Error messages and warnings

Warnings:

- **Names should be equal or select another directory** – invalid output region, you should select another path/name
- **Do you want to make a copy?** – when input region is to be replaced by output one, you can create its copy.
- **Matrix is out of region. Continue?** – usually arbitrary coordinate system of source work region is different of real coordinate system
- **Elevation matrix does not cover the entire region. Some results can be incorrect.**
- **Map border does not exist. Do you want to create one using passport data?** If there is no map border in the source sheet, you should create one for output sheet, otherwise it will not be processed.

Errors, that stop processing:

- **Invalid catalog of control points;**
- **There is no code of control point in the catalog;**
- **There is no semantics code of control point ID in the catalog**

Errors, that stop processing of current map sheet.

- **Control point arrays are not filled out;**
- **Too few points for transformation;**
- **Map sheet coefficients are not found;**
- **New extents of a map sheet are not found;**
- **Errors of map border creation;**
- **Passport does not contain new sheet coordinates.**

All errors-related information is displayed at the dialog. It is important to take it into account even in case when processing is complete successfully.
All error and warning messages are duplicated in the Work region register.

4.7. Raster image transformation

Basic sources of errors, included raster objects (scanned maps) are source paper or transparent film deformations. Aerial raster images also characterized by tilt, relief displacement, errors caused by Earth curvature, refraction and difference between scales of

raster image and output digital map.
The main purpose of raster transformation is minimizing influence of listed errors before on-screen digitizing.
Each raster should be transformed separately.
There are 5 transformation algorithms supported:

- By two points (rotation)
- Rotation with scaling
- By the border of nomenclature vector map sheet
- By set of control points
- By exterior orientation parameters (for aerial raster images)

As a result of transformation, raster image gets resampled in such a way that corresponding image points coincide with control points (taken from vector map). Raster scale, size and origin position are changed after transformation.
Raster transformation is provided by rsstrans.dll, started from **Tools/Run application/Raster transformation** menu.

4.7.1. Raster transformation, step by step

Raster transformation process is organized in following steps:

- Select source raster (**Source raster**)
- Select output raster (**Output raster)**
- Select transformation method (**Transformation**)
- Set process parameters
- Select raster area to be transformed

Transformation parameters:

1. Rotation includes following modes:

- rotation and scaling
- rotation without scaling
- horizontal alignment

2. Transformation by map border:

- by map corners
- by all points of map border (including arch points)

You also have to select needed sheet from the list if Work region consists of several map sheets.

3. Transformation by control points

- select control points catalog (**Control points**)
- select method of getting measured coordinates (**Measured points**)
- set maximum control points residual (**Control points residual**)
- select elevation matrix if 3D transformation

4. Transformation by exterior orientation parameters

- select control points catalog (**Control points**)
- select method of getting measured coordinates (**Measured points**)
- set maximum control points residual (**Control points residual**)
- select elevation matrix if 3D transformation

Besides, you should set type of photo (airphoto, central or panoramic) and focal length value in mm.
You can transform entire raster as well as its fragment, selected by rubber rectangle or by entering corner coordinates from keyboard.
In case of rotation you can transform only entire raster.

Press **Run** to start transformation. In case of transformation by control points system may ask you about points to be rejected.

4.8. Export to DXF format

Provides export of **VectOr** vector maps to DXF (version AutoCAD-14).

There are following limitations of export procedure:

- Object semantics is not exported;
- Object coordinates in DXF file are stored in meters in coordinate system of the source map
- Layers have new numbers, file of correspondence between layer number and its name is created (.LAY).
- Objects, which can not be converted are replaced by “marked” objects (some standard objects of different types). So no objects are lost when export.

Displaying style of vector objects in DXF file is created based upon **VectOr** map symbols. If necessary description of point objects can be retrieved from symbol file (.DXL). Symbol file is created using AutoCAD and a text editor.
DXL file should be selected in corresponding dialog text field if needed.
Labels are displaying as normal or italic depending onto starting and ending points of metrics.
Two temporary files are created when processing so you need disk space twice as big as DXF file size. By default DXF file and temporary files are created in MAP-file directory.
All error messages are written to LOG file.

4.8.1. Symbol file structure

Symbol file is used when converting to DXF format.

```
.DXL                (one line)
.SCALE   2000       (one line)
SYMBOL              (several lines)
SYMBOL              (several lines)
SYMBOL              (several lines)
...
SYMBOL          (several lines)
.END            (one line)
 where,
.DXL     - mandatory keyword
.SCALE   2000
.SCALE - mandatory keyword
 2000    - map scale
.END     - mandatory keyword
```

SYMBOL description consists of 3 lines:

```
-OBJECT CODE                    (one line)
-SEMANTICS (optional)           (several lines)
-SYMBOL DESCRIPTION             (several lines)
```

OBJECT CODE looks like:

```
.OBJ EXTERNAL_CODE  DOT
 where,
.OBJ - mandatory keyword
 EXTERNAL_CODE – external object code in VectOr (8 digits)
 DOT – mandatory keyword (for point object)
```

SEMANTICS looks like:

```
.SEM NUMBER_OF_CODES
SEMANTICS_CODE   SEMANTICS_VALUE\
SEMANTICS_CODE   SEMANTICS_VALUE |-->number of lines is equal to
   ...                                                |NUMBER_OF_CODES, each
SEMANTICS_CODE   SEMANTICS_VALUE /  code at the new line
     where,
.SEM - mandatory keyword
SEMANTICS_CODE, SEMANTICS_VALUE – integer values
```

Semantics is optional part of the file. It is used only for symbols of common external code and displaying style but different graphical representation (for example – round metallic pillars, concrete pillars, wood pillars etc). Semantics is assigned according to the map classifier.
Symbol description:
BLOCK block in DXF terms ... consisted of graphical primitives used to represent ENDBLK point object.
Block is created in AutoCAD environment.
Data in the line should be written from the first position.

4.8.1.1.Sample of symbol file

Symbol file for 1:2 000 maps processing contains a description of two symbols:

```
.DXL
.SCALE    2000
  //Beginning SYMBOL
.OBJ 51470000 DOT  - SYMBOL CODE
.SEM 2  ---\
48 1          |--->  SEMANTICS
10 3       ---/
BLOCK  ---\
 . . .          |--->  SYMBOL DESCRIPTION
ENDBLK ---/
      //End SYMBOL
     //Beginning SYMBOL
.OBJ 51550000 DOT  - SYMBOL CODE
BLOCK   ---\
 . . .          |--->  SYMBOL DESCRIPTION
ENDBLK ---/
   //End SYMBOL
.END
```

4.8.2. Creation of symbol file (DXL)

Symbol file is a text file with .dxl description.
Symbol file contains a description of map symbols of a map of selected scale, prepared by AutoCAD. It can be used only for point objects processing. As a rule, one symbol file is created for maps of one type and scale.

For example:
file 2000.dxl – for cadastral city map of 1:2 000 scale.

To create a file you should:

1. Add to symbol file object code (.OBJ).
2. Load AutoCAD.
3. Draw a symbol in AutoCAD. Symbol extents should be in mm. Coordinates of origin point should be 0,0 (in coordinate system of AutoCAD scheme).
4. Press **Create block** and:
   - At the appeared window **Creating block description** press **Select objects**
   - Select graphical primitives used to draw a symbol and press Spacebar
   - At the appeared **Creating block description** window enter unique block name (up to 30 characters, for example Well) and set origin point coordinates as 0,0
   - Press **OK** to create block
   - Use **File/Export** option of the main menu to save clock to DXF file (for example BLOCK.DXF). You should use DXF version 12.
   - Find block (Well) description in the DXF file and copy it to symbol file after SYMBOL_CODE from BLOCK keyword to ENDBLK keyword.
5. Assign semantics if needed (.SEM).

4.8.2.1.Assigning semantics

To assign semantics to object in the symbol file you should use file of text classifier for point objects SEMANT.TXT. This file consists of 2 tables:

- TABLES OF SEMANTICS;
- TABLES OF OBJECTS.

Afterwards:

- Open file of text classifier for point objects SEMANT.TXT.
- Find table row with external object code in TABLE OF OBJECTS. Memorize all SEMANTICS CODES with this external code. SEMANTICS CODES, marked by "*" should be obligatory used.
- Go to SEMANTICS TABLE. Among all memorized SEMANTICS CODES find codes with SEMANTIC VALUE is "classifier". For these codes select corresponding numeral SEMANTICS VALUE (do not use name of semantics).
- Assign semantics codes and values, you got, to the object in symbol file in accordance with symbol file description.

4.9. Control of absolute elevations

Used to control absolute elevations of map sheet objects. At the first step you should enter contours interval (for controlling standard topographic map with constant contours interval) or enter elevation or depth values to **contours interval** field. Control of elevations (depths) can be implemented either taken into account direction of digitizing or not. Use **Digitizing direction** option to set on/off this parameter. If it is off digitizing direction is not taken into account and elevations are controlled only by real elevation values. In this case you can set arbitrary contours interval. This mode is used if you have big number of errors, caused by digitizing direction with standard contours interval.
To eliminate error messages related to "break" objects (like bluffs) you should include codes of such objects to MAPKWA.INI file in VectOr directory.

MAPKWA.INI structure:

```
// <comment>
<object code>   <type>
<object code>   <type>
for example:     91000000   0
                 31410000   1
   where:        0 – line object
                 1 – polygon object
```

Application modes available:

- Control of absolute elevation values of topographic map sheet with constant contours interval (enter contours interval, for example: 20)
- Control of absolute elevation values of topographic map sheet with variable contours interval (enter elevation values range and contours interval for this range, for example: 150 500 10 500 2000 20 2000 8000 50)
- Control of absolute elevation values of geographic map sheet by known elevation values (enter elevation values for this sheet, for example: 10 20 50 100 200 500 1000 1500 2000)
- Control of depth level lines of topographic or geographic map sheet by known depths values (enter such values like this: 2 5 10 20 50 100 150 200)

Use **Filter** button to select sheets to be processed (**Sheets** pane). To start processing, press **Run** button. You can cancel process (**Cancel** button). In this case application LOG will contain only errors related to already processed objects.
You can view processing results in **Results** window of **Map editor.** LOG file line looks like this:

"Elevation error h1 h2 (n1 n2)"
where h1, h2 – elevations of erroneous objects,
n1, n2 - IDs.

You will get negative elevation values for **up-down** digitizing direction and positive values for **down-up** digitizing direction.

5. Useful advises

5.1. Creation of arbitrary map fragment

You can create map fragment of arbitrary shape by cutting it from standard rectangular or trapezoidal map. For example it can be a zone of known radius around selected map object. Note that such non-standard maps should have type – “user” maps.
To create such “zone” map you should:

- Create user map to copy zone map to.
- Create polygon object that encloses new map border or build a zone using **Buffer zone** process and save it as a map object.
- Mark objects to be copied (**Search/Mark**)
- Select object – border of creating map;
- Open mode **Copy marked objects to another map** (**Map editor**)
- Set on **Cut by selected object** option
- Select a user map to copy objects to
- Copy objects

5.2. Creating raster map by paper source

If you are short in time to digitize scanned raster map to convert it to vector format you can use raster map as a background and vectorize just objects you currently need. In this case you need to combine all materials to raster or raster-vector Work region.
You can create raster map in 2 ways:

1. If you combine source raster map sheets to one map you have to create a passport for every map sheet, included to Work region and make for each of them following operations:
   - Open vector map sheet;
   - Add to the map corresponding raster;
   - Make raster transformation by map corners (**Run application / Raster transformation**)
   - Cut raster by map border (**Raster list / Properties / Extract / By map object**)

2. If you combine raster map from different fragments (if for example big paper source was scanned by overlapped portions) you need:
   - Open one of the fragments (it is recommended to begin with the fragment located inside common image)
   - Make first step orientation (**Raster list / Properties/Place by two points / Horizontal alignment**)
   - Add second raster and georeference it to the first one: (**Raster list / Properties/ Place by two points with scaling and rotation**) using two points on each raster
   - Cut raster by drawn outline (**Raster / Properties / Extract / Manually**)

For example. There are 3 raster images converted to RSW format from BMP, PCX or TIFF format. To combine them to raster map you need:

1. Georeference first raster by two points on the raster and vector map or by control points set.
2. Georeference second raster by two points on the second raster and corresponding points on the first raster (or somehow else)
3. Georeference third raster
4. Set visible area for each of rasters
5. Save combined raster map to exchange format. As a result this map can be loaded as a whole from RSW format.

6. Appendix A. DIR file structure

DIR file used to combine different vector and raster maps to Work region. DIR file contains name of region file, name of region, name of classifier and names of loading SXF, TXT and MAP files.
File DIR has a following structure:

DIR
NAME < region name >
< name of file-classifier RSC >
< name of data file >.....
< name of data file >

< Region name > - region name (up to 24 characters). It is optional field. If it does not exist it will be equal to the name of sheet of first SXF file, included to the region.

< Name of classifier file> - name of RSC file, mandatory field

< Name of data file > name of binary or text SXF file or MAP file, mandatory field.

First file string must contain DIR keyword. The second string is a classifier file name. For example MAP103P.RCS. Following strings contain names of SXF, TXT or MAP files in arbitrary order. Each file name is stored in separate string. If file name does not include paths, files must be stored in DIR file directory (or its subdirectories).
For example. DIR file is stored in C:\DATA directory. SXF file name looks like \OMAHA\omaha.sxf. So full path to SXF file is C:\DATA\OMAHA\omaha.sxf. You can also include full paths to file names.
Different files may be stored in different directories.
All files should contain maps of common type and projection.
If the Work region covers several zones of coordinate system SXF file that covers maximum area should be at the first place in the SXF files list. All other SXF files will be georferenced to the coordinate system of the first one.

7. Appendix B. Sample of SXF file

```
// EXAMPLE of a text SXF FILE
   // RECTANGULAR COORDINATES
   // TOPOGRAPHIC MAP
   P000 BERN
```

```
P001 0. L-32-039-2-2. A
P002 1
P101 0.8188502 0.1287180
P102 0.8203048 0.1287180
P103 0.8203047 0.1308997
P104 0.8188505 0.1308998
P109 5199356.6 2376216.0
P110 5208620.7 2376408.1
P111 5208431.0 2385915.0
P112 5199166.9 2385737.7
P116 1
P117 1
P119 1
P207 50000
.DAT 4
// LAKE (KEY: 3/4, 3 * 65536 + 4 = 196612)
// WATER TYPE- FRESH
// SHORELINE FEATURES - CONSTANT
// TRUE ALTITUDE - 546 m
.OBJ 31120000 SQR
.KEY 196612
8
5202894 2378715
5202876 2378775
5202844 2378795
5202784 2378790
5202740 2378713
5202744 2378668
5202804 2378655
5202894 2378715
.SEM 3
33 100
36 100
 4 546
// RICH WOOD (KEY: 7/41)
// RELATIVE ALTITUDE - 25 m
.OBJ 71111100 SQR
.KEY 458793
6
5206181 2380839
5206106 2380903
5206113 2380923
5206168 2381003
5206265 2380961
5206181 2380939
.SEM 1
1 25
// BRIDGES (KEY: 6/434)
.OBJ 62310000 VEC
.KEY 393650
2
5207754 2379350
5207794 2379470
// SERVER (KEY: 6/183)
.OBJ 62130000 DOT
.KEY 393399
1
```

```
5205731 2378440
// CITY LABEL (KEY: 256/2)
// TYPE of the FONT 5, CODE of COLOUR - 101, TEXT - "BERN"
.OBJ 88000000 TIT
.KEY 16777218
1
5203728 2377794
> BERN
.SEM 2
14 5
94 101
.END

.SXF 3.0
// EXAMPLE of a text SXF FILE
// GEODESIC COORDINATES
// TOPOGRAPHIC MAP
P000 BERN
P001 0. L-32-039-2-2. A
P002 1
P101 0.8188502 0.1287180
P102 0.8203048 0.1287180
P103 0.8203047 0.1308997
P104 0.8188505 0.1308998
P109 5199356.6 2376216.0
P110 5208620.7 2376408.1
P111 5208431.0 2385915.0
P112 5199166.9 2385737.7
P116 7
P117 1
P119 1
P207 50000
.DAT 4
// LAKE (KEY: 3/4, 3 * 65536 + 4 = 196612)
// WATER TYPE- FRESH
// SHORELINE FEATURES - CONSTANT
// TRUE ALTITUDE - 546 m
.OBJ 31120000 SQR
.KEY 196612
8
0.8194135 0.1292739
0.8194108 0.1292878
0.8194059 0.1292925
0.8193964 0.1292916
0.8193893 0.1292742
0.8193898 0.1292638
0.8193991 0.1292606
0.8194135 0.1292739
.SEM 3
33 100
36 100
 4 546
// RICH WOOD (KEY: 7/41)
// RELATIVE ALTITUDE - 25 m
.OBJ 71111100 SQR
.KEY 458793
6
```

```
0.8199360 0.1297456
0.8199245 0.1297606
0.8199256 0.1297652
0.8199345 0.1297833
0.8199496 0.1297732
0.8199360 0.1297456
.SEM 1
1 25
// BRIDGES (KEY: 6/434)
.OBJ 62310000 VEC
.KEY 393650
2
0.8201782 0.1293969
0.8201848 0.1294242
// SERVER (KEY: 6/183)
.OBJ 62130000 DOT
.KEY 393399
1
0.8198578 0.1291976
// CITY LABEL (KEY: 256/2)
// TYPE of the FONT 5, CODE of COLOUR - 101, TEXT - "BERN"
.OBJ 88000000 TIT
.KEY 16777218
1
0.8195414 0.1290589
> BERN
.SEM 2
14 5
94 101
.END
```

8. Appendix C. MTRCREA.TXT file structure

MTRCREA.TXT file defines objects used to create elevation matrix.
TXT file consists of information and comments strings (marked by // characters)
TXT file contains sections. Each section begins with «.» character.
Section **Absolute elevation objects** contains classification codes and names of objects with attribute **Absolute elevation**. Object name is optional parameter and separate of classification code by space. If section starts with .ABS_H OBJECTS keyword, following are codes of objects included to processing (matrix calculating). If section starts with .ABS_H OBJECTS ALL keyword, all objects with **Absolute elevation** attribute are included automatically and keyword is following codes of objects excluded from processing.
Section **Relative elevation objects** contains classification codes and names of objects with attribute **Relative elevation.** Object name is optional parameter and separate of classification code by space. If section starts with .REL_H OBJECTS keyword, following are codes of objects included to processing (matrix calculating). If section starts with .REL_H OBJECTS ALL keyword, all objects with **Relative elevation** attribute are included automatically and keyword is following codes of objects excluded from processing.
Optional section **Hydrology objects with constant elevation** contains classification codes and names of hydrology objects with constant elevation (lakes for example) that do not have attribute **Absolute elevation**.
Optional section **Hydrology objects with variable elevation** contains classification codes and names of hydrology objects with variable elevation (rivers for example).
Section **Constants** contain values and names of constants such as **Absolute elevation** or **Relative elevation**.
Sample of MTRCREA.TXT file:

```
//-------------------------------------------------------------------------
//          Objects used to calculate elevation matrix
//-------------------------------------------------------------------------
//-------------------------------------------------------------------------
.ABS_H OBJECTS    «ABSOLUTE ELEVATION» objects
//-------------------------------------------------------------------------
// code          name
//-------------------------------------------------------------------------
   11200000          points of state geodetic network
   12000000          elevation pickets
//
   21000000          main contour lines
   21300000          additional contour lines
//
   31120000          lakes
//
//-------------------------------------------------------------------------
.REL_H OBJECTS          «RELATIVE ELEVATION» objects
//-------------------------------------------------------------------------
// code    default values (m)    name
//-------------------------------------------------------------------------
   71111100       30          REACH WOOD (HIGH TREES)
   71111110       30          REACH WOOD (LOW TREES)
   71123000        7          GARDENS
//-------------------------------------------------------------------------
.CONSTANTS          CONSTANTS
//-------------------------------------------------------------------------
// value          name
//-------------------------------------------------------------------------
  4               code of attribute «ABSOLUTE ELEVATION»
  1               code of attribute «RELATIVE ELEVATION»
//
.END
```

Sample of text file with a list of excluding codes:

```
//..... Objects used to calculate elevation matrix
//-------------------------------------------------------------------------------------------------------
.ABS_H OBJECTS ALL
// all objects with attribute «ABSOLUTE ELEVATION»
//
// code    name
//-------------------------------------------------------------------------------------------------------
.REL_H OBJECTS ALL
// all objects with attribute «RELATIVE ELEVATION» except:
//-------------------------------------------------------------------------
// code    name
//
   22630000      BLUFFS
//-------------------------------------------------------------------------
.HYDRO_CONST_H  OBJECTS
// HYDROLOGY OBJECTS WITH CONSTANT ELEVATION
// code    name
//
  31120000      LAKES
  31130000      RESERVOIRS
//-------------------------------------------------------------------------
.HYDRO_VAR_H  OBJECTS
```

```
// HYDROLOGY OBJECTS WITH VARIABLE ELEVATION
// code    name
//
  31410000       RIVERS
//-------------------------------------------------------------------------
.CONSTANTS              CONSTANTS
//
// value       name
//
  4               code of attribute «ABSOLUTE ELEVATION»
  1               code of attribute «RELATIVE ELEVATION»
//
.END
//-------------------------------------------------------------------------
```