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Geographic Institute of Mali,
Ministry of Equipment, National Development, the Environment
and Urban Planning, Republic of Mali(IGM)

THE NATIONAL TOPOGRAPHIC MAPPING OF THE REPUBLIC OF MALI IN THE KITA AREA

MANUAL
for
DIGITAL TOPOGRAPHIC MAPPING

OCTOBER 2001

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PREFACE

In response to a request of the Government of the Republic of Mali, the Government of Japan decided to conduct “The National Topographic Mapping of the Republic of Mali in the Kita area”.

This Manual prepared by the study team and IGM counterpart for the overall digital mapping method through the technology transfer.

Detailed operation of the equipment and computer software shall be referred to the manuals provided by each makers.

As this manual prepared as a version 1.0, it is expected and recommended in the future to modify and add through the actual mapping project by IGM.

I wish to express my sincere appreciation to the IGM of the Republic of Mali for the close cooperation they extended to the team.

October, 2001

Junichi Koseki
Team Leader
Study Team of The National Topographic Mapping of the Republic of Mali in the Kita area

MANUAL FOR DIGITAL TOPOGRAPHIC MAPPING

(GPS System, Digital Level, Aerial Photography, Photo Interpretation, Field Identification, Field Completion, Computer Operation)

Contents

CHAPTER 1 GPS SYTEMS

A. 300 GPS SYSTEM AND COMPUTER PROCESSING OF DATA

1. Introduction:

The Leica system 300 equipment consists of GPS reception equipment and a P.C. computer data processing software.

This equipment includes:

2. GPS Sensors:

These are receivers which can capture GPS signals from NAVSTAR satellites and calculate the distance to visible satellites. The different types of sensors are used with AT 202/203 antennas.

3. GPS Controllers:

These control the sensors and record data. They include a display panel and a keyboard, the interface used for topography during field work uses GPS equipment.

There are 2 types of controllers: CR333 and CR344. The CR344 model allows operations in real time and may be connected to a modern radio. The user interface of the controller includes 6 function keys (F1 to F6).

4. Post-Processing software:

which allows the processing of observations gathered with GPS receivers (sensors and controllers) in order to determine the base lines and coordinates.

The SKI model for static mode is the standard post-processing program for bi-frequency receivers.

The static mode is an observation method from 2 stationary receivers or more. It is suitable to determine long base lines, measured using at least 4 satellites. To obtain precise results on long lines, it will be necessary to make observations for at least 1 hour, but preferably for 2 or more hours.

In general, the software must be installed by the Leica Manufacturer, including a brief training period.

If this is not a case, the instructions given in the notice provided by the Manufacturer must be strictly followed.

B.OPERATION OF THE GPS-300 SYSTEM

For field observations, the static mode based on the principle of 2 receivers was used. The reference receiver was set at one point with continuous observations through satellites. The roaming receiver moves from point to point within a set time for one type of work indicated.

1. Installation of equipment in the station:

- Installation of the sensor with antenna on a fixed tripod
- connection of the battery to the sensor or the controller using a 1.8 m cable, and connection of the controller to the sensor through a 2.8 m cable.

For long duration observations, it will be necessary to connect 2 batteries at a time to the sensor. The batteries will be charged in advance.

2. Operation of the instrument:

The following operations will be carried out:

- Insert the battery in the memory card and introduce it into the controller
- Be sure that a new memory card is formatted in advance using the procedure described in the user notice for the GPS-300 system.

3. Measurement (or Observations) with the GPS:

After formatting, carry out the formalities to allow the start of observations. Next, allow 2 receivers to follow the satellites and record data for 15 minutes:

- Enter an identifier (point 1D), that is, references of the station point
- Measure the altitude of the point with the tape-holder hook and enter this value in the “Height” zone. If the antenna is installed on a tripod with GRT 44 support and a base, its excentricity must be exactly 0.441 m.
- Enter this value in the “Antenna Offset” zone.

After the introduction of all the required parameters, press the “MEAS (F1)” key to start the measurements.

After the starting phase of the controller is finished, the equipment will capture data from satellites within several minutes.

The controller will provide information to the operator regarding the number of satellites observed, the number of measurement periods recorded and the current GDOP.

- Wait until the receivers are in contact with available satellites, for example 3 / 3.4 / 4.5 / 5 or 6 / 6.
- Conduct measurements for around 5 minutes and transfer the measurement results obtained to the files to be printed for this purpose
- After measurement for several minutes and establishment of the parameters required in the Survey menu, press “STOP (F1)”.

The following message should appear: "Stop Measuring? (Y/N)".

- Validate with “Y” to stop measurements.

The observations are then stopped and you will have the possibility of changing the identification of the point, the height read and the shift up to the antenna, for the last time.

- Now press “REC-PT (F1)” to record information on the point in the memory card introduced before.
- Next, press “EXIT-M (F2)” to quit the mission. The following message will appear: “Exit Mission? Sure? (Y/N)”.
- Validate with “Y”. You will return to the “Main Menu”. At this time, you may turn off the controller by pressing the “OFF” key.

4. Remarks on GPS measurements:

- The GPS is a differential positioning system based on two receivers which simultaneously measure and observe the same satellites. The results are provided by the SKI post-processing software.

The fixed station for the reference receiver and the mobile station for the roaming receiver are designated.

The SKI software calculates the base lines between the reference receiver and the roaming receiver, which must be configured in the same recording interval and in the same recording mode, that is, “Compacted” or “Sampled”.

The receivers (reference and roaming) remains stationary to provide sufficient time to record the satellite signals for the resolution of ambiguities.

The observation time required to obtain a precise result during post-processing is dependent on various factors: length of base line, number of satellites, geometry of satellites (GDOP), ionosphere.

- Ionospheric disturbances are based on time and the geographical position of the receivers on the ground.

With a SR299 sensor, the minimum observation time for rapid statistical surveys with 4 satellites or more and a good GDOP (< or = 8) is 2 minutes.

This may be sufficient for short lines. However, in case of very strong ionospheric disturbances, it is often necessary to extend the observation time.

It is impossible to precisely indicate the observation time required for the GPS system.

- In fact, the ionospheric instability constitutes the principal obstacle to the precision of GPS measurements. These influences are 3 to 4 times higher during daytime than at night, and varies with the length of the line.

The ionospheric effects also change based on time and the geographical position of receivers. Systematic errors may be introduced into the measurement of phases and may lead to results outside specifications.

The only way to minimize these influences is to carry out sufficiently long observations to allow the appropriate post-processing.

- Lines exceeding around 15 km must be observed as long as possible (a minimum of one to 2 hours). It may be advantageous to measure long lines at night when ionospheric disturbances are weakest.

C. PROCESSING OF DATA IN THE SKI SOFTWARE:

After connecting the battery to the controller and the controller to the computer, proceed as follows:

- turn on the controller and the computer
- start Windows, then SKI
- select the transfer mode and create the project.

It must be noted that transfer may also be made from a memory reader.

1. Creation of the Project:

The project is created to transfer data from the memory card. Proceed as follows:

- select the "Project" module
- call "Manager", then "New"
- enter an access path in which you want to record the project
- enter a project name and quit the project component.

2. Importing data:

All data recorded in the different controllers must be transferred (imported) into SKI. After transferring the recorded data in the controller memory cards on the computer hard disc, a backup may be saved by transferring it to a diskette. Then, proceed as follows:

- select the "Import" module
- call "Measurement"
- select the GPS controller
- select the "Memory card" support if you wish to save the data on a diskette
- select the "Internal Memory" module to store data in the internal memory (hard disk)
- follow displayed instructions, then press "OK". The data will then be read by SKI.
- next, select the data sets or work that you wish to copy into the computer and press "COPY". Once the copy is made, press "OK".

Remarks: The data must then be imported to a particular project.

Data copied in the computer are displayed in the left box, and the project where it is stored is displayed in the right box. Next:

- select the data by clicking on it and
- press "Insert" to Transfer the data to the project. Once importation is completed, quit the "Import" component.

3. Data processing

a. Processing mode

The SKI software proposes two processing modes. One will allow evaluation of the base line and the other will calculate the position of single points. For this, the following must be carried out:

- select “Configuration”
- select the “Processing Mode” module
- press “Base Line”
- or press “Single Point”.

b. Data processing

- select the “Data Processing” module. The date in which you carried out the measurements is displayed
- select this date, then press “OK”. The date will be selected
- select “Manual”. A diagram showing the two stations from which measurements were made, appears
- select the reference station tool displayed at the bottom of the screen
- click one of the lines. This will be selected as the reference station and displayed in **red**
- select the roaming station tool at the bottom of the screen
- click on the other line. This will be selected as the roaming station and displayed in **green**
- Once the base line has been selected, click OK. To start calculations, click on "Commute"
- select all the points (roaming station) by highlighting them
- select the “Store” module (for storage)
- select "slot" and click on “Results” to display the results
- press “Print” to print results
- exit by pressing “Exit”.

Remarks: A line will be displayed with the corresponding specification.

It is therefore possible to export results for subsequent processing.

To display the coordinates, proceed as follows:

- click on Details
- move the cursor to the line and click.

The coordinates of the roaming points (roaming station) will be displayed on the screen for the report.

D. ADJUSTMENT:

- select the “Adjustment” module
- select “Import”
- select “SKI Project”
- select and validate (click) the reference station
- press “OK”
- select “Id”
- press “Exit”
- select the “Coordinate and class module”
- double click on the reference
- select “Point to be computed”
- click “Fielded points position and Height”
- introduce the WGS 84 geographical coordinates and the altitude (Z) of the reference station
- select “N” for latitude
- select “W” for longitude, according to the KITA project case
- reduce the scale by selecting the “Utilities” menu
- click on “Set scale at 0.01”, then press “OK”
- select “Show” and click “grid”
- return to the Utilities menu and click on “Print” for printing

Select “Export to Datum Map” (Utilities), then “OK”.

- select “Geodetic” --- “select all”
- write the name: “coordinate set” --- “export”

E. DATUM MAP:

- select “Import” ---------- “export”
- click on “Coordinate set”, then “OK”
- click on “Edit” --- “select all” --- “Edit”
- maintain only the numbers and delete the other figures and letters
- select “Geodetic” --- “OK”
- press “Display” --- “print”.

F. CALCULATE THE TRANSFORMATION PARAMETERS

This will determine a set of transformation parameters between two coordinate systems.

Example: WGS 84 coordinates (system A)
UTM coordinates (system B)

In the case of two, three, even seven points, proceed as follows:

- select “Datum Map”
- select “Transformation Parameter”
- click “Classical”
- press “Determine parameters”. the following table will appear:
- “coordinate set system A”
- “coordinate set system B”

Proceed as follows:

- 1. Select the set of coordinates for system A
- 2. Select the set of coordinates for system B
- 3. Press “OK”

Select “Datum/Map”

- click “Import” --- “Export”
- select “Coordinate set” --- “Add-type of input “
- select coordinates for points, then “OK”
- press Edit --- “Cartesian”, then “OK”

Return to “Datum/Map”

- click “Import” --- “export “
- click “Edit” --- “Cartesian”
- click a common point in system A and in system B
- select “Match”
- repeat from 1 for all common points
- press “OK”

NB: Auto Match can also be selected.

G. TRANSFORMATION OF COORDINATES:

- return to SKI
- select “Datum/Map” --- “Transform coordinate”
- select the set of coordinates as follows:

  WGS 84 - UTM ---- UTM
- press “OK”. The transformed results will appear
- click.

CHAPTER 2 DIGITAL LEVEL

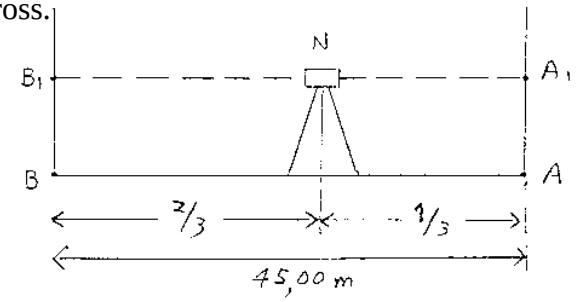
A. UTILIZATION MANUAL FOR THE N.A. 2000 WILD DIGITAL LEVEL

First phase: CHECK (Control of digital level)

For this operation, select a distance less than or equal to 45.00 m.
For example (A, B) and divide into 3 equal parts.
The operation is carried out in two stages.

First stage:

Place the station level at a distance of 1/3 between points A and B (or 15 m from point A) and proceed as follows, pressing the buttons across.



- **Program PROG**
- **↑ DSP**
- **DSP ↓ DSP**

until **CHECK X ADJUST** appears.

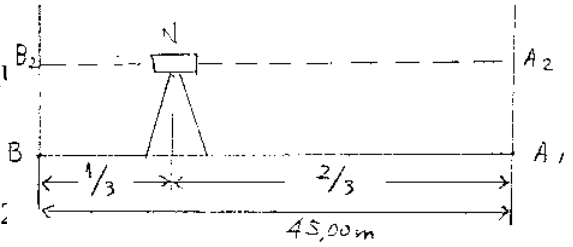
- press the **RUN** button
- press back
- press the **Red** button to have measurement (A1)
- press forward
- press the **Red** button to have measurement (B1).

After these operations, the equipment will display Move Instrument.

- To confirm, press the YES button.

Second stage:

This time, place the station level at a distance equ
30 m from point A).



- press forward to the pattern placed in B
- press the **Red** button to have measurement (B2
- press back to the pattern placed in A
- press the **Red** button to have measurement (A2)
- press the DSP button until Compute coll is displayed.

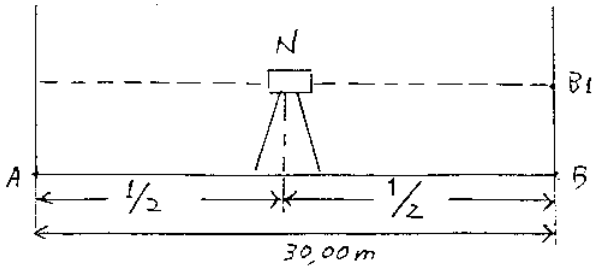
Second phase: ADJUST

The operation consists of two stages:

First stage:

In the station, place the level at the middle of the two points (A and B) and follow the following programming during measurements by pressing the buttons across.

- 1. Select program ON
- 2. Initialization INIT
- 3. Order O
- 4. OK
- 5. (D.CLR?) OK or NO
- 6. OK
- 7. T? (display temperature T = 25 °C for example) OK
- Cloudy OK, to answer the different questions until the display of the rear measurements (A1) and front measurements (B1).



At the same point, turn the 200 gr tripod, go back to the station and repeat the same operations, beginning with the front measurement (B2), then the rear measurement (A2) until Move appears.

Second stage:

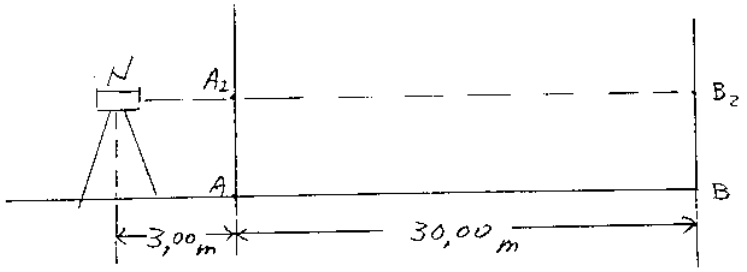
Place the level at 3 m from point A, that is, at around 1/10 of the distance (A,B) (see figure). Start by pressing forward to the pattern in B to have the B2 measurement.

Then press back to the pattern placed in A to have the A2 measurement.

At the same point, turn the 200 gr tripod, go back to the station and repeat the same operations, beginning with the front measurement (B2), then the rear measurement (A2) until the end of the program.

Remark:

1. For single leveling of the station, conduct the same operations, changing the order number to 3 instead of 0.
2. For double leveling of the station, change the order number to 5 instead of 3.



CHAPTER 3 AERIAL PHOTOGRAPHY

A. MANUAL FOR AERIAL PHOTOGRAPHS

1. Preparation

Operations to establish a base map requires the taking of aerial photographs, which can only be obtained through aerial views of the space covering the project zone. This requires the signing of an agreement contract with organizations specialized in the field. They will be provided with technical and related specifications such as:

- area to be photographed and its characteristics
  (surface area, geographical coordinates of limit angle points)
- the scale to be adopted for photographs
- characteristics of the photograph chamber
- type of film to be used
- overlapping (end and side laps)
- flight altitude
- flying drift
- favorable period for operations.

2. Control of flight plan

The flight plan is provided by the Company in charge of the flight. The beneficiary Client must:

- verify if this plan complies with its requests
- verify the precision of flight lines
- approval or disapprove the overlap rate given by the Company.

3. Administrative formalities

The beneficiary Client is in charge of:

- requesting authorization for taking photographs from bodies in charge of the sector and according to the laws in force;
- requesting for flight and landing authorization from the National Civil Aviation Department, specifying the picture taking period, the nationalities of the crew members and the type of plane.

4. Taking of photographs

Upon arrival of the plane, the beneficiary Client must:

- inspect the photography chamber of the plane and its technical characteristics;
- verify the type of film;
- verify the photo navigation GPS system
- provide crew members with all information on the meteorological conditions of the region
- assign a supervisor who must participate in all phases of the flight and the pre-processing of films to control the results of the operation
- inform the crew of flight prohibited zones in the territory, in short, provide all the necessary information to assure the success of the photographing activity.

5. Preliminary control

At the end of the picture taking and before the plane is repatriated, the beneficiary Client should conduct a systematic quality control of the results, which consists of:

- developing a set of films on the spot after having taken all the necessary provisions
- check the negatives if there are no clouds, obstacles, dust particles, etc.
- print the contact proofs
- check overlaps (end and side laps)
- control the side-slip of the plane
- verify the approximate scale of the photos
- verify if the film negatives are complete and if the entire project zone has been photographed.

N.B.: This control is conducted in a specialized laboratory and in the recommended office with performing equipment and qualified personnel.

6. Documents to be furnished:

At the end of operations, the Company must provide a flight plan, the assembly table and operation reports with all the necessary indications which must be approved by the beneficiary Client.

The flight plan furnished must include the flight numbers and the photo numbers.

In addition, after film processing in the laboratory and the quality control of the prints, carried out by the Client, the Company must provide the following documents:

- one set of films and negatives;
- one set of contact proofs;
- one set of photos enlarged by at least 2 times
- a report on meteorological conditions recorded during the taking of photographs (weather, temperature, climate, etc...).

CHAPTER 4 MANUAL ON PHOTO INTERPRETATION WORK

Photo interpretation constitutes one of the stages for the establishment of the map. This is carried out using aerial photographs by at least 2 times.

A. PROCEDURE:

1. Selection of photo proofs at a scale of 1/50,000, covering the project zone.
2. Selection of photo prints enlarged at a scale of 1/25,000
3. Fixation of the tracing paper on enlarged photos for their working up.
4. Selection of old maps including the zone (for example: the 1/200,000th)
5. Preparation of design tools (set of Rotring, pens, erasers, colored crayons, rulers, etc...).
6. Report (or design) on tracing paper of the detail identified from the photo.
7. Checking of omissions and correction of errors noted during interpretation work.

B. METHOD OF REPORTING DETAILS ON PRINTS:

1. Communication means: (in black)

1. Trace the itineraries and report the corresponding numbers represented in the prints (1 to 7). Do not include road and path conventional signs.
2. Mention the numbers corresponding to the level of each segment of road and path.

* Do not forget to place the corresponding numbers after each crossing and orient them towards the north.
* Only take the corresponding numbers even if they do not conform with the types of lines.

2. Vegetation: (in green)

1. Only represent details exceeding a height of 5 mm x 5 mm.
2. Generalize by encircling the vegetation area and neighboring planting areas.
3. Give the corresponding conventional signs within the contours according to the legend.
4. Represent the plantation area with small green circles, 0.5 mm in diameter.

3. Hydrography: (in blue) and bridges (in black)

1. Represent the lakes, rivers, canals, ponds, marshes, etc.. according to their actual size.
2. As much as possible, write the names of the lakes in the center of the nappe.
3. Mention the name of water courses in the northern side based on their form.

* Lines, names and numbers are in blue.
* Verify the water course winding, referring to the assembly map at a scale of 1/200,000.
* The water course is one of the most important figures.

4. Relief: (in bistre)

1. Place the corresponding conventional signs for escarpments, dikes, rocky terrain, outcrops, etc.
2. Report the above-mentioned figures in the prints prepared with level curves.

5. Living areas:

1. Generalize the living areas with a population above 50,000 inhabitants (classification from 1 to 4).
2. Encircle the living area.
3. The county towns of districts, circles, regions and States which correspond respectively to the classifications (4, 3, 2 and 1).
4. Place a red circle (diameter 1.5 mm) in the center of the residential area whose population varies between 10,000 and 50,000 inhabitants.
5. The area classified as number 6 or where the population is less than 10,000 inhabitants is represented by a background red shaded circle with diameter of 1 mm.
6. Names of inhabited areas (in red)

Areas classified above no. 3 (example: Kita) will be written in bold letters.

6. Administrative Limit: (in red)

Trace the administrative limit according to the legend, referring to the existing map with a scale of 1/200,000.

7. Railway, electrical power transport line: (in red)

1. Place the signs corresponding to the railway line and station in their actual position. Provide the railway line based on enlarged (2x) aerial photos.
2. Carefully check the number of railway tracks.
3. The detailed prints are made through the color scanner. The final maps are made after compilation using the screen image.

N.B: Doubtful information on details are indicated in forms drawn up for this purpose and entitled Questionnaire Forms.

These are filled up and enclosed in the corresponding aerial photographs to be used for field interpretation work.

CHAPTER 5 FIELD IDENTIFICATION

A. MANUAL ON PHOTO IDENTIFICATION WORK

Identification represents a very important stage in the map establishment process. It requires certain operations as follows:

1. Documentation:

consists of

- aerial photographs at a scale of 1/50,000 covering the project zone;
- enlarged photographs (2x) at a scale of 1/25,000, previously worked up in the office;
- direct leveling marks, astronomic and geodesic points marked in the area;
- list of villages in the administrative area;
- topographical documents including old maps at a scale of 1/200,000;
- documents providing marginal information for the map.

N.B: The documentation must be complete, clear and comprehensible for any type of map user.

2. Gathering of information:

This constitutes a very important phase in field work and is generally carried out through inquiries among the population, and the administrative and municipal authorities in the areas concerned. In addition, various information must be gathered from the administrative technical services in charge of the following areas:

- **Public Works:**

For

- a survey of the road crossings and their viability at any season;
- marking of existing works in the hydrographic network (bridge, foundation, etc.)
- list of all infrastructures and equipment built after the photos are taken;
- list of all projects financed and which will be surely carried out.
- **Forestry Administration:** To delineate fauna and halieutic reserves (in accordance with laws in force and authorizations to circulate in these areas).
- **ASECNA:** To secure the list of certified lands with their characteristics and their official names.
- **Energy:** To avail of existing high voltage lines or those to be built.
- **Tourism:** To receive information on accommodation facilities, important sites, historical or archaeological sites.
- **Agriculture:** To know the areas which can be cultivated, plantations, pilot farms, rice fields, etc.
- **Gas companies:** To know the locations of gas stations required to supply the worksheets vehicles.
- **Security:** To inform the local authorities (police and the army eventually) regarding the objectives of the project, its duration and its field of implementation.

3. Preliminary surveys:

More precise information is gathered from the heads of villages and local authorities regarding:

- name and type of collective equipment
- delineation of administrative limits (districts, circles, regions and states)
- viability of road crossings between areas
- various information on the elements (waterfalls, rapids, ponds, fountains, isolated wells, etc.)
- all other marginal information included in the map legend.

4. Preparation for field work:

a) Choice of itinerary, based on:

- viability of roads for cars and paths found during the photographic identification and preliminary surveys;
- distance from the base: in this case, provide several exits from the field;
- allowances for employees for travel and living expenses in the country;
- regular provision of gasoline and requirements for vehicles.

b) Establishment of documents: refer to the old map:

- all itineraries to provide details to be identified;
- doubtful elements in the questionnaire forms;
- approximate locations of leveling marks, astronomic and geodesic points, whose existence must be verified in the field;
- information received during the preliminary surveys.

c) Other field documents and material

- daily itinerary logbook;
- GPS portable equipment to determine the coordinates of collective equipment (schools, health centers, religious centers, etc..)
- design tools (colored crayons, erasers, rulers, etc.)
- hand stereoscopes
- detailed photography equipment on the spot;
- recording instruments for names of villages, water courses, hills,. etc..

5. Field work

Field work consists of travelling throughout the area considered according to itineraries carefully selected in the office. Its objective is to gather all information required on the spot and confirm them before the photos are worked over. Often due to difficulties in the field in certain areas, the employees are not systematically able to reach all the villages. In these cases, they must gather information from the authorities in the neighboring areas. They also must make stereoscope observations to verify the details of information received.

* **For each inhabited area:** note the information regarding the following:
  - classification number of the village
  - cemented wells
  - school
  - dispensary
  - mosques and churches
  - camping areas
  - GPS coordinates taken
  - market
  - post office
  - customs stations
  - police
  - water towers
  - station, bus stops
  - sacred forests
  - Muslim and Christian cemeteries
  - names of neighboring villages, direction and approximate distances
  - names of ponds, water courses, valleys, neighboring summits
  - tourist and historical areas
  - etc..

* **For each uninhabited area:** note interesting information regarding the vegetation, forests classified as reserves or not, intermittent or permanent water courses, planting fields, relieves, etc...

N.B.: All information received in the field, irrespective of the source, must be checked and confirmed before being printed, worked over and attached to enlarged photos.

6. Expected results

At the end of the field work for this first phase for the establishment of the map, the identification agent must be sure that all details found in the field are exact and included in prints prepared in advance in the office.

CHAPTER 6 FIELD COMPLETION

A. MANUAL ON COMPLETION WORK IN THE FIELD

Completion is the last phase of the field work. Its objectives are as follows:

- to correct the remaining gaps after the photo identification and interpretation of images
- to verify the transfer of information collected during photo identification in the draft maps;
- to reduce errors in the new map to a maximum.

1. Documentation:

- one set of the original draft maps;
- one set of the printed draft maps;
- one set of enlarged (2x) photos worked over in the office;
- leveling marks
- marks of astronomic and geodesic points;
- list of administrative villages
- documents on administrative limits and forest reserves;
- design materials (colored crayons, erasers, rulers, etc.)
- portable GPS instruments.

2. Office work: this covers the report on:

- roads built after the pictures were taken;
- financed road projects to be certainly carried out and whose plans are available;
- forests and reserves based on the coordinates of certain border points, or with reference to old maps;
- posts indicating a change in the direction of high voltage lines built or being projected;
- all astronomic and geodesic points according to their coordinates;
- leveling marks according to indication files;
- administrative limits based on documents and old available maps.

3. Field work:

The principle remains the same as during the photo identification process. However, particular emphasis is placed on the gathering of supplementary information regarding the toponymy of villages, water courses, hills, fauna and halieutic reserves, etc.

4. Meeting with local authorities:

Meetings will be conducted with the heads of local communities (government representatives, mayors, heads of villages and their advisers) who have better knowledge of their environment, for the following purposes:

- to confirm the entire toponymy of the draft map;
- to complete missing details;
- to verify the transcription of the names of elements indicated in the draft maps;
- to confirm all other information received during the preceding phases;
- to confirm the classification of roads and paths;
- to verify their continuity through certain details in the field;
- to report new elements based on their coordinates determined through GPS observation;
- to remove useless, abandoned or dilapidated elements.

5. Cleaning work in the office:

Cleaning is the last phase before the map is drawn up, using digital compilation methods and the structuring of data in the computer. It requires great care to assure the clarity and quality of the final document (map). For this purpose, the agent must completely verify all the identified details interpreted in the field.

This will be followed by:

- a reporting of additions using a green crayon
- erasures using the yellow crayon
- enclosing the identification and interpretation files of each of the new elements or those whose names, form, procedure and structure in the field were changed in the draft maps.

CHAPTER 7 COMPUTER OPERATION

A. USE OF THE PERSONAL COMPUTER

1 Starting and stopping of the computer

- The access and exit codes of the NT Windows operating system

2. Use of the mouse

Different uses for the mouse:

- Click the left button once to validate or orient data
- Click the right button once to cancel an ongoing operation or to display a menu
- Double click the left button to open or activate a file or directory

Slide the pressed left button of the mouse to move an element.

3. Operation:

- Switch the computer and its peripherals then turn them on.
- For the password, simultaneously press the keys, Ctrl+Alt+Del
- Introduce the password and click OK
- Start the computer by clicking Start

Following the syntax: Program__Management2__User__New user, which will give the following table:

Recording at prompt for the first user:

- Name of user
- Complete name of user
- Justification
- Password
- Password (confirm)
- Deactivate changing of passwords
- Click on Group(G)__Guest__A__OK__OK

The name of the new user is recorded.

- Exit and restart to verify the quality of recording by pressing:

Start__Shutdown__Lock off__Yes.

Return to the initial position (Ctrl+Alt+Del)

- Reintroduce the name and password of the user in the displayed table

If the commands are correct, NT Windows will reappear on the screen.

4. Sharing of files

For this sharing, there must be a network composed of:

- A central server (Network)
- One or several computers connected to the server (Local users).

5. Operation for the sharing of files:

Follow this syntax:

Start__Program__open the file manager (Explorer)

- Highlight the file (activate)
- Press the right button of the mouse (open the menu)
- Return to the Propriete (Property) menu

In this menu, open Partage (P) (Share).

Click the share button

Select the desired option and click OK

In the file manager, the file in question will provide an open hand to indicate that the file has been shared.

- To cancel the sharing of files, return to the same syntax:
- Open Partage__No partage and the open hand will disappear in the icon.

B. INSTALLATION OF A PRINTER MANAGER

In this case, the printer manager is contained in a diskette.

1. Copy the content of the diskette in the directory called C:\TEMP\
2. Click on Start ... Run and click

- search the TEMP directory found in C:\

take the executable file and press OK

3. Follow the installation instructions given by the computer

- select the port for the connection of your printer
- in this case, the port is LPT1
- - press OK
- select the name of the printer found in the list of printers
- the name is CANON-BIC-80V
- select it and press OK

4. Ask the printer for a page test.

N.B: Installation may be directly made from the diskette without copying the files from A:\ into the C:\TEMP directory.

C. BASIC OPERATIONS FOR THE SE MICROSTATION SOFTWARE

1. Starting

Start the Microstation Manager as follows:

Start__Program__SE Microstation__SE Microstation

2. Creation of the design file:

In the Microstation Manager window:

Click on File__New to open the window Create Design file

Click the command Drivers to select d

- - Select the Seed file

Type the name of the new document__OK

N.B: Do not enter the name under which a document is already filed since this may replace the preceding document.

Click on Mali seed__2nd.dgn which was especially created__OK

(this file will provide a general view in two dimensions).

3. Installation of measurement units

Click on Settings__Design file__Working units.

In the Working unit window, enter the data__OK

To save the measurement units

Click on File in the menu bar__Save settings.

4. Enlargement and reduction of the image on screen

Click on Tools__View control to display the Tool Bars window to control the view in two dimensions:

Use the different tools to: scroll-enlarge-reduce-choose a window-have an overall view.

5. Design of several lines

Click on Tools__Main__Main to display the Main window with the different design tools which include:

Arcs - cells - change attributes - dimension - element selection - ellipses - fence - group - linear elements - manipulate - measure - modify - patterns - points - polygon - page - text.

D. MANUAL ON BASIC OPERATIONS FOR THE DESCARTES SOFTWARE

1. Starting

Press Start → Program →MicrostationSE→ Descartes Microstation

or

Double click on Microstation Descartes icon

The Microstation Manager table appears

Press OK. The following table appears:

Mesh 2d dgn (2D) - Microstation SE

Select File → Descartes Image Manager, the Image table appears.

2. Conversion of format

Selection File - Batch Conversion

The dialogue box: Batch Conversion appears

Continue:

1) Designate the disk (drivers)
2) Designate the file indicated in the window (directories) in which your file is stored before conversion d:\users\igm user\image-file\
3) Select the type of data defined at the time of storage
4) Display the window type in HMR (hmr)
5) Designate the type of image with Pixel Type (group scale)
6) Select the file where you wish to store your file after conversion
   d:\users\igm user\image-file\
7) Select the file to be converted
   nd 29-3-3c sh o.tif
8) Press the button for validation
9) Verify 100% at the bottom of the screen which indicates the end of the conversion of data if the TIF file is converted into HMR
10) Press the validation button (OK).

3. Transfer the image data

In the Image Manager dialogue box

- Press File - Open

The dialogue box Open Images appears

- Verify the disk (drives)
- The file (directories)
- File nd 29-3-3c sh o.tif
- Activate the number 2 window (view 2)
- Press OK, the image corresponding to the file appears in the “Image Manager” dialogue box:
- d:\users\igm user\image-file\nd 29-3-3c sh o.tif

4. Display the information Under Microstation

- Presentation of view 1 (print)
- Presentation of view 2 (orthographic image)

5. Display of orthographic image data in the required position

Layout of the HMR data file in the fixed zone

- Click Utilities → Register the dialogue box, Registered Untitled is displayed
- Click Tools → Register, the menu to control points appears
- Change the coordinate of the orthographic image for georeferencing:
    - Click the mode "click the four points"
    - Select "Place control point"
    - Click similar points one after the other, starting with the view 1 grid.

These operations mentioned above will display the coordinates of similar points.

- Save the obtained coordinate values.
    - Click on File → Save As the dialogue box and Save Model is displayed.

For recording, follow these operations:

1. Indicate the disk where the information will be stored
2. Click the file in which your file will be stored
3. Enter the file name (maximum of 8 letters)
4. Validate (OK).

6. Transfer of orthographic image information to the HMR data file

- Click Apply → To Image, the menu for the transfer of information (resampling) is displayed.
- Conduct the following operations:

1) Indicate the HMR data file

Select (1), the dialogue box "Select the Input Image file" appears

Repeat the operations;

- select the disk (d)
- select the user file
  - select the directory: igm user
  - select the file: Image-file

You will have d:\users\igm user\image-file\

Select nd 29-3-3c sh-23 O.hmr

- Press OK to display the Image Input in front

...\images-file\nd 29-3-3c sh-23-O.hmr

2) Indicate the RGR file

* Select (2) the dialogue box "Select the Model file" appears

- Repeat the operations above and you will have:

d:\users\igm user\image-file\

- Select the new RGR name. For example: Marni RGR

Press OK to display "Model" in front.

...\users\igm user\image-file\marni rgr

* Select (3) the dialogue box "Enter n Output Image file name" appears

Repeat the same operations above and you will have:

d:\users\igm user\image-file\

3) Enter the name of the new file to be georeferenced, for example: Modibo

- Press OK to display Output Image in front

...\igm user\image-file\modibo hmr

4) Entering the surface dimension as one Pixel point constitutes an image or 10,000 m.

5) Enter figure 254

6) Verify if the size of the two files are identical (press the command “Explore” for verification).

7) Press the “Run ALL” key for validation.

8) Present OK and return to page 2 of the guide document.

In the dialogue box “Image-Manager”

- Change the view by clicking number 1
- Click “File” → Open the dialogue box. “Open Image” appears.

- Repeat the operations:
- Select the disk (D)
- Select the file: USERS
- Select the directory: igm user
- Select the file: image-file

  You will have d:\users\igm user\image-file\
- Select the name of the new file which was georeferenced, for example: Modibo hmr: you will have:

  d:\users\igm user\image-file\modibo hmr
- Press OK to display the dialogue box, “Image Manager” with d:\users\igm user\image-file\modibo hmr
- Click “Display” - Fit Images to View 2. The orthographic image is displayed in View 2.

7. Georeferencing the print (superimposing of images)

Conduct the same operations given above by changing the TIF extension to BMP.

TEXTBOOK
FOR
DIGITAL TOPOGRAPHIC MAPPING

DIGITAL COMPILATION, STRUCTURIZATION
AND RELATED WORKS OF KITA PROJECT

(Version 1.0$_1$)

March 2001

Asia Air Survey Co., Ltd.

Preface

In response to a request from the Government of the Republic of Mali, the Government of Japan decided to conduct "The Study of National Topographic Mapping of the Kita Area in the Republic of Mali"

This "Textbook for Digital Topographic Mapping, Digital Compilation, Structurization and Related Works of Kita Project" was prepared based on the execution of actual work of digital compilation, structurization and related works with the counterparts of IGM at Bamako and Kita.

This Textbook summarized the outlines and key points of each work of digital compilation, structurization and related works of digital topographic mapping and following the actual work process.

Detailed operational method of the equipment and computer software shall be referred to the manuals provided by each makers.

It is expected that this textbook will be used effectively for planning of future digital topographic mapping project by IGM.

March 2001
At Bamako, Mali

Mr. Toru Watanabe
Mr. Yoshiteru Matsushita
JICA Study Team for Kita Project
Asia Air Survey Co., Ltd.

Textbook for Digital Topographic Mapping
(Digital Compilation, Structurization and Related Works of Kita Project)

Contents

Figures

Table

Basic Concept of Mapping Work

1. Mapping work consists of many kind of works such as aerial photography, ground survey, aerial triangulation, field identification, field completion, plotting, editing and so on.

2. Mapping work will be done step by step following the workflow.

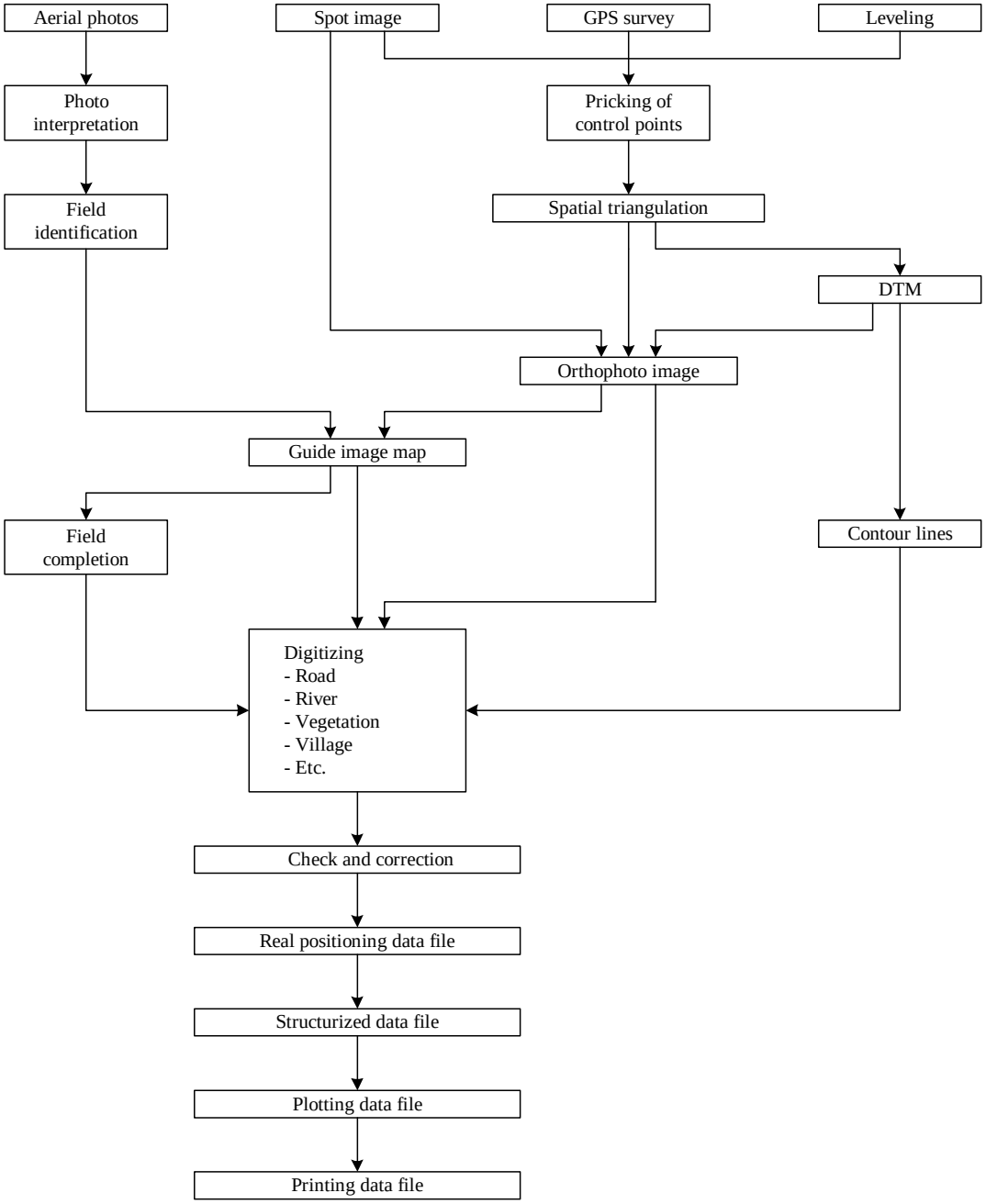
3. The results of each stage of work will be the basis of the next stage of work.

4. Therefore, basically, the results of previous stage of work will not be changed at the next stage of work.

5. However, when the mistake in the previous stage of work were found, it must be corrected immediately.

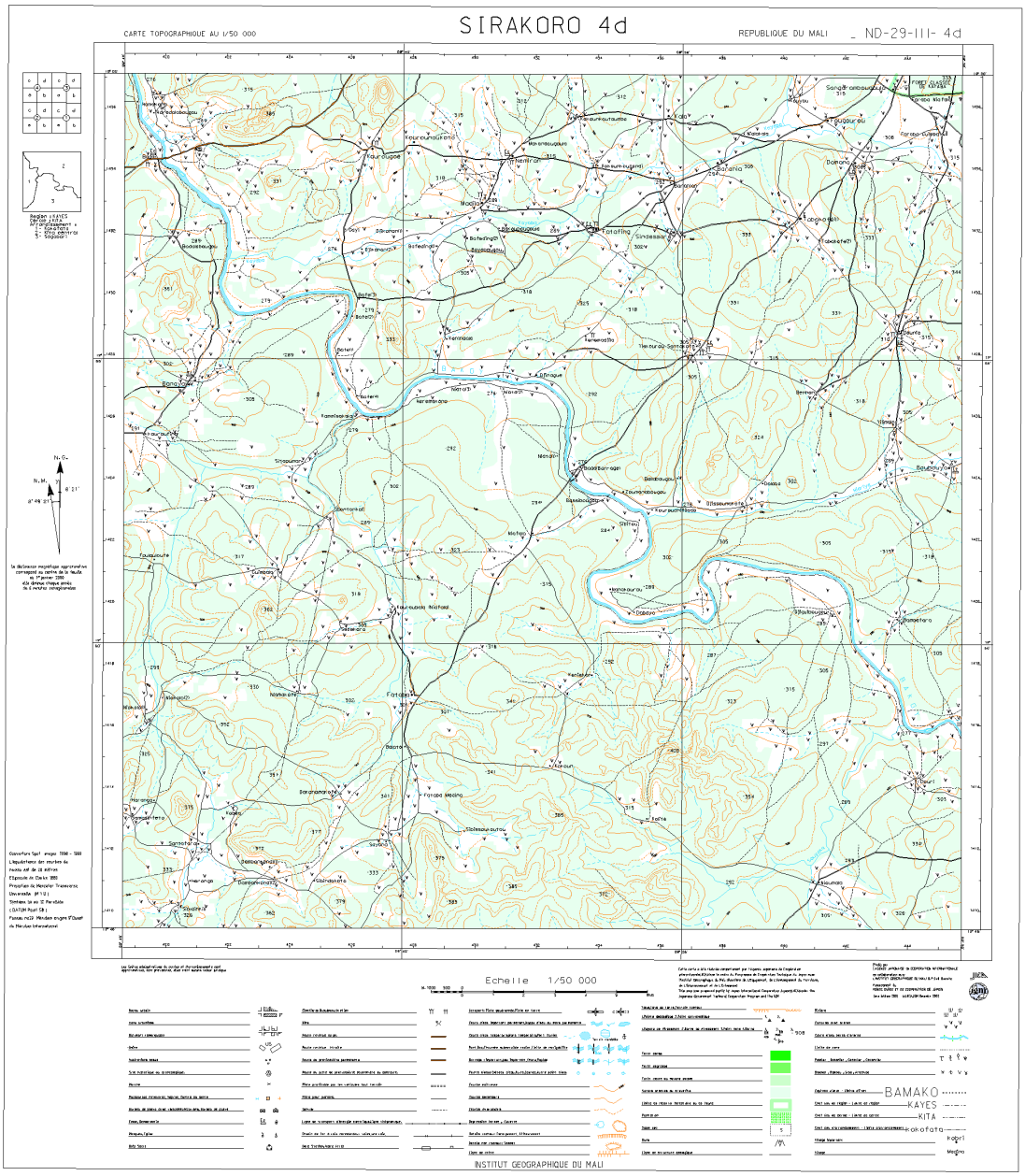
Outline of Workflow of Kita Project

Figure 1 "Outline of Workflow of Kita Project"



1:50,000 Scale Digital Topographic Map of Kita Project

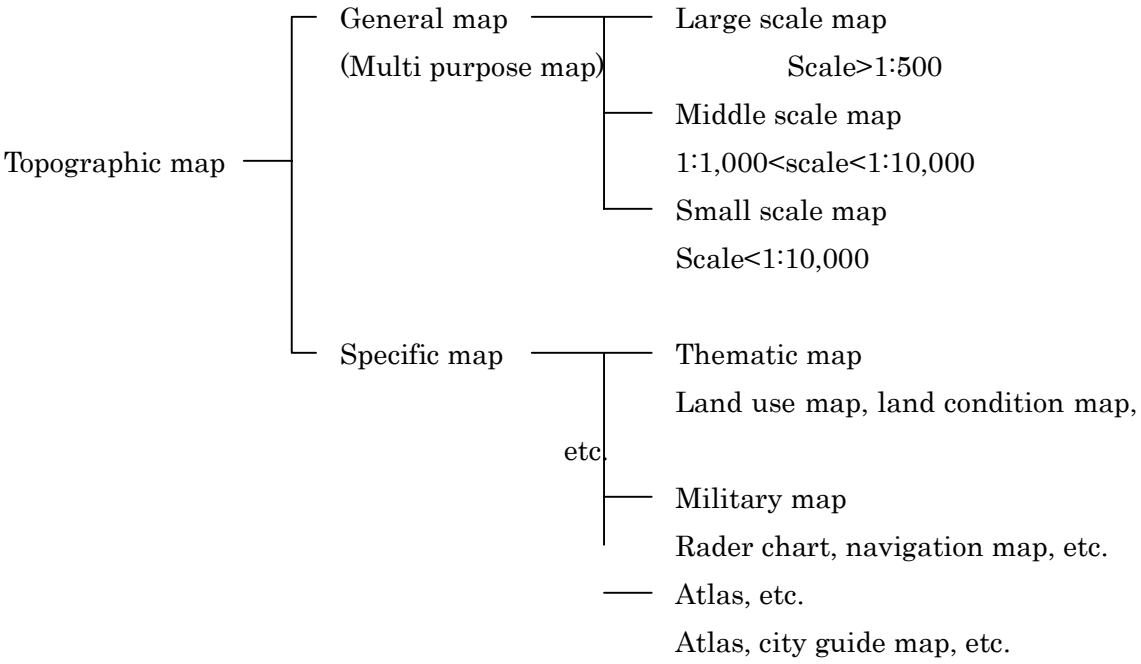
(ND29-3(SIRAKORO)-4d)



Chapter 1. Classification of Topographic Maps

1.1. Type of topographic maps

Generally, topographic maps can be classified as follows:



Usually, large scale maps will be made by ground survey method such as tachometric method, mesh survey method, plane table survey method and so on.

Middle scale maps will be made by photogrammetric method using aerial photos.

Small scale maps will be made by photogrammetric method using aerial photos and satellite images.

Specific map will be made based on the general maps.

Above classification is not a definite classification. Classification of maps will be changed depend on the persons and countries.

1.2. Accuracy and map expression limit

1. Large scale topographic maps

Large scale topographic maps have an enough accuracy for various kind of design works and constructions

In case of 1:500 scale topographic maps, 1 m on the ground equals to 2 mm on the topographic maps.

Therefore, almost of all objects such as road, river, railway, houses, buildings and so on can be shown on the large scale map as real positions.

2. Middle scale topographic maps

In case of middle scale topographic maps, major objects such as roads, river, railways, big structures and so on can be shown on the map as real positions. However, at the crowded area such as town area, small houses and so on can not be shown on the map as real positions.

The topographic maps with above-mentioned characters is called as “Middle Scale Topographic Maps”.

3. Small scale topographic maps

In case of small scale topographic maps, due to the reason of map scale, center line of major objects such as road, river, railways can be shown on the map as real positions. However, another objects can not be shown on the map as real positions.

To show the objects on proper relative positions, map symbols will be used for small scale topographic maps. However, at the crowded area such as town, horizontal transposition of symbols will be necessary not to overlap the symbols on the map.

The topographic maps with above-mentioned characters is called as “Small Scale Topographic Maps”.

1.3. Map symbols

The figures to draw the nature and artificial features, etc. on the paper are called as “Map Symbols”.

All of the nature and artificial features will not be shown on the topographic maps. According to the standard, nature and artificial features will be selected and shown on the topographic maps. Such standard is called as Standard of Map Symbols.

The map symbols can be classified as symbols concerning nature, and symbols concerning artificial features. However, Map symbols have to be changed depend on the scale of topographic maps. Therefore, several kind of map symbols suitable for map scale have to be prepared.

The contents of map symbols for general maps will be as follows:

1. Scale
2. Color
3. Artificial features (roads, railways, building and house, boundary of vegetation, vegetation symbols administrative boundaries and so on)
4. Nature (river, coastal line, lake, pond, land forms and so on)
5. Annotation (name of town, village and so on)
6. Marginal information (map layout and map information outside of neatline)

Chapter 2. Basic Conditions of Topographic Mapping

2.1. Ellipsoid, projection and geodetic datum point

To make topographic maps, it is necessary to define the following conditions at first.

1. Ellipsoid

Followings are major ellipsoid which are used for topographic maps.

1. Bessel's ellipsoid
2. Hayford's ellipsoid
3. Clark's ellipsoid
4. WGS-84

For example, Bessel's ellipsoid is adopted by Japan and WGS-84 is adopted by Indonesia.

2. Projection

The method how to draw the spherical surface to the plane is called as "Projection". To draw the spherical surface on the plane, topographic maps have following three distortions and it is impossible to make following three distortion zero at the same time on any kind of maps.

1. Distortion of distance
2. Distortion of angle
3. Distortion of area

The major projection used for topographic maps are as follows:

1. Polyhedral projection
2. U.T.M. projection
3. Conformal projection
4. Conical projection
5. Mercator projection

3. Geodetic datum point and reference points for horizontal coordinates

Every countries have the geodetic datum point for survey and mapping and the longitude and latitude of geodetic datum point were decided. Based on the geodetic datum point, triangulation points and GPS points were established. These triangulation points and GPS points will be used for survey and mapping works.

4. Vertical datum point and reference points for elevation

The 0 m of topographic maps is the means sea level (MSL). The MSL will be changed at the location of earth. Therefore, every countries have own MSL values.

MSL was decided by tidal observation and harmonic analysis. Based on the decided MSL, datum point for elevation were established and bench mark network were established. These bench marks will be used as reference points for elevation of survey and mapping works.

Kita Project adopted following:

1. Ellipsoid — Clark 1880
2. Projection — U.T.M.
3. Reference point for horizontal coordinates.
   Triangulation points of 12degrees parallel survey
4. Reference point for elevation
   Existing bench mark (Datum point at Dakar)

However, depend on the purpose of mapping and the scale of topographic maps to be prepared, ellipsoid, projection and so on will be changed.

For example, large scale topographic maps for design work and construction will be prepared by rectangular coordinates system. The datum elevation of navigation chart and maps to be used for harbor construction is not MSL but LLWH (lowest low water height).

In case we can not find suitable reference points for horizontal coordinates

and elevation, it is necessary to decide a datum point for horizontal coordinates and elevation by GPS survey and tidal observation.

2.2. Map sheet plan

Generally, General maps will be prepared from small scale topographic maps at first and then, more large scale topographic maps will be prepared.

Therefore, when we make new topographic maps, it is necessary to make map sheet plan considering the existing small scale topographic maps sheets.

Furthermore, the maximum paper size which we can used for topographic maps such as plotter paper and printing paper is decided. Generally, the map paper size including marginal information will be A-1 size as maximum.

For example, one sheet of 1:200,000 scale topographic map will be covered by 16 sheets of 1:50,000 scale topographic maps.

Chapter 3. Merit and Demerit of Digital Topographic Maps

3.1. Merit

Digital topographic maps have the following merit comparing analogue topographic maps (printing maps).

1. It is easy to correct the change of topographic maps due to the reason of digital data.

2. It is easy to change the scale of topographic maps. However, the accuracy of topographic maps will not change.

3. To make a analogue topographic maps (printing maps), printing machine is necessary. However, in case of digital topographic maps, topographic maps can be plotted out by using plotter only.

4. It is possible to deliver the digital topographic data to the user by CD-ROM and other method. The cost of making CD-ROM is low comparing printing topographic maps.

5. Digital topographic data have layer structures. Therefore, digital topographic data can be used for the basic data for GIS.

3.2. Demerit

Digital topographic data have the following demerit comparing analogue topographic maps (printing maps).

1. Special equipment such as computer, digital plotter, software and so on will be necessary to make digital topographic maps.

2. Special attention have to be paid to keep the digital topographic data. It is very difficult to recover the destroyed data.

3. There is not merit for the users who have not computer and necessary software.

Chapter 4. Preparatory Work for Digital Topographic Mapping

4.1. Neatline

Topographic maps will be prepared sheet by sheet according to the decided map sheet plan. Therefore, it is necessary to prepare neatline of each sheet at first. The distances of neatline of topographic maps are different sheet by sheet.

Generally, in case of small scale topographic maps, map sheet will be divided by longitude and latitude. In case of Kita Project, sheet size of 1:50,000 scale topographic map is 15 minutes in longitude and 15 minutes in latitude.

Following is the method to make neatline of each sheet of topographic maps.

1. To decide the map sheet plan.

2. To calculate the values of longitude and latitude of each corner of map sheets.

3. To convert the values of longitude and latitude of each corner of map sheets to the values of U.T.M. coordinates.

4. The converted U.T.M. coordinates will be plotted by using Microstation.

5. To draw the lines to connect the each plotted point.

4.2. Map symbols

Map symbols to be used for topographic mapping will be decided before starting actual works. Basically, map symbols will be decided based on the existing map symbols.

In case that map symbols for digital topographic maps is not existing, it is necessary to create map symbols for digital topographic maps referring to the existing analogue maps.

Map symbols will be little different depend on the scale of topographic maps and kind of maps. It is difficult to apply one map symbols to all kind of topographic maps. Therefore, several kind of map symbols shall be prepared scale by scale and purpose by purpose.

The document which describe the rules and application of map symbols is called as “Standard of Map Symbols”.

The map symbols used for Kita Project is shown on the Figure 4.1 “Map Symbols of Kita Project (No.1)”, Figure 4.2 “Map Symbols of Kita Project (No.2)”, Figure 4.3 “Map Symbols of Kita Project (No.3)” and Figure 4.4 “Map Symbols of Kita Project (No.4)”.

Figure 4.1 "Map Symbols of Kita Project (No.1)

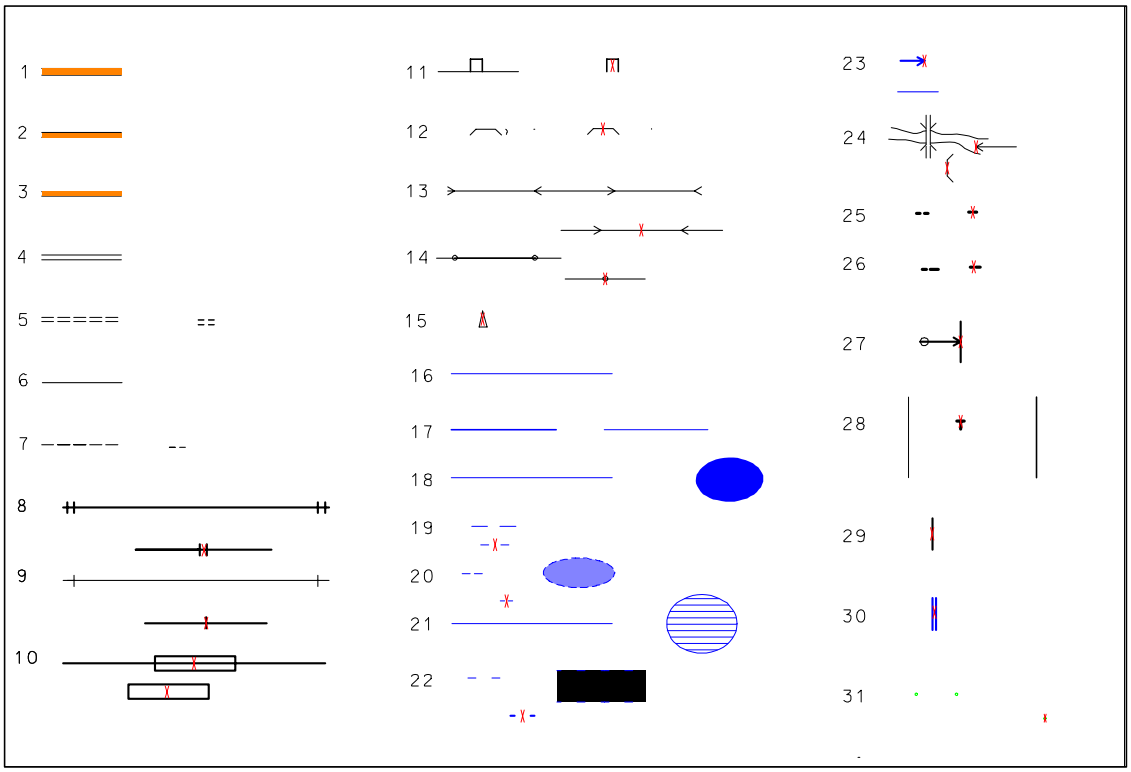


Figure 4.2 "Map Symbols of Kita Project (No.2)"

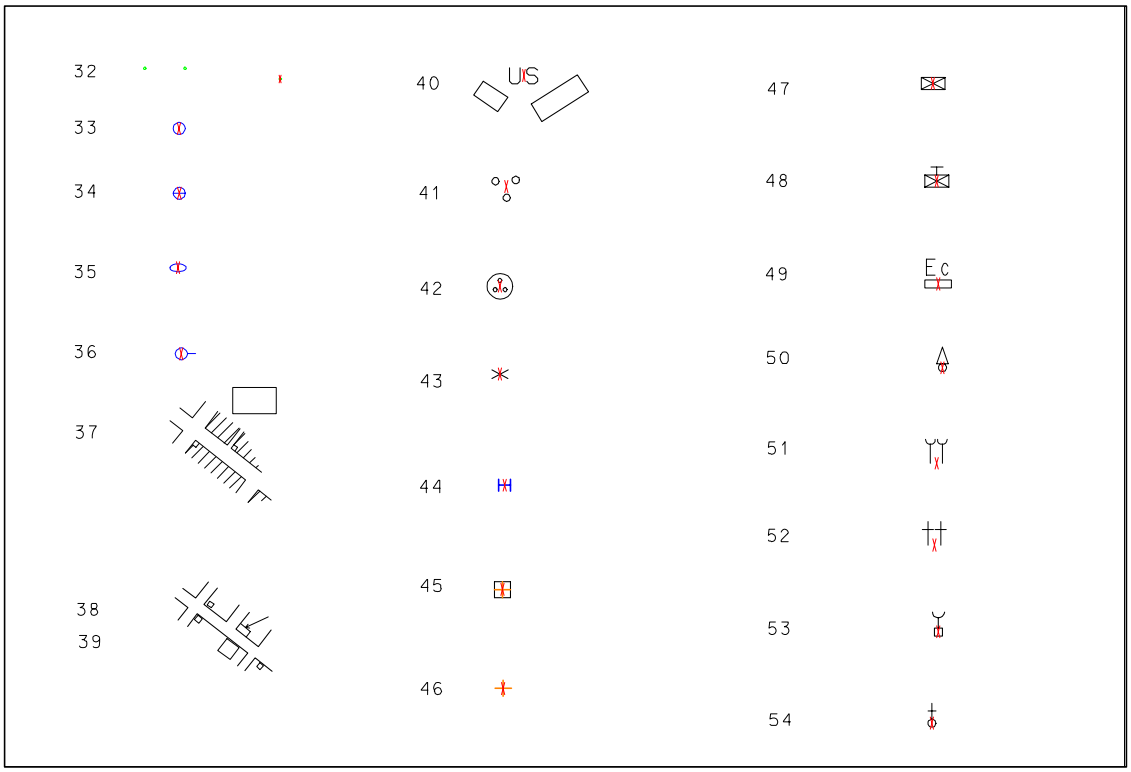


Figure 4.3 "Map Symbols of Kita Project (No.3)

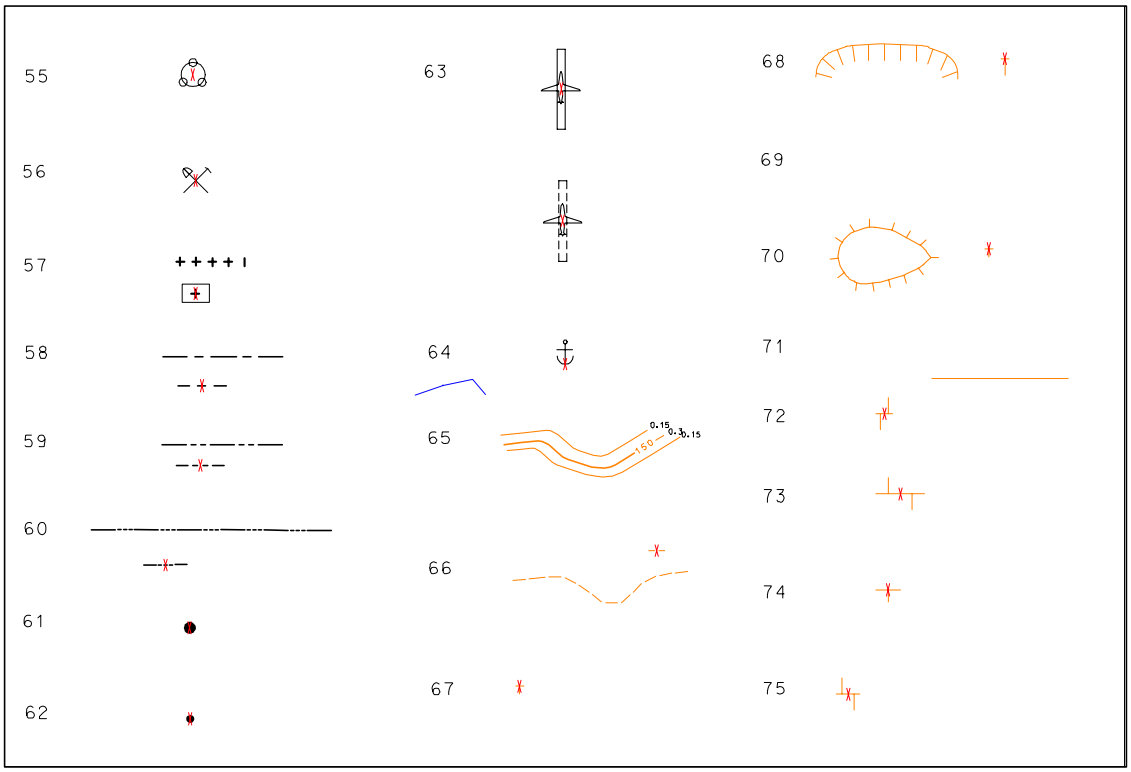
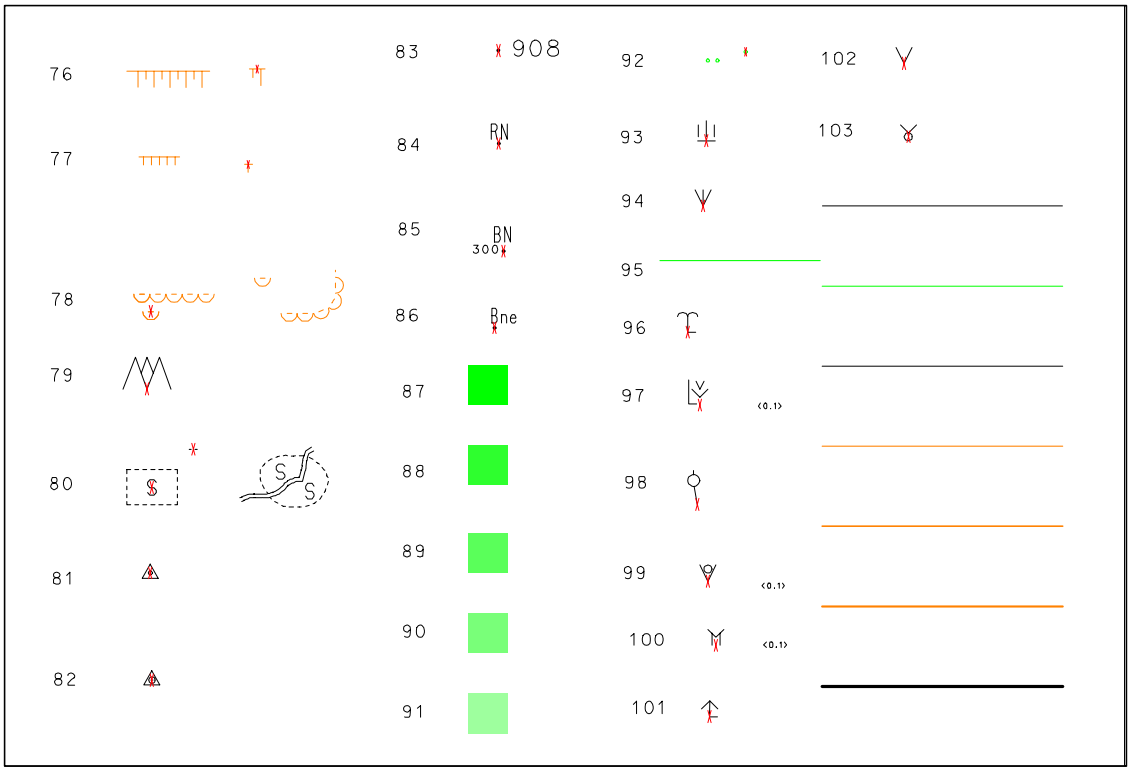


Figure 4.4 "Map Symbols of Kita Project (No.4)



4.3. Annotation

Before starting the actual work of digital topographic mapping, it is necessary to decide the type and size of character (name of village and town, river name, marginal information) to be used.

The annotation used for Kita Project is shown on Table 4.1 “Data Structure of Kita Project”.

4.4. Marginal information

Marginal information means the outside area of neatline and shows the various information of topographic maps. The marginal information is one of the important portion of topographic maps.

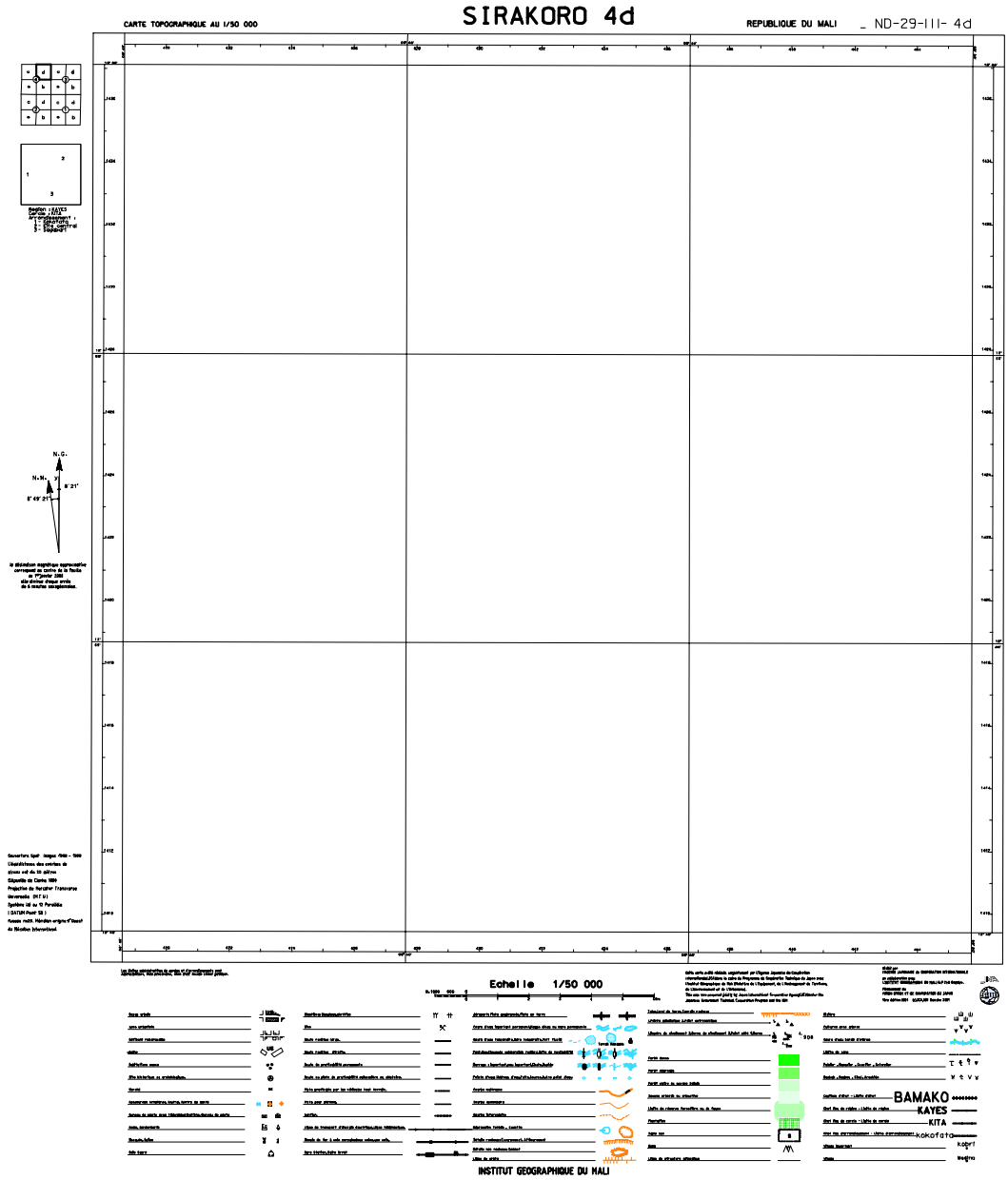
In case the existing digital marginal information data is not available, it is necessary to create a new marginal information referring the existing one.

Following is the main items to be shown on the marginal information.

1. Sheet name and sheet number
2. Scale of topographic map
3. Scale bar
4. Description of map symbols
5. Executed authorities
6. Date of mapping
7. Description of geodetic datum point
8. Ellipsoid
9. Projection
10. Coordinates of neatline and grid line
11. Etc.

The marginal information of Kita Project is shown on Figure 4.1 “Marginal Information of Kita Project”.

Figure 4.5 "Maginal Information of Kita Project"



4.5. Type of digital data

Digital topographic maps consist of the following three type of data or combination.

1. Line data
2. Area data
3. Point data
4. Text data

For example, road data will consists of following type of digital data.

1. Double line road Line data and area data
2. Single line road Line data

Digital topographic data also consists of following 2 kinds data.

1. Position Coordinates of data points. The figure will be drown by connecting each point.
2. Attribute

Attribute consists of following three kinds of data.

1. Color Color of line
2. Line style Type of line such as dotted line
3. Line weight Width of line

Therefore, before starting the actual digital topographic mapping work, it is necessary to decide that each item to be shown on the digital topographic maps consists of what type and digital data.

4.6. Layer structure

Topographic map consists of many data such as river, railway, road, vegetation, administrative boundaries, symbols and so on. Furthermore, each item consists of sub-items. For example, in Kita Project, river data consists of following three sub-items and the classification of the river is as follows:

1. Double line river	Width of river is more than 50 m River with water through year
2. Single line river	Width of river is less than 50 m River with water through year
3. Single dotted line river	Width of river is less than 50 m River with water only rainy season

In case of digital topographic mapping, each data will be obtained and stored in the different layers. For example, in Kita Project, river data was obtained and stored as follows by using Microstation.

1. Double line river	Data was obtained and stored in Level 32.
2. Single line river	Data was obtained and stores in Level 31.
3. Single dotted line river	Data was obtained and stored in Level 33.

The image of layer structure is shown on Figure 4.2 “Image of Layer Structure”.

Above structure of digital topographic mapping is called as “Layer Structure”. In Microstation, layer is called as “Level”.

Furthermore, it is necessary to decided the color, line style and line weight of each data.

The structure including level, color, line style and line weight is called as “Data Structure”.

The data structure of Kita Project is shown on Table 4.1 “Data Structure of Kita Project”.

Figure 4.6 "Image of Layer Structure"

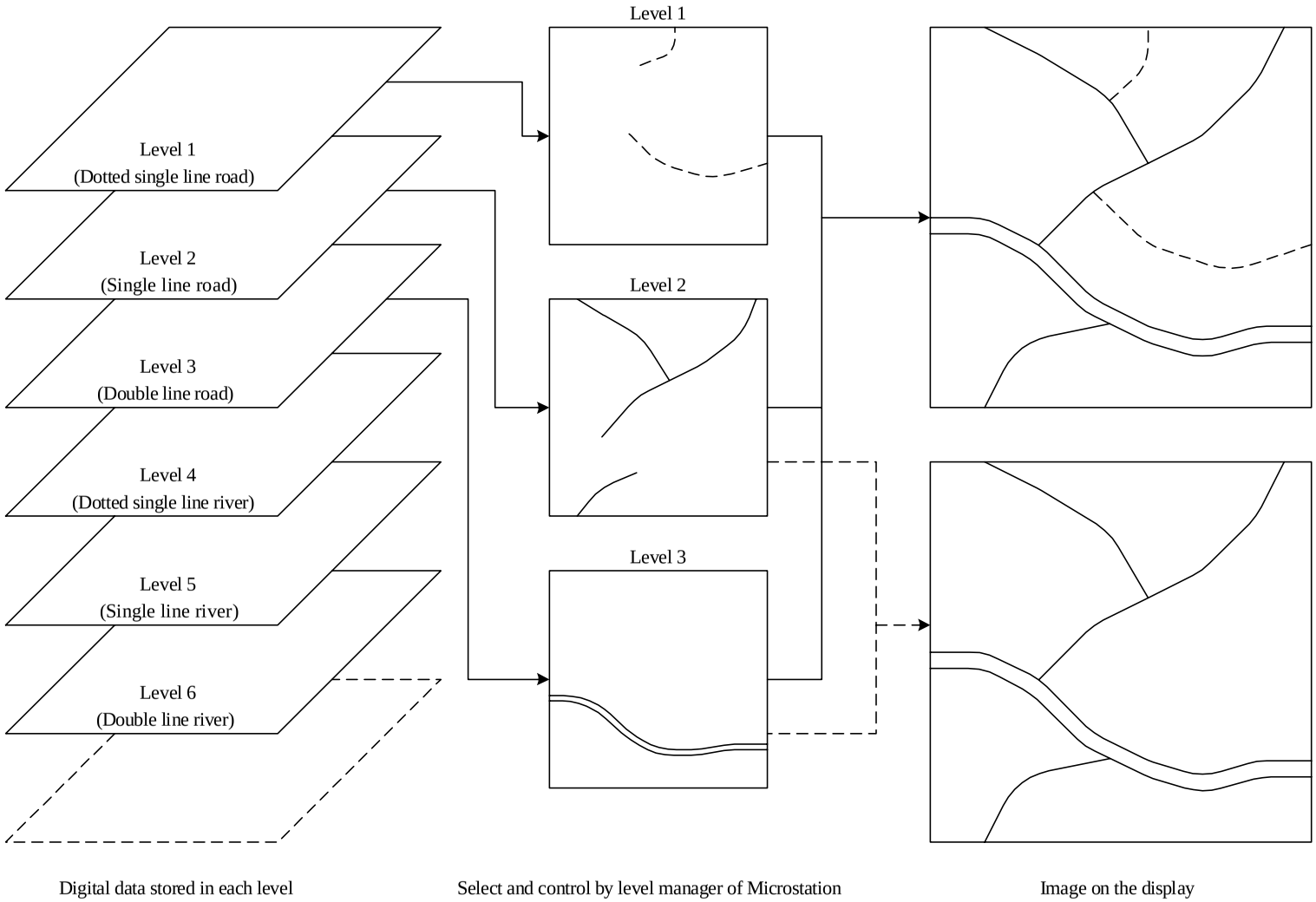


Table 4.1 "Data Structure of Kita Project"

Ordre Affich	Code No.	Articles des données	Niveau	Couleur	Style ligne	Poids ligne	Typed'élement	Couleur encre
4	1	Route revetue large	41	1	0	2	LS	Noir
4	1.1	Route revetue large	12	6	0	0	Fond	Brun
4	2	Route revetue étroite	41	2	0	2	LS	noir
4	3	Route de praticabilité permanente	41	3	0	1	LS	noir
4	4	Route ou piste de praticabilité saisonnière ou aléatoire	41	78	0	1	LS	noir
4	5	Piste praticable par les véhicules tout terrain	43	79	2	1	LP	noir
4	5.1		48	4	2	2	LS	noir
4	6	Piste pour piéton	49	82	0	3	LS	noir
4	7	Sentier	49	83	3	3	LP	noir
4	7.1		13	0	0	0	Fond	blanc
2	8	Chemin de fer à voie normale : deux voies	46	96	0	5	LP	noir
2	9	Une (1) voie	47	98	0	5	LP	noir
1	10	Gare station	45	87	0	5	s;Fond	noir
1	11	Halte , Arret	45	88	0	4	S;Fond	Noir
1	12	Passage à niveau superieur	45	89	-	3	S	noir
1	13	Ligne de transport d'énergie électrique	56	106	0	3	LP	noir
1	14	Ligne téléphonique	56	107	0	3	LP	noir
1	15	Relais hertziens ou antenne	52	105	-	1	S	noir
2	16	Cours d'eau important	32	50	0	1	SH	bleu
1	16.1		32	151	0	3	FONT=32	TX=1500
2	17	Cours d'eau permanent	31	46	0	4	LS	bleu
1	17.1		31	46	0	2	FONT=32	TX=1000
2	18	Nappe d'eau ou mare permanente	32	51	0	1	Fond	bleu
2	19	Cours d'eau temporaire	33	52	3	1	LP	bleu
2	20		33	150	5	1	LP	bleu
2	20	Mare temporaire	14	53	0	0	Fond	bleu50
2	21		33	151	0	3	LS	bleu
2	21	Terrain humide	14	54	0	1	HA	bleu50
2	22	Terrain inondable	25	21	0	0	Fond	bleu
2	22	Terrain inondable	25	152	3	2	LP	bleu
5	22.1		34	51	2	2	LP	bleu
1	23	Depression fermee	33	55	-	5	S	bleu
2	23		33	56	0	3	LS	bleu
1	24	Pont	40	76	-	3	S	bleu
1	25	Bac	43	80	0	6	LP	noir
1	25.1		43	55	0	3	Font=32	TH=75,TW=65
1	26	Chaussée submersible radier	43	81	0	6	LP	noir
1	27	Limite be navigabilité	30	45	-	5	S	noir
1	28	Barrage important ou peu important	31	47	0	4	LS	noir
1	28		31	153	1	4	LP	noir
1	28.1	Barrage important ou peu important	31	48	0	6	LS	noir
1	29	Chute	29	34	-	5	S	noir
1	30	Rapide	29	35	-	5	S	noir
1	31	Cours deau borde d'arbres	39	58	1	1	LP	vert
1	32	Cours deau forestiere	39	59	1	1	LP	green
1	33	Chatrau deau	27	22	-	1	S	bleu
1	34	Puits	27	23	-	1	S	bleu
1	35	Source	27	24	-	1	S	bleu
2	36	Autres point deau	27	25	-	1	S	bleu
2	37	Noyau urbain	18	19	0	1	SH	noir
2	37.1	Noyau urbain	11	19	0	1	AH	noir
1	38	Zone urbanisée	17	19	0	3	SH	noir
1	39	Batiment remarquable	16	18	0	1	SH	noir
1	40	Usine	27	26	-	3	S	noir
1	41	Habitations cases	15	18	-	3	S	noir

Note:

Ordre Affichage 1 = cote plus haut 6 = plus bas cote

Type d'Element SH =Forme LP = Modele pour Ligne

P = Point AH = Hachures pour zone

AP = Modele pour zone LS = ficelle de Linge

S = Symbole

Ordre Affich	Code No.	Articles des données	Niveau	Couleur	Style ligne	Poids ligne	Typed'élement	Couleur encre
1	42	Site historique ou archéologique	27	27	-	2	S	noir
1	43	Marché	19	19	-	3	S	noir
1	44	Ressources hotelières	29	36	-	4	S	bleu
1	45	Hopital	29	37,102	-	2,3	S	noir
1	46	Centre de santé	29	38	-	4	S	noir
1	47	Bureau de poste	27	28	-	1	S	noir
1	48	Bureau de poste avec Télécommunications	27	29	-	1	S	noir
1	49	Ecole	29	39	-	1	S	noir
1	50	Gendarmerie	27	30	-	1	S	noir
1	52	Cimetiere chrétien	29	41	-	1	S	noir
1	53	Mosquée	29	42	-	3	S	noir
1	55	Bois sacré	29	44	-	1	S	noir
1	56	Mine	28	33	-	1	S	noir
1	57	Capitale d'état	1	11	7	2	TX	black
1	57.1		5	109	0	5	Font=32	TX=300
1	58	Chef lieu de région	1	—		2	TX	black
1	58.1		5	109	0	4	Font=32	TX=200
	59	Limite de cercle	1	14	6	4	LP	black
1	59	Chef lieu de cercle	1	—		1	TX	black
1	59.1		5	109	0	4	Font=32	TX=175
	60	Limite de commune	1	16	3	4	LP	noir
1	60	Chef lieu de commune	1	17		0	TX	black
1	60.1		5	109	0	3	Font=32	TX=150
1	61	Village important	27	31	-	1	S	noir
1	61.1		5	109	0	1	Font=32	TX=125
1	62	Village	27	32	-	1	S	noir
1	62.1		5	109	0	1	Font=32	TX=100
1	63	Aeroport	23	20	-	3	S	noir
1	63.1		23	21	-	3	S	brun
3	64	Port fluvial	31	49	-	3	S	brun
3	65	Courbe de niveau :	41	4	0	4	LS	brun
3	65	Courbe de niveau :	41	5	0	3	LS	brun
1	66	Intercalaire	46	97	3	2	LP	brun
1	66.1		25	7	0	1	Font=3	TX=40
1	67	cuvette	42	77	0	1	LP	brun
1	68	Détails rocheux:Escarpement	45	90	0	1	LP	brun
1	70	Details non rocheux	44	84	0	3	LP	brun
1	72	Ligne de crete	44	85	0	2	LP	brun
1	76	Talus	44	86	0	1	LP	brun
1	77	Leve de terre	45	91	0	2	LP	brun
1	78	Terrain rocheux	45	92	0	1	LP	noir
1	79	Dune	45	93	-	1	S	noir
4	80	Sable sec	45	94	-	3	S	noir
1	80.1	Sable sec	45	95	2	3	LP	noir
1	81	Points géodésiques	50	99	-	1	S	noir
1	81.1		50	99	0	1	Font=3	TX=50
1	82	Point astronomique	50	100	-	1	S	noir
1	83	Point coté	50	101	-	1	S	noir
1	83.1		50	101	0	1	Font=3	TX=100
1	84	Repère de nivellement	50	102	-	2	S	noir
1	85	Borne de nivellement	51	103	-	2	S	Noir
1	85.1		50	103	0	2	Font=3	TX=50
5	86	Borne	51	103	-	2	S	Noir
5	87	Foret Dense	39	60	1	0	Fond	Vert/100
5	88	Forets degradees	39	61	1	0	Fond	Vert/80
5	89	Forets claire ou savane boisee	39	62	1	0	Fond	Vert/60
3	90	Savane arboree	39	63	1	0	Fond	vert/40
1	91	Limite de reserve forestiere	39	64	0	6	SH	vert/100
	91.1		37	112	0	5	Font=32	TX=300

Note:

Ordre Affichage	1 = cote plus haut	6 = plus bas cote
Type d'Element	SH =Forme	LP = Modele pour Ligne
	P = Point	AH = Hachures pour zone
	AP = Modele pour zone	LS = ficelle de Linge
	S = Symbole	

Ordre Affichage	Code No.	Articles des données	Niveau	Couleur	Style ligne	Poids ligne	Typed'élement	Couleur encre
1	92	plantation	39	65	0	1	SH,AP	vert
1	93	Rizières	39	66	-	1	S	noir
4	94	Cultures avec arbres	39	67	-	1	S	noir
1	95	Haie,cloture maraichere	38	57	0	3	AH	blanc
1	96	Palmier	39	68	-	1	S	noir
1	97	Bananier	39	69	-	1	S	noir
1	98	Cocotier	39	70	-	1	S	noir
1	99	Cotonnier	39	71	-	1	S	noir
1	100	Baobab	39	72	-	1	S	noir
1	101	Bambou	39	73	-	1	S	noir
4	102	Sisal	39	74	-	1	S	noir
1	102.1	Sable sec	45	37	2	3	LP	noir
6	103	Arachide	39	75	-	1	S	noir
	104	Arachide	58	130	0	0	S	vert
	105	Ligne de Structure geologique	55	111	0	1	LS	noir
	106	Nom de montagne	36	113	0	5	Font=32	TX=150
		Neat line						black
		Valeur des Longitude et Latitue						black
		Graduation des Longitude et Latitude						black
		Code grillages locale						black
		Graduation des grillages standard						black
		Valeur de courbe de niveau						brown
		Destination(chamin)						black
		Destination pour annotation						black
		Nom de carte						black
		Numero de carte ajacente						black
		Numero de carte						black
		Legende						black
		Projection de carte						black
		Index for administrative zone						black
		Index for adjascent sheets						black
		Mapping history						black
		Scale						black
		Published Y,M						black
4		The other necessary item						black
1		Scale bar						black

Note:

Ordre Affichage	1 = cote plus haut	6 = plus bas cote
Type d'Element	SH =Forme	LP = Modele pour Ligne
	P = Point	AH = Hachures pour zone
	AP = Modele pour zone	LS = ficelle de Linge
	S = Symbole	

Chapter 5. Data Files for Digital TopographicMapping

5.1. Real positioning data file

The data files which will be created at each stage of digital topographic mapping work are as follows:

1. Real positioning data file
2. Structurized data file
3. Plotting data file
4. Printing data file

The process of creating above mentioned data file is shown on Figure 5.1 "Data Files at Each Stage of Digital Mapping".

The real positioning data file means the raw digital data which is obtained from the first stage of digital mapping process.

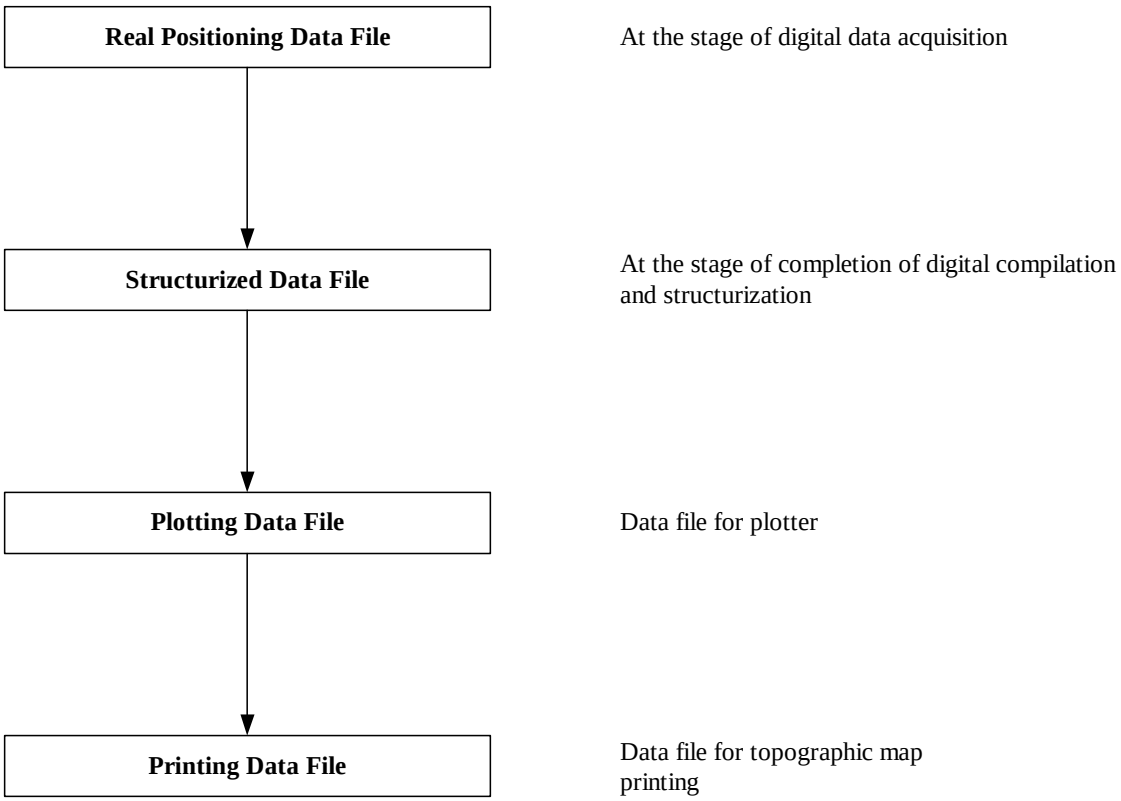
In Kita Project, the real positioning data files means the digital data which will be obtained from the digitizing method.

In case of using digital plotter, the real positioning data file is the digital data which will be obtained from the digital plotting instruments.

Therefore, the real position data shows the real position of river, road, railway and so on and the processes such as transposition, intermittence, symbolizing and etc. are not yet carried out.

The real positioning data file is the basis for structurized data file.

Figure 5.1 "Data Files at Each Stage of Digital Mapping"



5.2. Structurized data file

The structurized data file means the data which is structurized and compiled to meet the specific purpose of application such as spatial analysis in the GIS. The process to make structurized data file from the real positioning data file is called as “Structurization”.

The example of the structurization for GIS is as follows:

1. Road network structurization
2. Land use polygon structurization
3. Town area polygon structurization

The contents of structurization will be changed depend on the purpose and contents of data to be created. Therefore, before the execution of structurization, it is necessary to decide the contents to fit the purpose of use.

In case of digital topographic mapping, structurization means that the digital data is obtained and stored according to the data structure which were decided before starting the actual work.

Therefore, usually, in case of digital topographic mapping, structurization will not be necessary if the digital data acquisition were executed according to the data structure correctly.

However, through the execution of digital mapping work, maybe, data structure have to be modified by various reasons. Therefore, after completing the digital data acquisition, it is necessary to check that the digital data is obtained according to the final decided data structure correctly or not.

Structurized data file will be created based on the real positioning data file.

5.3. Plotting data file

The plotting data file means the digital topographic data file created by compiling the structurized data file for the purpose of producing topographic maps by plotter. The transposition of horizontal position, intermittence, symbolizing (fill, patterning and hatching) and so on are processed in the same style as printed topographic maps.

Following processes shall be done to the structurized data file to make plotting data file.

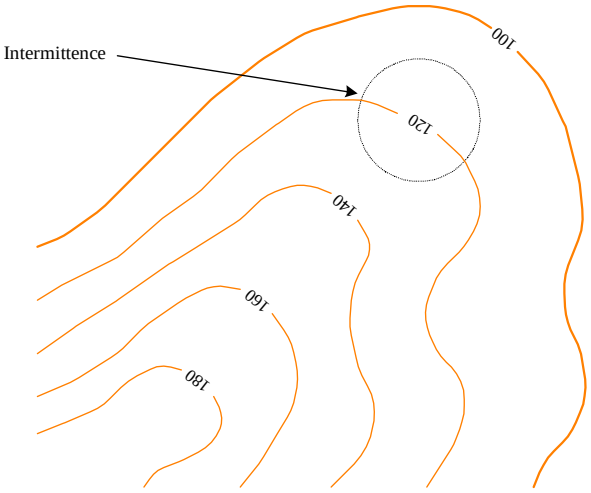
1. Symbolizing according to the standard of map symbol
2. Patterning according to the standard of map symbol
3. Hatching according to the standard of map symbols
4. Transposition according to the standard of map symbol
5. Intermittence according to the standard of map symbols
6. Elimination according to the standard of map symbols
7. Abbreviation according to the standard of map symbols
8. Combination with marginal information data

The image of difference between the real positioning data file (same ad Structurized data file)and plotting data file is shown on the Figure 5.2 “Difference of Image between Real Positioning Data File and Plotting Data File (Intermittence)”, Figure 5.3 “Difference of Image between Real Positioning Data File and Plotting Data File (Patterning and Fill for River)”, Figure 5.4 “Difference of Image between Real Positioning Data File and Plotting Data File (Transposition of Symbols)”, Figure 5.5 “Difference of Image between Real Positioning Data File and Plotting Data File (Patterning)”, Figure 5.6 “Difference of Image between Real Positioning Data File and Plotting Data File (Fill)”, Figure 5.7 “Difference of Image between Real Positioning Data File and Plotting Data File (Patterning and Fill for Road)”, Figure 5.8 “Difference of Image between Real Positioning Data File and Plotting Data File (Hatching for Town Area)”.

Figure 5.2 "Difference of Image between Real Positioning Data File and Plotting Data File (Intermittence)

Contour lines before intermittence

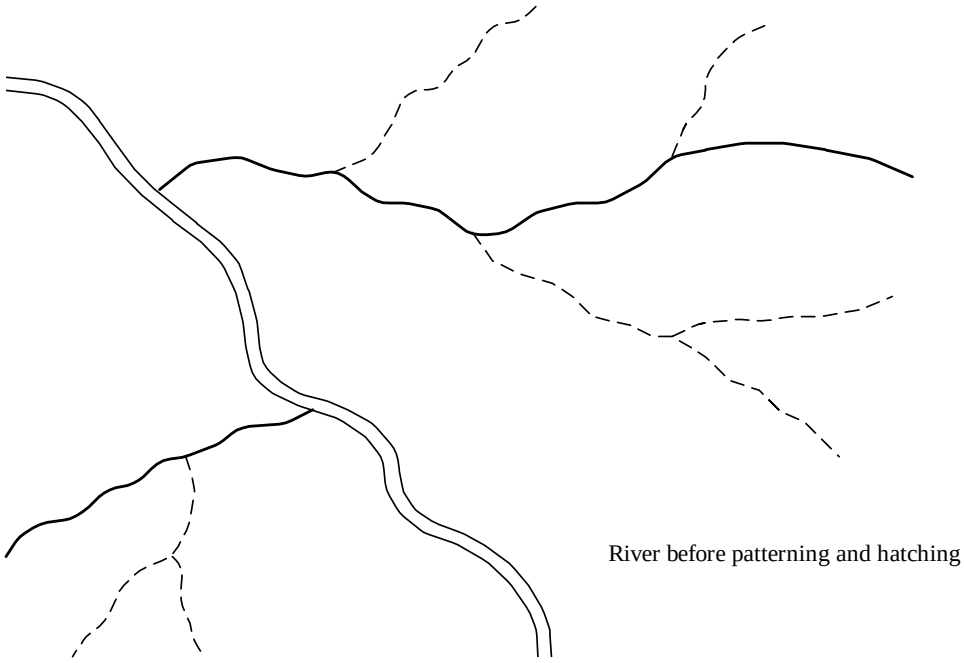
Real Positioning Data File and Structurized Data File



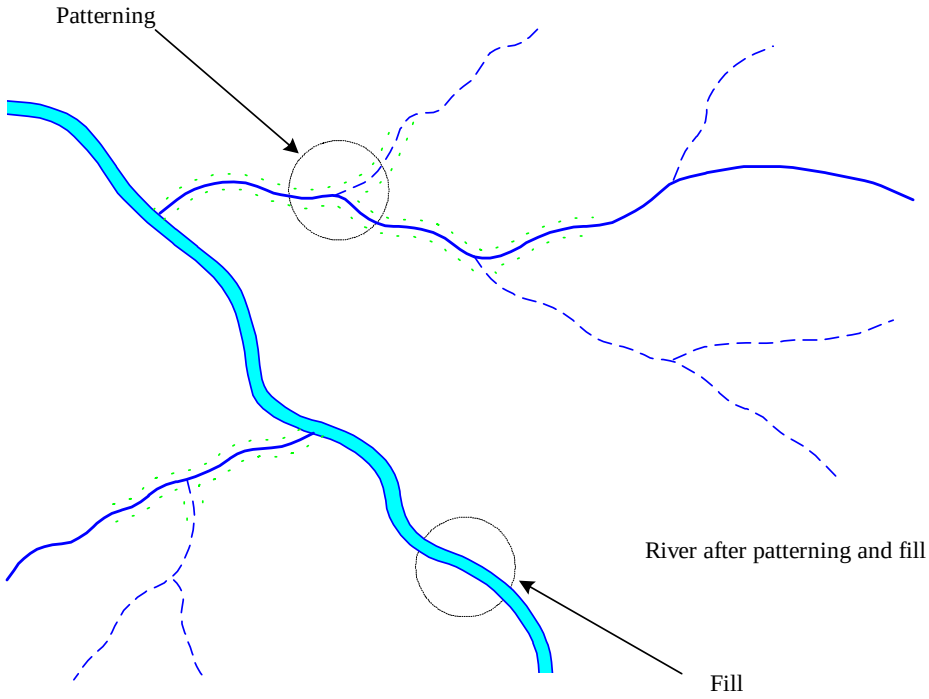
Contour lines after intermittence

Plotting Data File

Figure 5.3 "Difference of Image between Real Positioning Data File and Plotting Data File (Patterning and Fill for River)

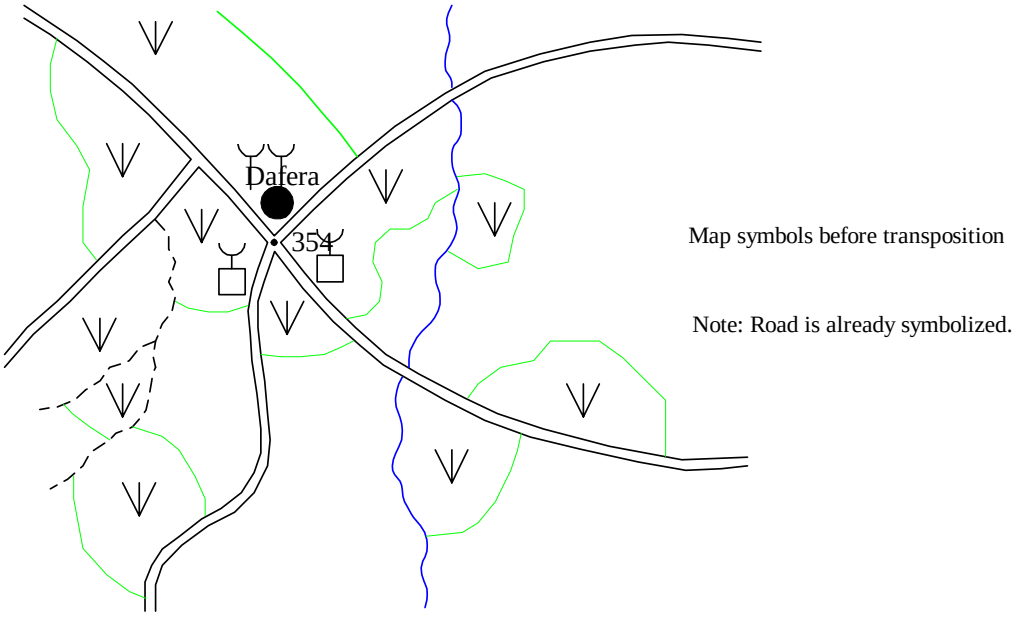


Real Positioning Data File and Structurized Data File

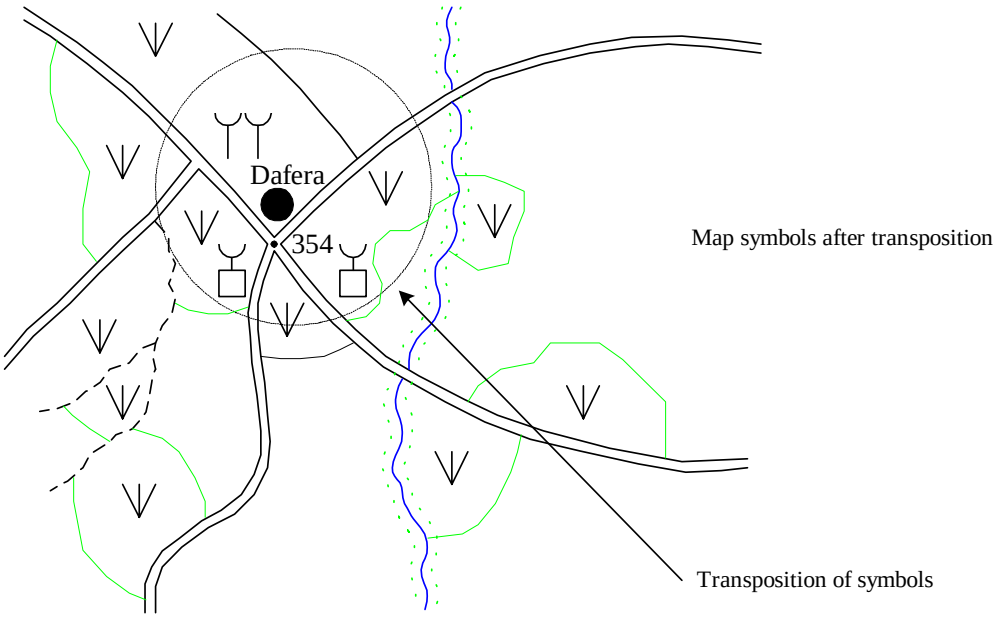


Plotting Data File

Figure 5.4 "Difference of Image between Real Positioning Data File and Plotting Data File (Transposition of Symbols)

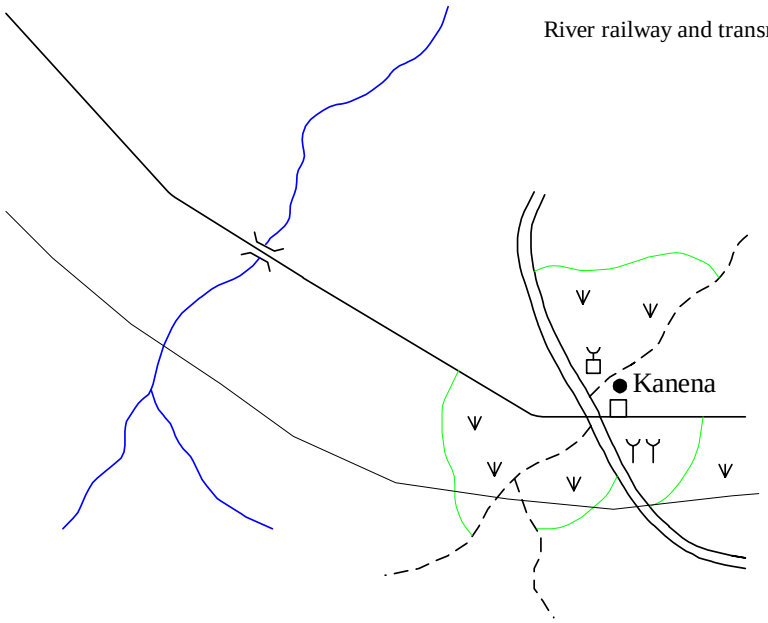


Real Positioning Data File and Structurized Data File

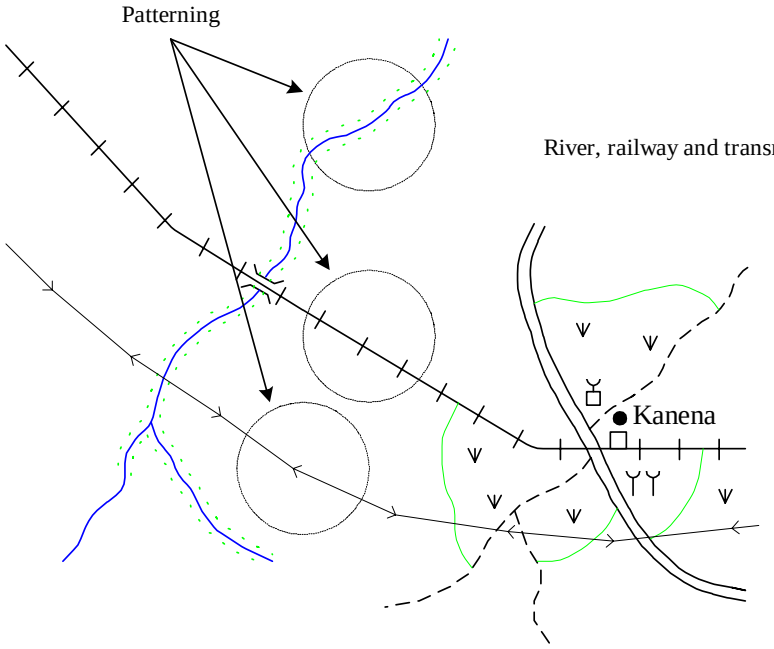


Plotting Data File

Figure 5.5 "Difference of Image between Real Positioning Data File and Plotting Data File (Patterning)

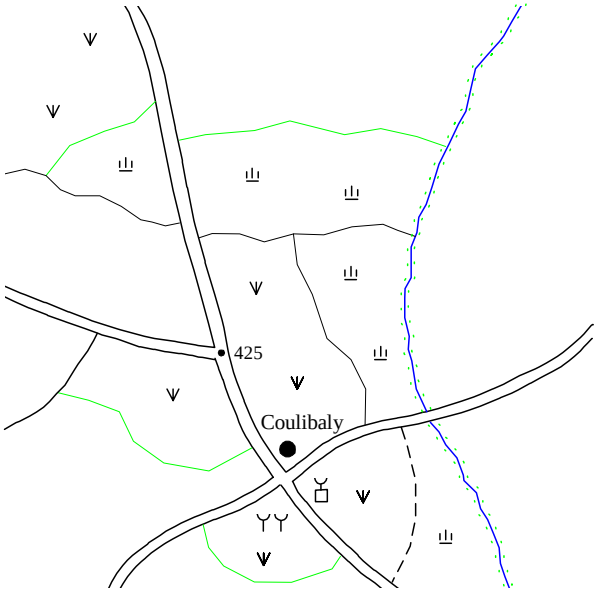


Real Positioning Data File and Structurized Data File



Plotting Data File

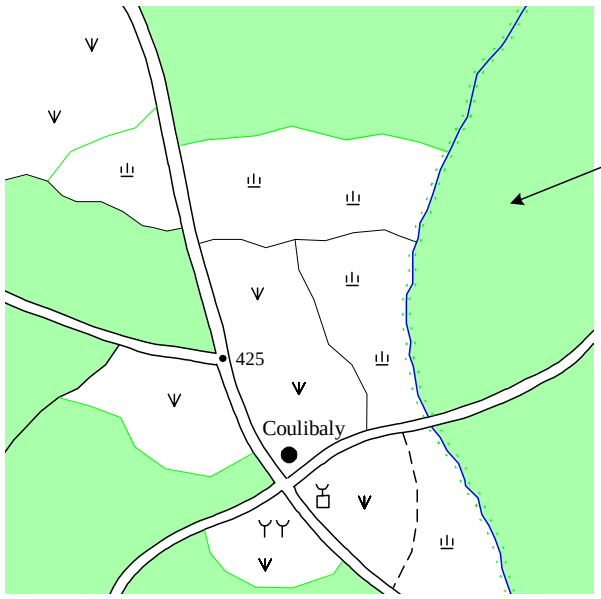
Figure 5.6 "Difference of Image between Real Positioning Data File and Plotting Data File (Fill)"



Before fill

Note:
Patterning for river and road are already executed.

Real Positioning Data File and Structurized Data File

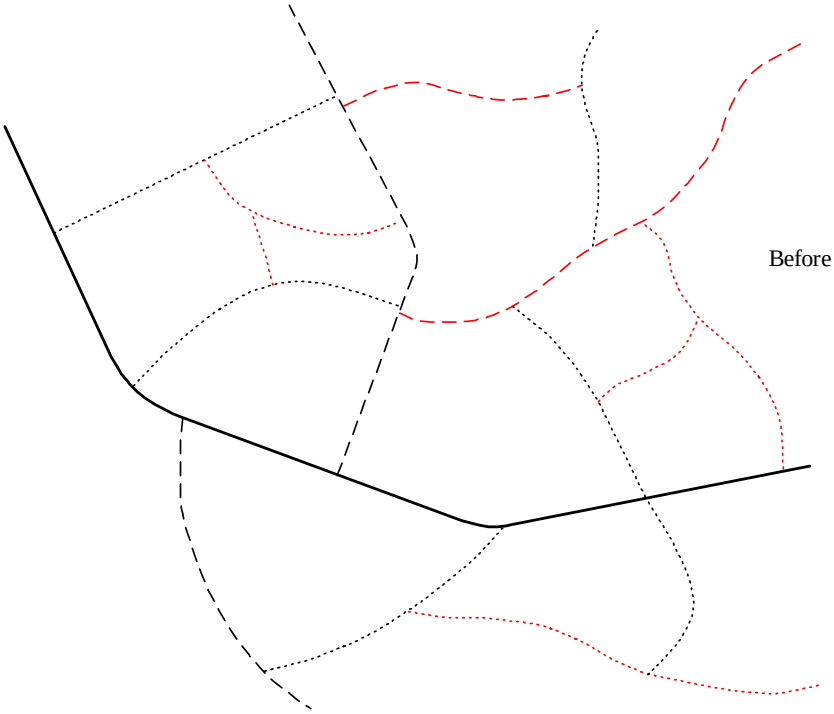


Fill for bush

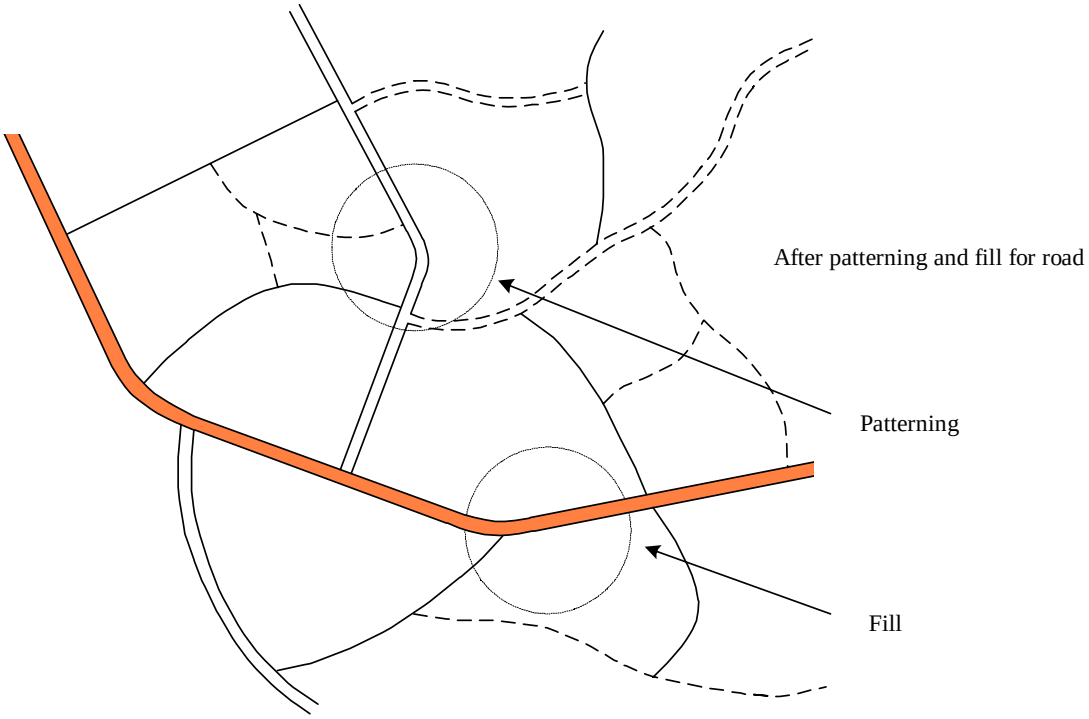
After fill

Plotting Data File

Figure 5.7 "Difference of Image between Real Positing Data File and Plotting Data File (Patterning and Fill for Road)

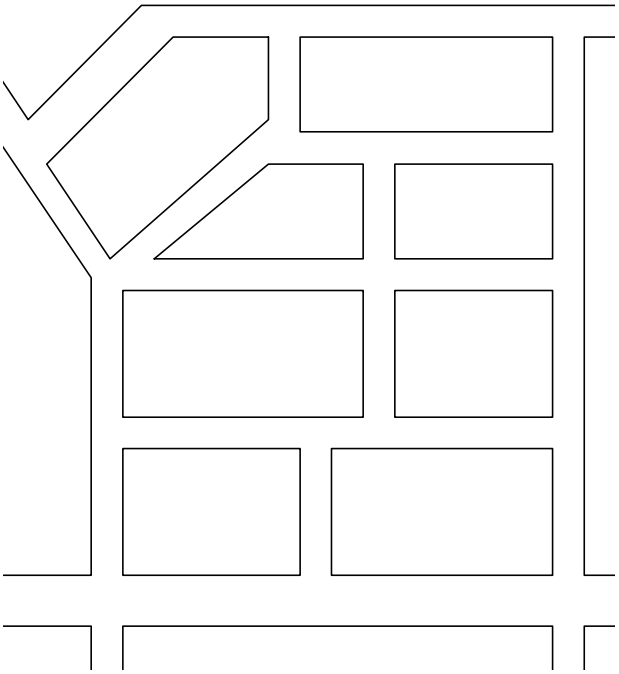


Real Positioning Data File and Strcturized Data File



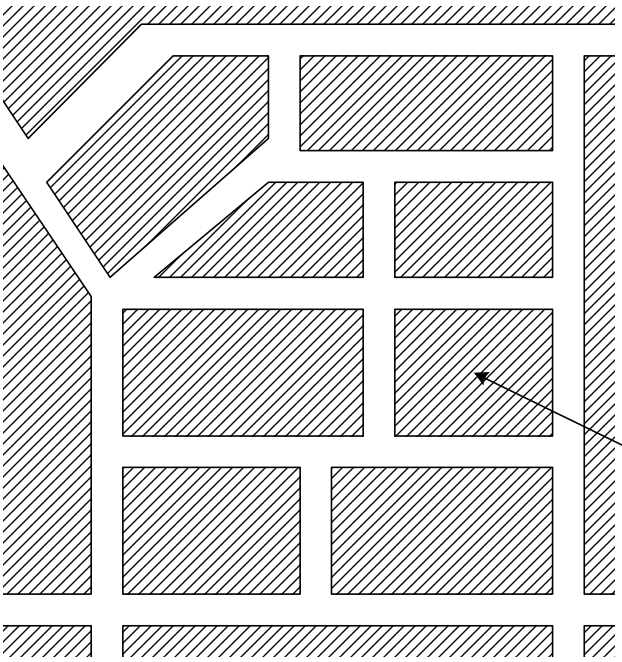
Plotting Data File

Figure 5.8 "Difference of Image between Real Positioning Data File and Plotting Data File (Hatching for Town Area)



Before hatching for town area

Real positioning Data File and Structurized Data File



After hatching for town area

Plotting Data File

5.4. Printing data file

The printing data file means the digital topographic data file obtained by compiling the plotting data file for the purpose of printing of topographic maps by printing machine.

Basically, the plotting data file and printing data file are same. However, the data format style may be different depend of the plotter and printer to be used.

In Kita Project, final printing map will be made by 4 colors (Black, Green, Blue and Brown). To create printing data file from the plotting data file, it is necessary to arrange the color to fit the final map color image, because, the color image on display and printing is little different.

Chapter 6. Acquisition of Digital Data (Digitizing)

6.1. Acquisition of digital data

At this stage, preparatory work for digital data acquisition for topographic maps has been completed. To obtain the digital data for topographic mapping, one of the following method or combination of the following several methods will be used.

1. To obtain the digital data by scanning of the existing analogue topographic maps by scanner.

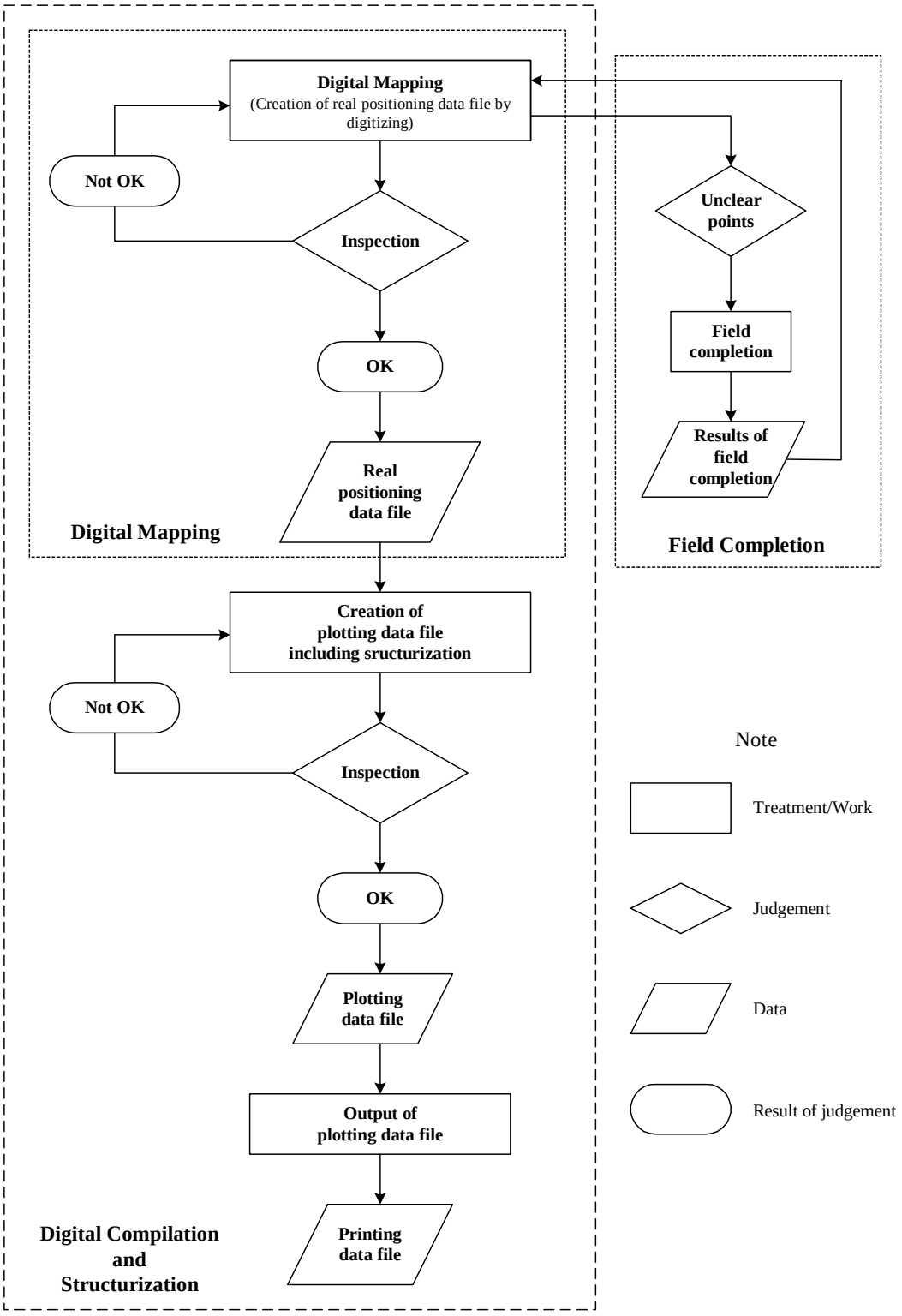
2. To obtain the digital data by digitizing of the existing analogue topographic maps or orthophoto image by digitizer.

3. To obtain the digital data directly from aerial photos by using digital plotter by photogrammetric method.

4. To compile the existing digital data.

In case of Kita Project, digital data of horizontal information was obtained by above Item 2 and digital data of vertical information (contour lines) was obtained by above Item 3.

Figure 6.1 "Workflow of Digital Compilation and Structurization"



6.2. Data and equipment used for digitizing

In case of Kita Project, digital data of horizontal information was obtained to digitize the orthophoto image made from Spot images.

Following data and materials were used for obtaining the digital data of horizontal information.

1. Data used for digitizing
    1. Orthophoto image (scale is 1:50,000) made from Spot images
    2. Guide image map prepared based on the results of field identification
    3. Aerial photos (scale is 1:50,000)
    4. Field identification data
    5. Photo interpretation data

2. Equipment used for digitizing
    1. Computer
    2. Display monitor
    3. Mouse
    4. Ink-jet plotter

3. Software
    1. Microstation J
    2. Microstation Decardes
    3. Geographics
    4. Excel

6.3. Working order of digitizing

Generally, Digital data of topographic maps will be obtained by following order.

1. River
   Main river including irrigation canal, lake and pond shall be drawn at first and then tributaries shall be drawn.
2. Road
   Main road shall be drawn at first and then small road shall be drawn.
3. Railway
4. Artificial structures such as public facilities and building and so on
5. Vegetation boundary
6. Contour lines
7. Map symbols
   Map symbols of public building such as school, mosque, church, police station and so on shall be drawn at first.
   Map symbols of private sector shall be drawn next.
   Map symbols of vegetation shall be drawn after completing of plotting above items.
8. Annotation

The reason why the digital data of topographic maps have to be obtained by above-mentioned order is as follows:

1. River, road and railway are main items of topographic maps. Therefore, generally, such items will be shown on real position on the map. However, other information will not be shown on real position in middle and small scale topographic maps due to the reason of relationship between the map scale and the limitation of expression of topographic maps.

2. Some vegetation boundaries will connect to the river, road and railway. Therefore, in case the lines of river, road and railway move, vegetation lines also have to be modified.

Digital data of vertical information (contour lines) will be obtained directly from digital plotter or DTM. Above-mentioned working order is the case of using digital plotter.

In case of Kita Project, digital data of vertical information (contour lines) were obtained from DTM.

6.4. Method of digitizing

In case of Kita Project, digital data (horizontal position) of topographic maps were obtained by digitizing of orthophoto images made from Spot Image. Contour lines were obtained from DTM created from the spatial aerial triangulation.

The points to be considered at the stage of digitizing are as follows:

1. Order of digitizing
   The line data (river, road, railways and so on) shall be obtained first.
   After completion of digitizing of line data, area data such as vegetation boundary will be obtained.

2. Unification of level, color classification, line weight and so on
   It is necessary to obtained the digital data according to the data structure (level, color, line type, line weight) which were decided at the preparatory work of digital topographic mapping.

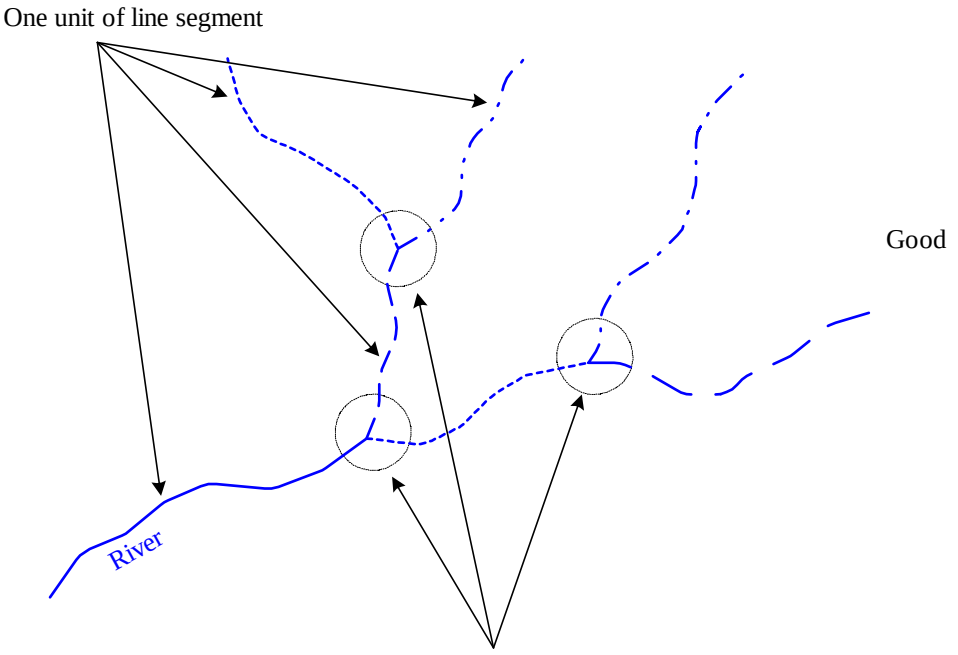
   This is one of the most important key factor for digital topographic data acquisition. If the digital data was not obtained correctly according to the data structure at the time of digital data acquisition, the work volume of structurization for digital topographic maps will become huge and difficult.

3. In case of obtaining the line data, segments of line shall be connected at the point of junction of river, road, railway and so on as shown on Figure 6.2 “Line Segment Unit (No.1)” and Figure 6.3 “Line Segment Unit (No.2)”.

It is necessary to take care about the maximum number of data points at one segment in Microstation is 101 points.

This is also one of the most important key factor for digital topographic data acquisition. If the digital data was not obtained by above-mentioned method, the work volume of creation of plotting data file will become huge and difficult.

Figure 6.2 "Line Segment Unit (No.1)"



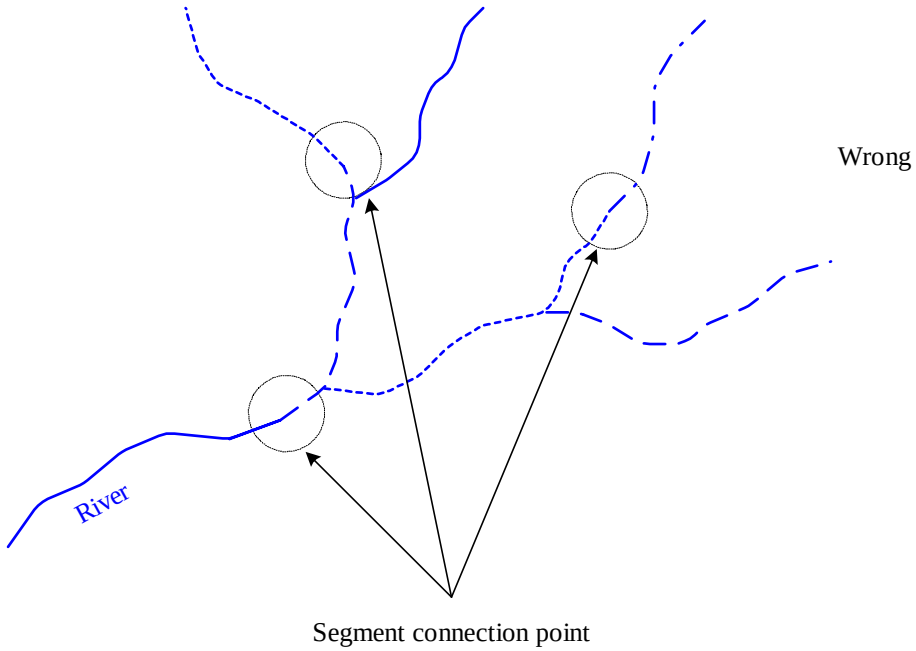
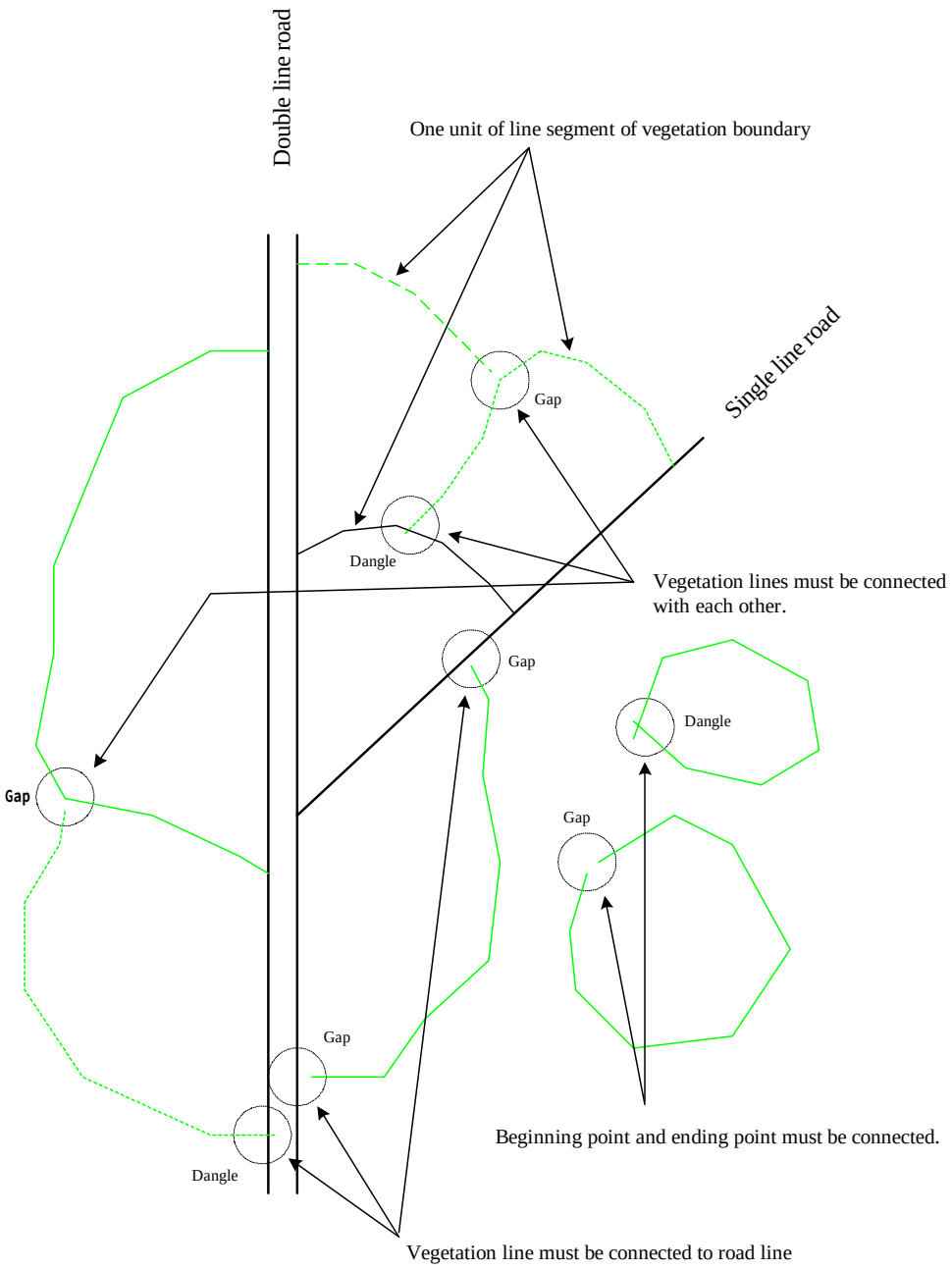


Figure 6.3 "Line Segment Unit (No.3)"



6.5. Check of digitized data

The digitized horizontal digital data will be combined with the contour line data and will be plotted out by plotter for checking. The major points to be checked at this stage are as follows:

1. The relationship between river and contour lines
2. The shape and type of river
3. The shape and type of road
4. The relationship between vegetation boundary and vegetation symbols
5. Connection of lines (gap and dangle)
6. Annotation (name of village, town and so on)
7. Connection between adjacent sheets
8. Etc.

The points to be corrected shall be marked on the plotted out manuscript for correction. Furthermore, the uncertain points will be marked on the plotted out manuscript and will be checked at the time of supplementary field survey at the site.

The major checking points are shown on Figure 6.4 “Relationship between River and Contour Lines (No.1)”, Figure 6.5 “Relationship between River and Contour Lines (No.2)”, Figure 6.6 “Connection of Tributaries”, Figure 6.7 “Relationship between Vegetation Boundaries and Vegetation Symbols”, Figure 6.8 “Gap”, Figure 6.9 “Dangle”, Figure 6.10 “Connection between Double Line Road and Single Line Road”, Figure 6.11 “Relationship between Road Type and Village”, Figure 6.12 “Connection between Adjacent Sheets (River)”, Figure 6.13 “Connection between Adjacent Sheets (Road)” and Figure 6.14 “Connection between Adjacent Sheets (Vegetation Boundary and Symbols)”.

Figure 6.4 "Relationship between River and Contour Lines (No. 1)

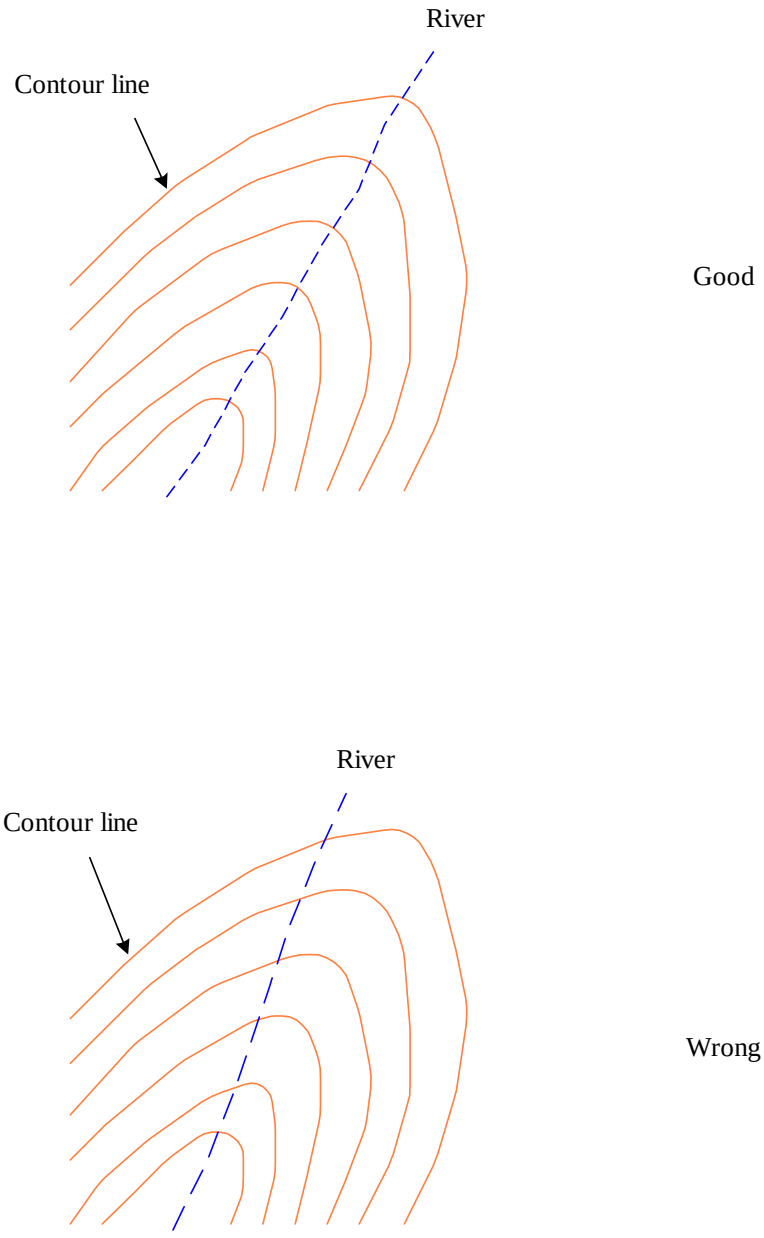


Figure 6.5 "Relationship between River and Contour Lines (No.2)

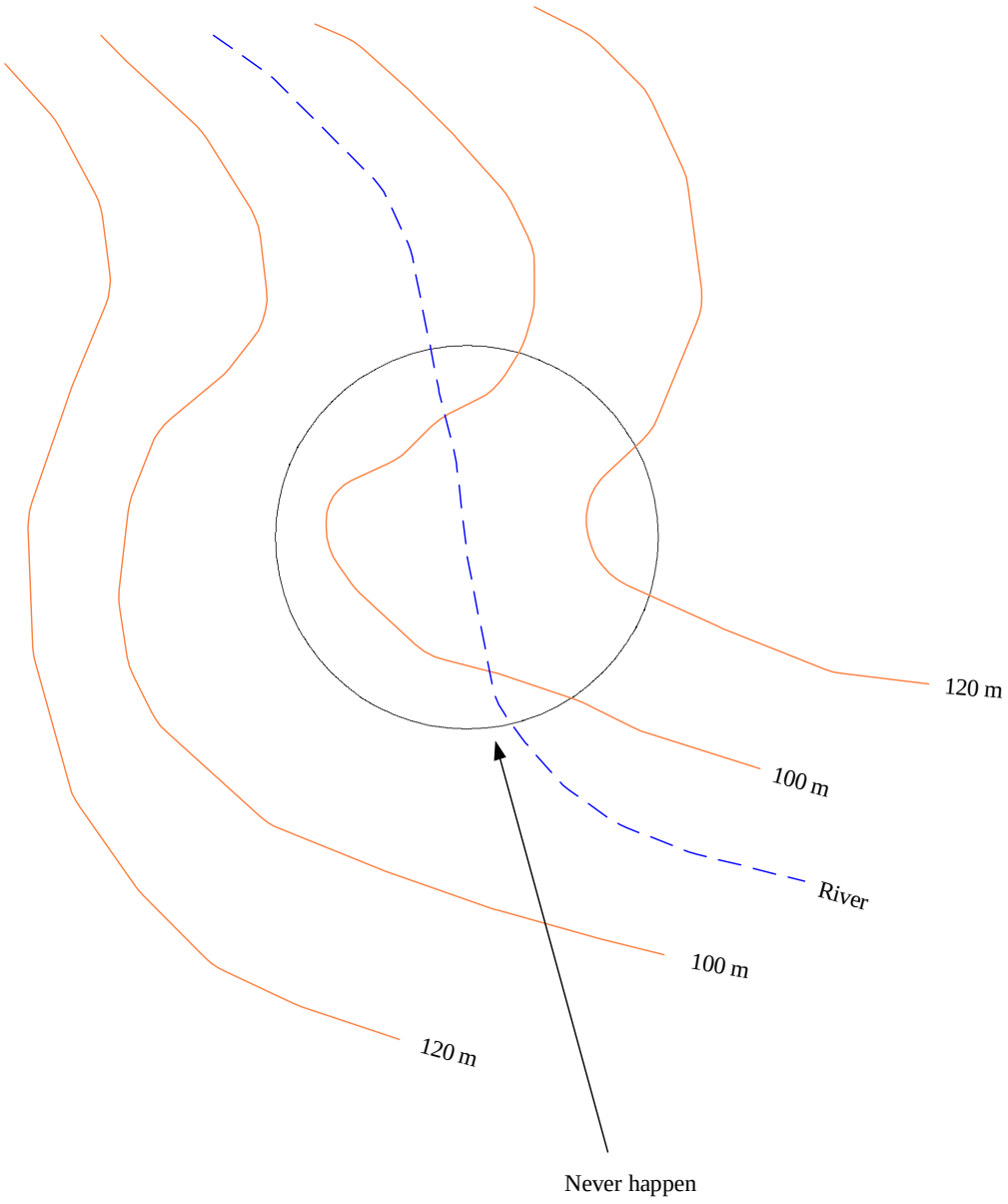


Figure 6.6 "Connection of Tributaries"

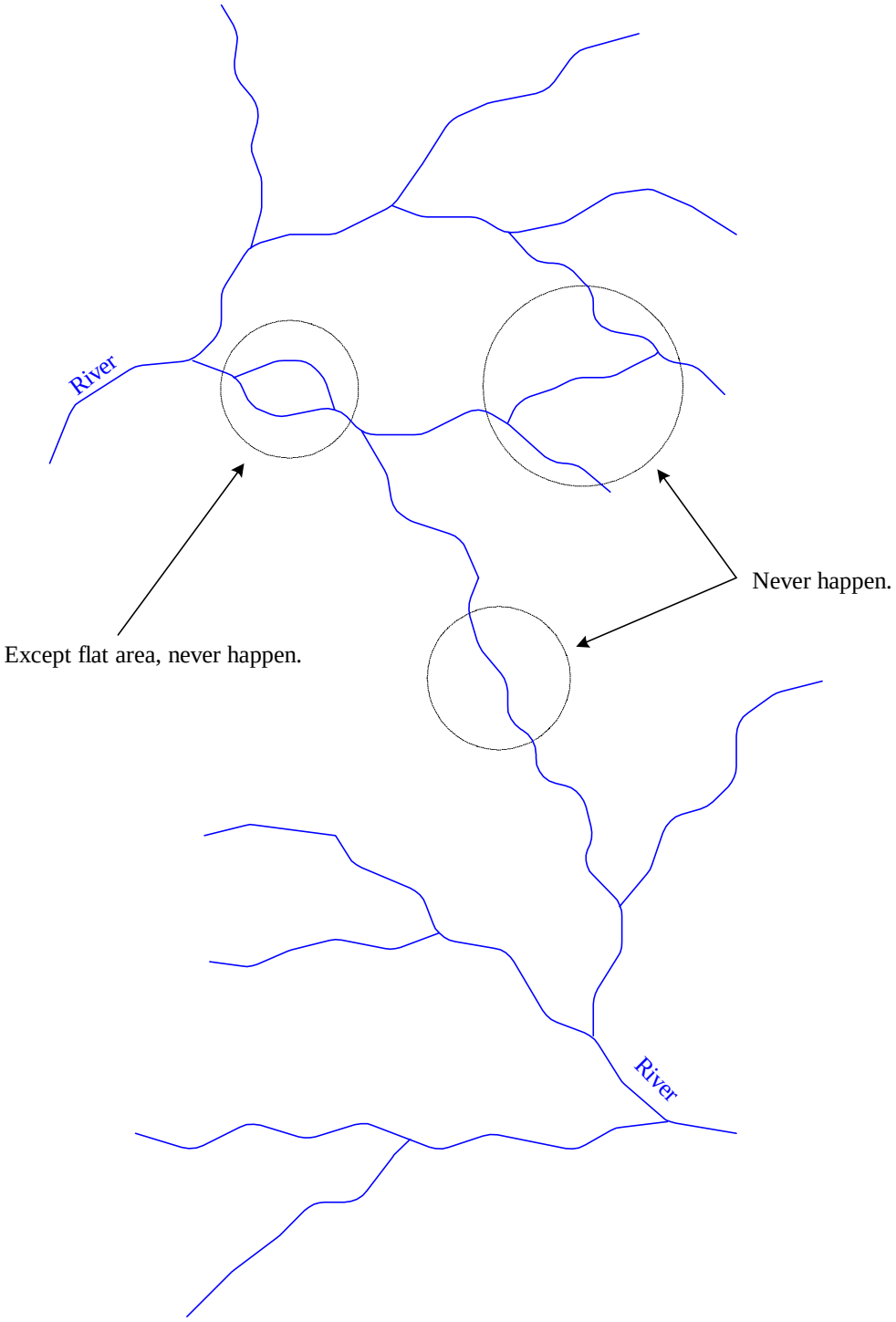
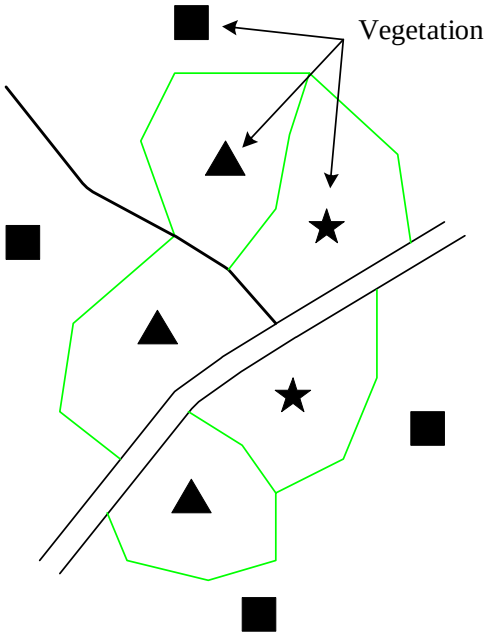
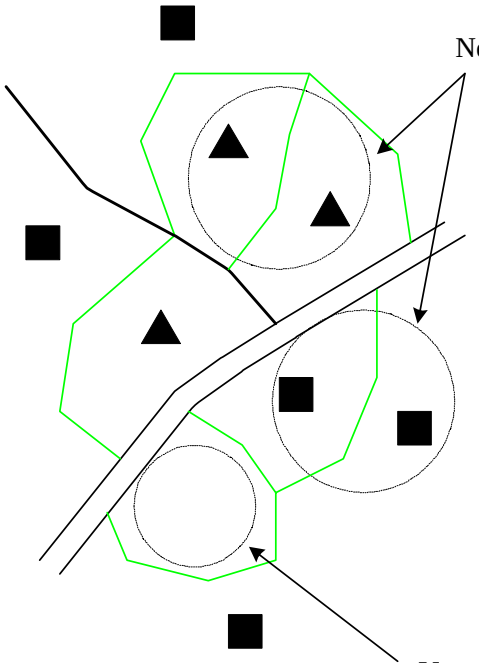


Figure 6.7 "Relationship between Vegetation Boundaries and Vegetation Symbols

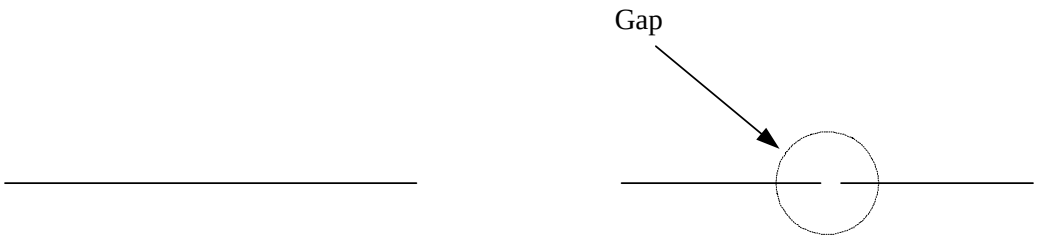


Good

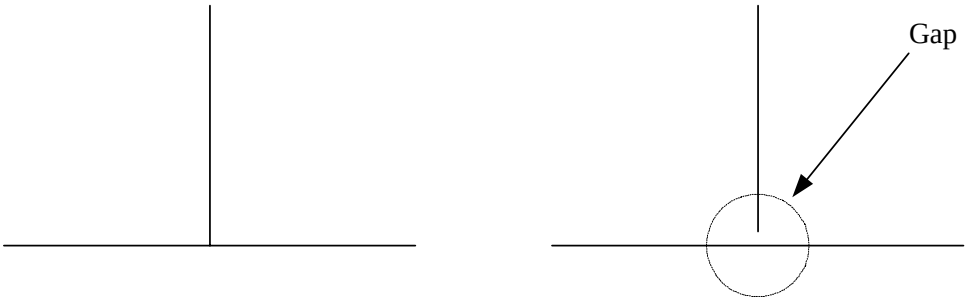


Wrong

Figure 6.8 "Gap"

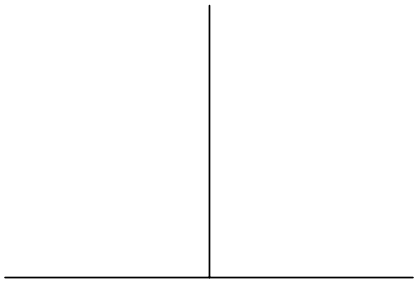


Good Wrong

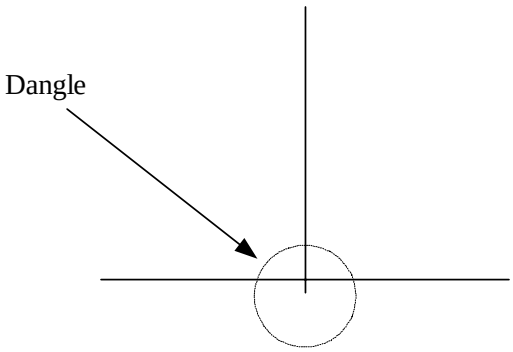


Good Wrong

Figure 6.9 "Dangle"



Good



Wrong

Figure 6.10 "Connection between Double Line Road and Single Line Road"

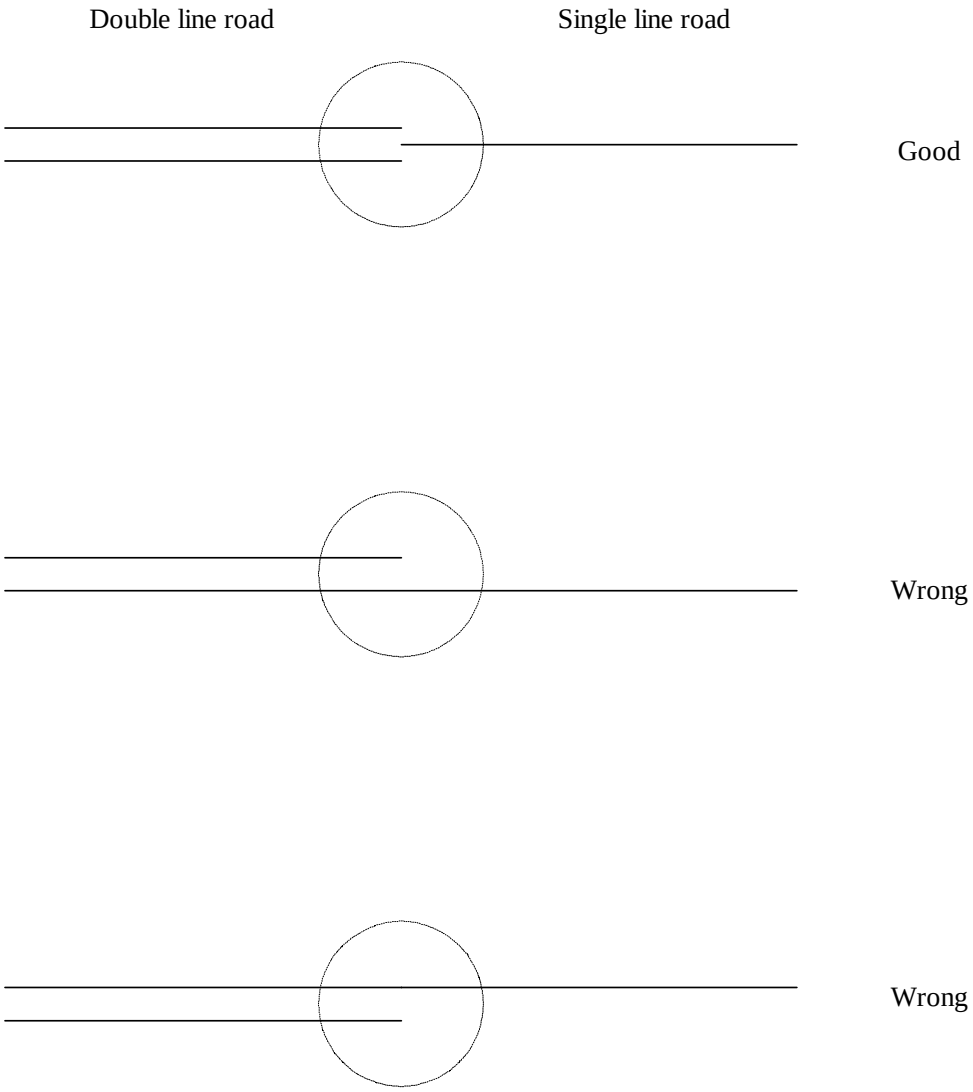
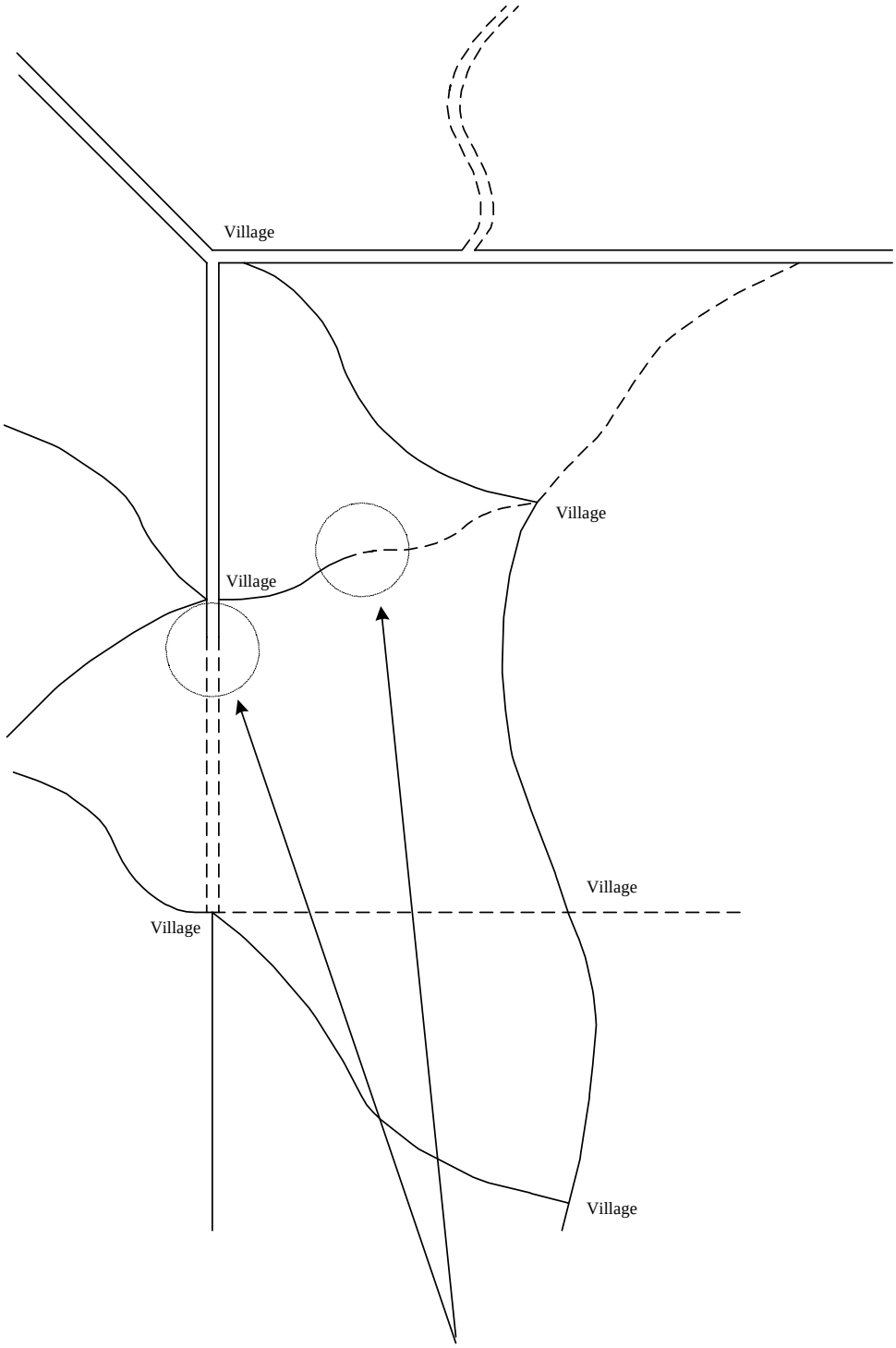


Figure 6.11 "Relationship between Road Type and Village



Basically, road type between villages shall be same.

Figure 6.12 "Connection between Adjacent Sheets (River)

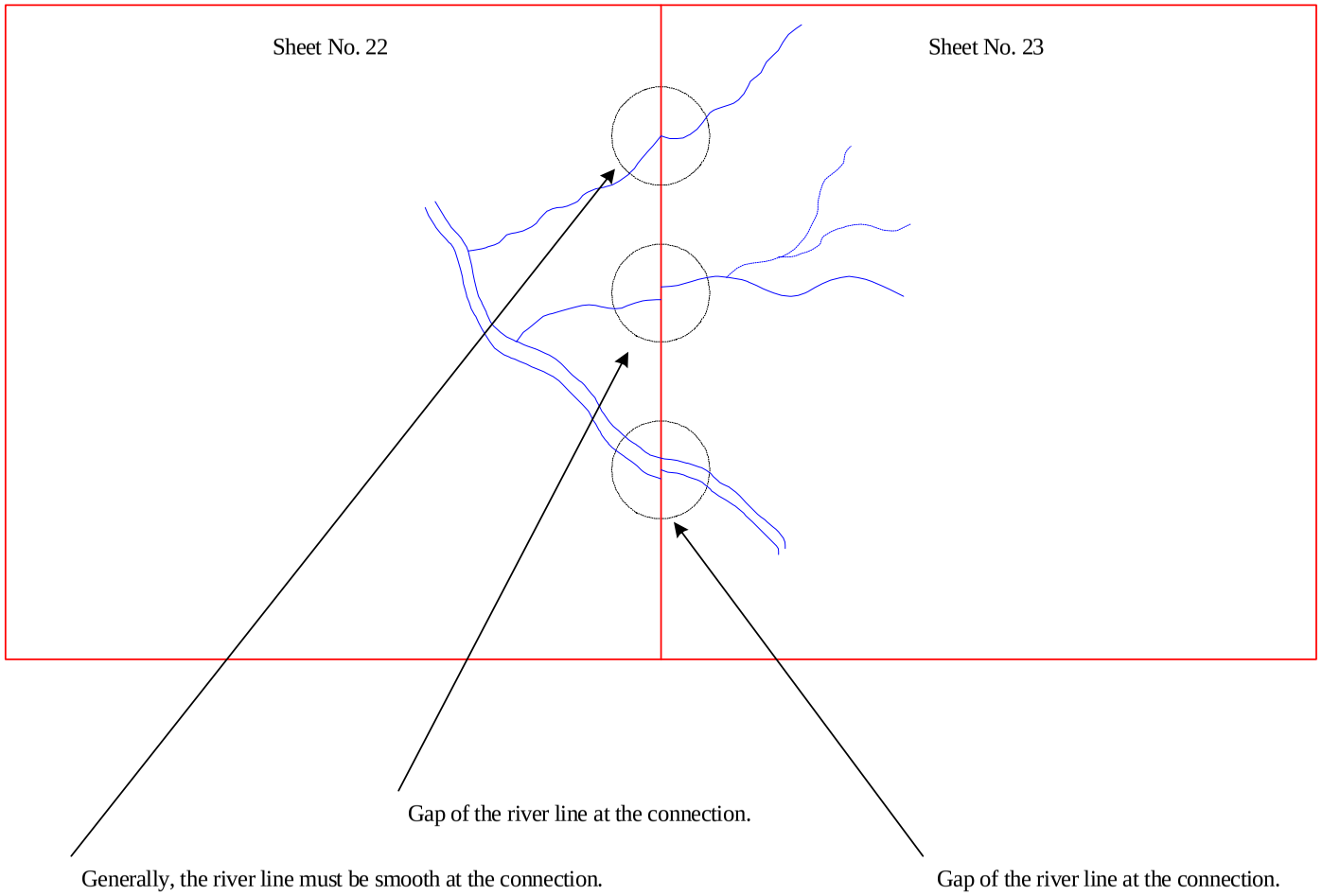


Figure 6.13 "Connection between Adjacent Sheets (Road)

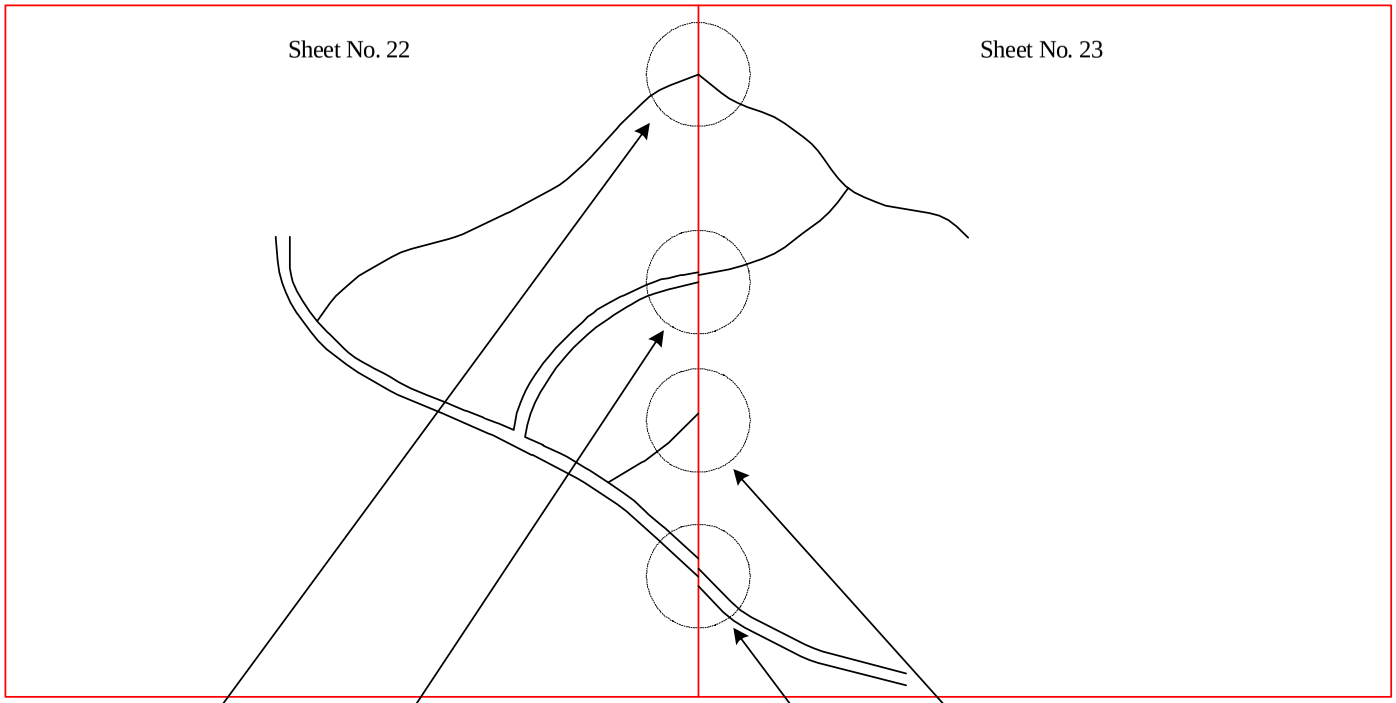
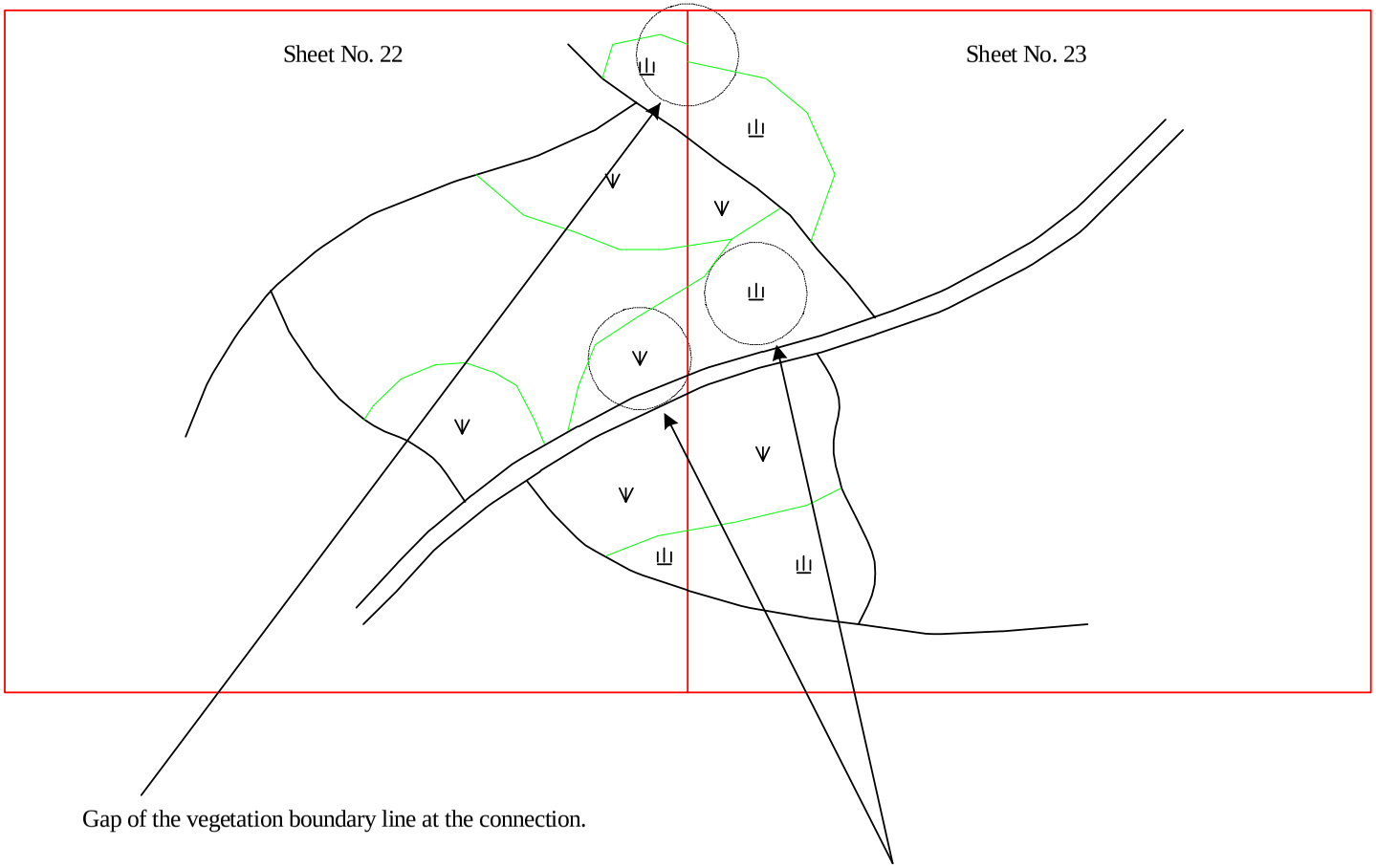


Figure 6.14 "Connection between Adjacent Sheets (Vegetation Boundary and Symbols)



6.6. Correction of digitized data

After completion of checking, digital data will be corrected based on the results of checking. The correction of digital data will be classified as follows and will be corrected under-mentioned order.

1. Correction of shape
   Same as the order of digitizing, correction of line data will be corrected at first. Therefore, the order of correction is as follows:

   1. River
   2. Road
   3. Railway
   4. Vegetation boundary
   5. Annotation
   6. Etc.

2. Correction of data structure
   After completion of the correction of shape, correction of data structure will be executed. The points to be considered at the time of correction of data structure are as follows:

   1. Connection of line segment
   2. Color
   3. Line style
   4. Line weight
   5. Layer number (Level number)

The points already corrected must be marked on the plotted sheet one by one in order to find the remaining of correction points easily.

Chapter 7. Supplementary Field Survey

7.1. Items for supplementary field survey

During the acquisition of digital data, discrepancy between field identification and digitizing, lack of data and so on will be found. The items impossible to solve by using existing data have to be checked in the field. Such work is called as “Supplementary Field Survey”.

The above mentioned points shall be marked on the plotted out manuscript during the check of digital data for supplementary field survey. Generally, the items for supplementary field survey are as follows:

1. Lack of village
2. Lack of village name
3. Lack of public facilities
4. Unification of road type
5. Shape of river from the view point of relationship with contour lines
6. New road, railway and so on newly constructed during the topographic mapping work
7. The portion which can not be obtained the digital data by the various reasons

Before starting supplementary field survey, it is necessary to mark the location to be identified on the plotted out manuscript, and also items to be checked will be noted on the plotted out manuscript.

Furthermore, it is necessary to select the most effective routes for supplementary field survey considering the road network and road condition in the project site.

7.2. Supplementary field survey

Supplementary field survey will be executed according to the results of works of Item 7.1 “Items for supplementary filed survey”.

Generally, the results of supplementary field survey will be noted on the plotted out manuscript of topographic maps at the site. Not only the items checked in the office, but also the items founded in the site during the execution of supplementary field survey have to be noted on the plotted out manuscript of topographic maps.

In case of the execution of supplementary field survey by many staff, it is recommended to decided how to note the results of supplementary field survey on the plotted out manuscript of topographic maps before execution of actual work.

Furthermore, it is recommended to use several colors ball point pens for supplementary field survey. For example, the description of location and contents to be check in the site will be noted by blue color ball point pen, and the results of supplementary field survey will be noted by red color ball point pen on the plotted out manuscript of topographic maps.

7.3. Arrangement of supplementary field survey results

After completion of the filed work of supplementary field survey, the obtained data will be arranged on the plotted out manuscript of topographic maps in the office for digital compilation work.

Usually, the persons who will execute the supplementary field survey and the persons who will execute the compilation of topographic maps based on the results of supplementary field survey are different.

Therefore, it is necessary to arrange the results of supplementary field survey to be able to easily understand the contents of the results by the person who is not participated to the supplementary field survey.

Usually, several color ball point pens and color felt-pens will be used for arrangement of supplementary field survey results. For example, The type of road will be marked by different colors according to the standard and supplementary field survey results on the plotted out manuscript of topographic maps.

In case of the database such as description of the existing bench marks, public facilities and so on is necessary, the data sheet for each items will be prepared. It is recommended to make such data sheets by digital method and stored in the computer for updating.

Chapter 8. Digital Compilation

8.1. Purpose of digital compilation

The purpose of digital compilation is to correct the digital data based on the results of supplementary field survey.

All digital data except the data to be corrected based on the results of supplementary field survey have to be obtained correctly according to the data structure, and have to be checked and corrected before this stage of work.

It is necessary to understand that this is the last stage for digital data acquisition and correction of obtained digital data except final check and correction. The following work form digital compilation such as creation of plotting data file and printing data file is not data acquisition and correction, but data processing.

8.2. Data used for digital compilation

The data used for digital compilation is as follows:

1. Supplementary field survey results
2. Plotted out manuscript of topographic maps

The equipment and software to be used for digital compilation is same as Chapter 6 Acquisition of Digital Data (Digitizing), 6.2 Data and equipment to be used for digitizing.

8.3. Working order of digital compilation

The work of digital compilation is to correct the digital data based on the results of supplementary field survey. Therefore, digital compilation means the digital data correction.

The working order of correction of digital data is same as mentioned on Chapter 6 Acquisition of Digital Data (Digitizing), 6.6 Correction of digitized data.

8.4. Method of digital compilation

The digital compilation means the correction of digital data. Therefore, the method of digital compilation is same as digitizing shown on Chapter 6 Acquisition of Digital Data (Digitizing), 6.4 Method of digitizing.

8.5. Check and correction of compiled digital data

After completion of digital compilation, digital topographic data will be plotted out using plotter for checking and correction.

It is necessary to check that all points to be corrected based on the results of supplementary fields survey have been already corrected by marking on the plotted out manuscript of topographic maps.

This is the last check and correction of digital data for topographic mapping. Following work from digital compilation is not acquisition and correction of digital data, but the process of digital data. Therefore, acquisition and correction of digital data after this stage of work will not be done.

Chapter 9. Structurization

9.1. Purpose of structurization

As already explained on Chapter 5 Data File for Digital Topographic Mapping, 5.2 Structurized data file, in case of digital topographic mapping, structurization means the acquisition of digital data according to the data structure which were decided before staring of the actual work.

Therefore, usually, in case of digital topographic mapping, structurization will not be necessary if the digital data acquisition were done according to the data structure correctly.

However, through the execution of digital topographic mapping work, data structure, maybe, have to be modified by various reasons. Therefore, in this stage, it is necessary to check that the digital data is obtained and stored according to the decided data structure correctly.

For GIS data creation, structurization is necessary to process the data to fit the purpose of GIS use.

9.2. Method of structurization

Up to this stage, all data is already correct except data structure. Therefore, it is not necessary to check the shape of line such as river shape, road shape, vegetation boundary and so on.

The correction in this stage is just the correction of data structure as mentioned below:

1. Layer number (Level number)
2. Color
3. Line weight
4. Line style
5. Element type
6. Continuity of line

To check the above-mentioned items from 1 to 5, color table file of Microstation will be used. Concerning the above-mentioned item of 6, logical error check program of Microstation will be used.

The method of checking using color table file of Microstation is shown on Figure 9.1 “Checking by Using Level Manager of Microstation (No.1)” and Figure 9.2 “Checking by Using Level Manager of Microstation (No.2)”.

It is difficult to check and correct the digital data by using the display only. Therefore, it is necessary to make a plotted out manuscript for visual checking.

Figure 9.1 "Checking by Using Level Manager of Microstation (No.1)"

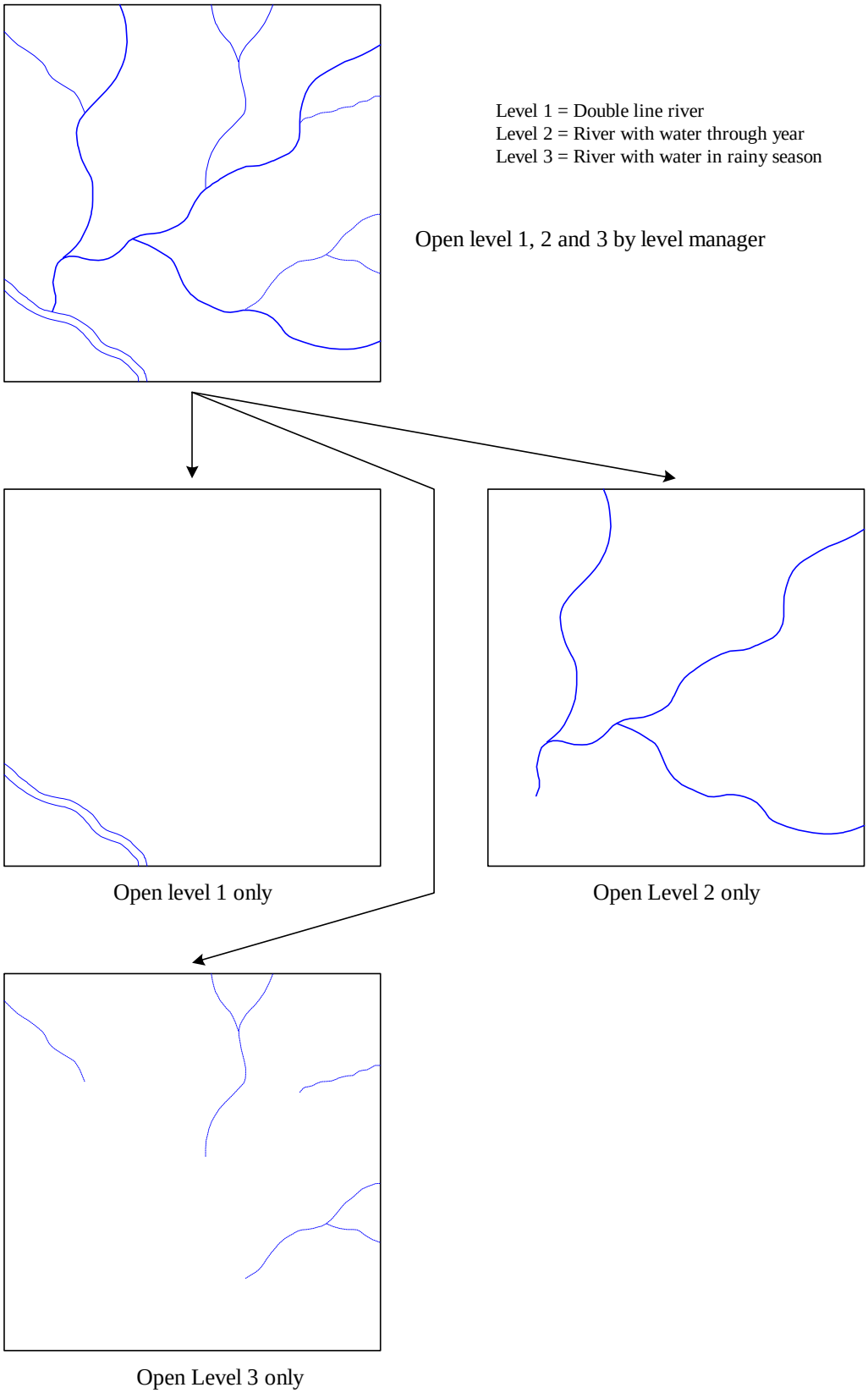
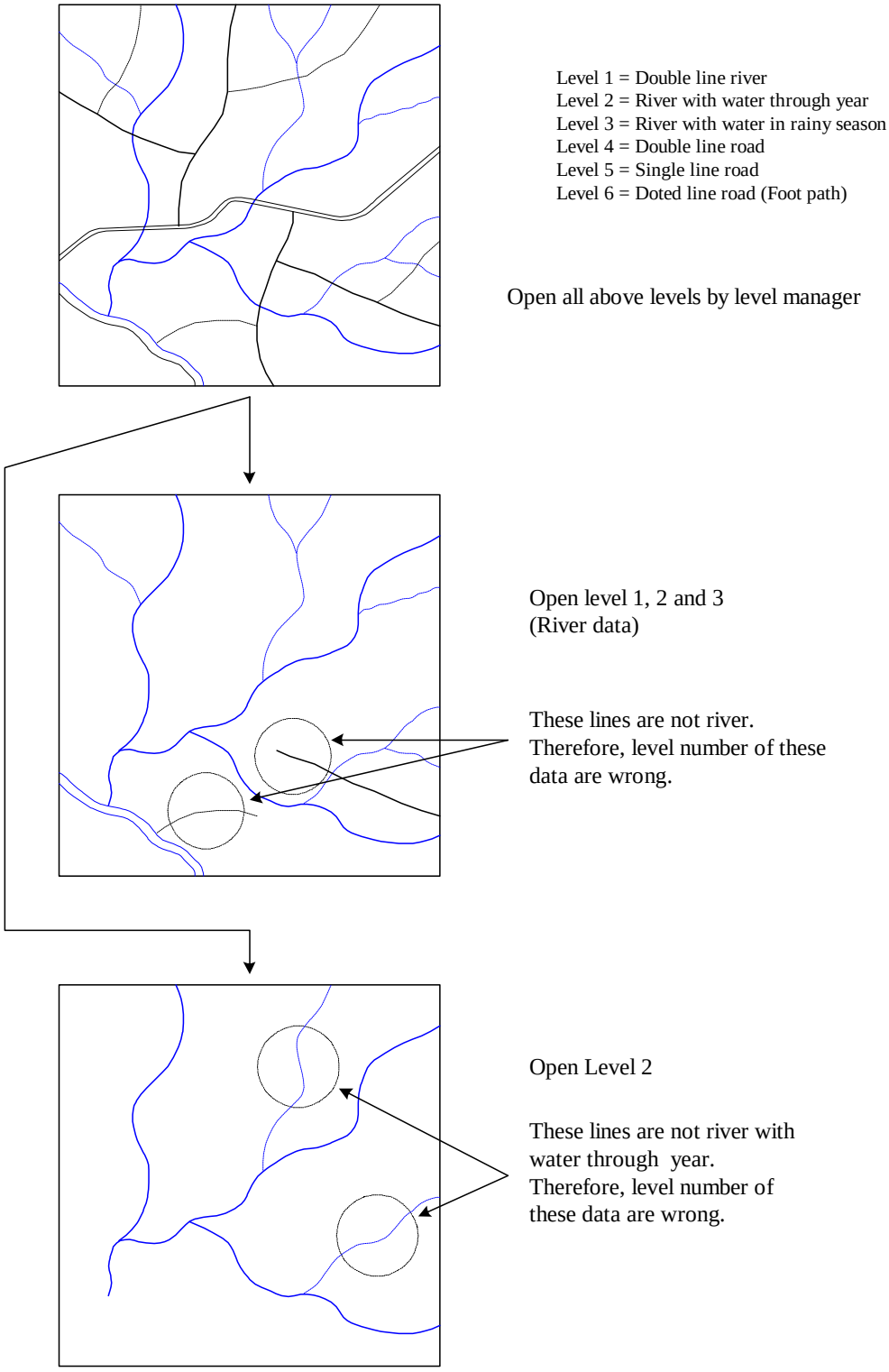


Figure 9.2 "Checking by Using Level Manager of Microstation (No.2)"



Chapter 10. Creation of Plotting Data File

10.1.Purpose of plotting data file

After completion of the structurization, plotting data file will be created. The purpose of creation of plotting data file is to process the digital data same style as an analogue topographic maps.

For this purpose, following three processes will be done.

1. Transposition
2. Intermittence
3. Symbolizing

Furthermore, symbolizing consists of following three processes.

1. Fill
2. Hatching
3. Patterning

The images of transposition, intermittence and symbolizing (fill, hatching and patterning) are shown on

Figure 5.2 “Difference of Image between Real Positioning Data File and Plotting Data File (Intermittence)”, Figure 5.3 “Difference of Image between Real Positioning Data File and Plotting Data File (Patterning and Fill for River)”, Figure 5.4 “Difference of Image between Real Positioning Data File and Plotting Data File (Transposition of Symbols)”, Figure 5.5 “Difference of Image between Real Positioning Data File and Plotting Data File (Patterning), Figure 5.6 “Difference of Image between Real Positioning Data File and Plotting Data File (Fill)”, Figure 5.7 “Difference of Image between Real Positioning Data File and Plotting Data File (Patterning and Fill for Road)” and Figure 5.8 “Difference of Image between Real Positioning Data File and Plotting Data File (Hatching for Town Area)”.

10.2.Transposition

In real positioning data file and structurized data file, the line, map symbol and annotation maybe overlapped at some part. Therefore, the process of moving map symbols and annotation will be necessary at the point of overlapping.

The above-mentioned process is called as “Transposition”.

The method of transposition is as follows:

1. The symbols which must be shown on the real position such as triangulation points, GPS points and point of spot elevation shall not be moved.

2. In case of overlapping of map symbol and annotation, annotation will be moved.

3. In case of overlapping of public facility symbol and vegetation symbol, vegetation symbol will be moved.

10.3.Intermittence

For example, in real positioning data file and structurized data file, the contour lines and contour values are overlapping. Therefore, the process of intermittence of contour lines will be necessary at the point of contour values.

The above-mentioned process is called as “Intermittence”.

The necessary points of intermittence are as follows:

1. Overlapping point between contour line and contour values
2. Overlapping point between double line road and river
3. Overlapping point between double line river and road
4. Bridge point

10.4.Symbolizing

In real positioning data file and structurized data file, road , railway, transmission line and so on are expressed as line. However, these data have to be express same style as the analogue topographic maps according to the map symbols.

For example, double line road have to be express as double lines and transmission line have to be expressed as transmission line symbols.

To process (change or addition) the data to the structurized data file according to the map symbol standard is called as “Symbolizing”.

Symbolizing consists of following three types of processes.

1. Fill
2. Hatching
3. Patterning

10.5.Fill

In topographic maps, some area will be filled by colors.

To paste a color to the area is called as “Fill”.

In Kita Project, Fill is applied for following items.

1. Water area
2. Road (double line and asphalted road)
3. Vegetation except cultivation land

10.6.Hatching

In topographic maps, some area will be filled by lines. For example, In Kita Project, Town area will be express by slant lines.

To draw the lines in the area is called as “Hatching”.

In Kita Project, hatching will be applied for town area only.

10.7.Patterning

Patterning means the method to add the cell (symbol mark or pattern) to the area or line according to the standard of map symbol.

For example, it is necessary to add the dots along the river, if there is a forest along the river.

In Kita Project, the necessary items for patterning are as follows:

1. Forest along the river
2. Railway symbol
3. Transmission line
4. Telephone line
5. Topographic feature
6. Boundary
7. Big dam

Chapter 11. Final Check and Correction

11.1.Purpose of final check

After finished the creation of plotting data file, digital topographic data will be plotted out by plotter. Using the plotted out topographic map, final check will be executed.

The created digital topographic data have already been checked and corrected at each stage of topographic mapping work. Therefore, it is considered that no items to be corrected in this stage if the check and correction are executed sufficiently.

The main check items in this stage is color image on the plotted out topographic maps. Usually, the color on the display and on the plotted out paper is little different.

Therefore, final color image must be decided by visual check based on the plotter out digital topographic maps. If the color image plotted out is not suitable for topographic maps, it will be changed by using color table.

11.2.Method of correction

The total number of available colors is 256 colors in Microstation. The color will be changed by using color table of Microstation. In this case, color number will not be changed. Only the color pallet corresponding to the color number will be changed.

Chapter 12. Updating of Digital Topographic Maps

12.1.Type of change

Any kind of topographic maps will be changed little by little after completion of topographic maps. Therefore, it is necessary to update the topographic maps periodically.

The changes of topographic maps will be classified as follows:

1. Change of horizontal information
   After completion of topographic maps, new road, building and so on will be constructed.

2. Change of vertical information
   Due to the reason of construction, landslide and so on, contour lines (vertical information) will be changed.

3. Change of attribute data
   Even though the horizontal information is not changed, but the attribute data such land use and name of public facilities will be changed. For example, paddy field will be changed to cultivated land.

12.2.Method of correction

There are several method for correction of change of topographic maps. Generally, following methods will be used for correction.

1. Correction of large area
   Generally, photogrammetric method will be used for large area's correction.

2. Correction of small area
   Generally, ground survey method will be used for small area's correction.

3. Correction of attribute data
   Basically, change of land use can be corrected by photogrammetric method. However, other attribute data such as name of village, new public facilities and so on have to collected in the field.

4. Correction by existing data
   If the existing data such as road design map and so on is available, such data and maps can be used for correction of topographic maps.

12.3.Correction by photogrammetric method

The method of correction by photogrammetric method will be executed by following order generally.

1. Establishment of photo signals
2. Ground control point survey
3. Aerial photography
4. Aerial triangulation
5. Acquisition of digital data by digital plotter
6. Correction of the existing digital topographic data

In case of not using digital plotter, correction will be executed by following order generally.

1. Establishment of photo signals
2. Ground control point survey
3. Aerial photography
4. Aerial triangulation
5. Orthophoto image making and creation of DTM
6. Horizontal data acquisition by digitizing of orthophoto image
7. Acquisition of contour lines from DTM
8. Correction of the existing digital topographic data

12.4.Correction by ground survey method

Generally, following three methods will be used for correction of topographic maps by ground survey method.

1. Ground survey using GPS
2. Tachometric method
3. Plain table method

Generally, both tachometric method and plain table method will be used for middle and large scale topographic mapping correction. Therefore, ground survey method using GPS is recommended for small scale topographic maps such as 1:50,000 scale topographic maps.

The standard working order of correction by ground survey using GPS is as follows:

1. The points to be observed will be checked at site considering the shape of objects and scale of topographic maps.

2. Horizontal coordinates of necessary points will be observed by GPS. In case accurate horizontal coordinates is necessary, translocation method will be used. In case the horizontal coordinates in not so important, single positioning method will be applied.

3. The observed coordinates will be plotted on the topographic maps.

4. The shape of the object will be drawn by connecting the plotted points..

12.5.Correction of digital data

Generally, following three methods will be applied for correction of digital data.

1. The shape of object to be corrected will be drawn directly using Microstation based on the coordinates obtained by ground survey or the existing data.

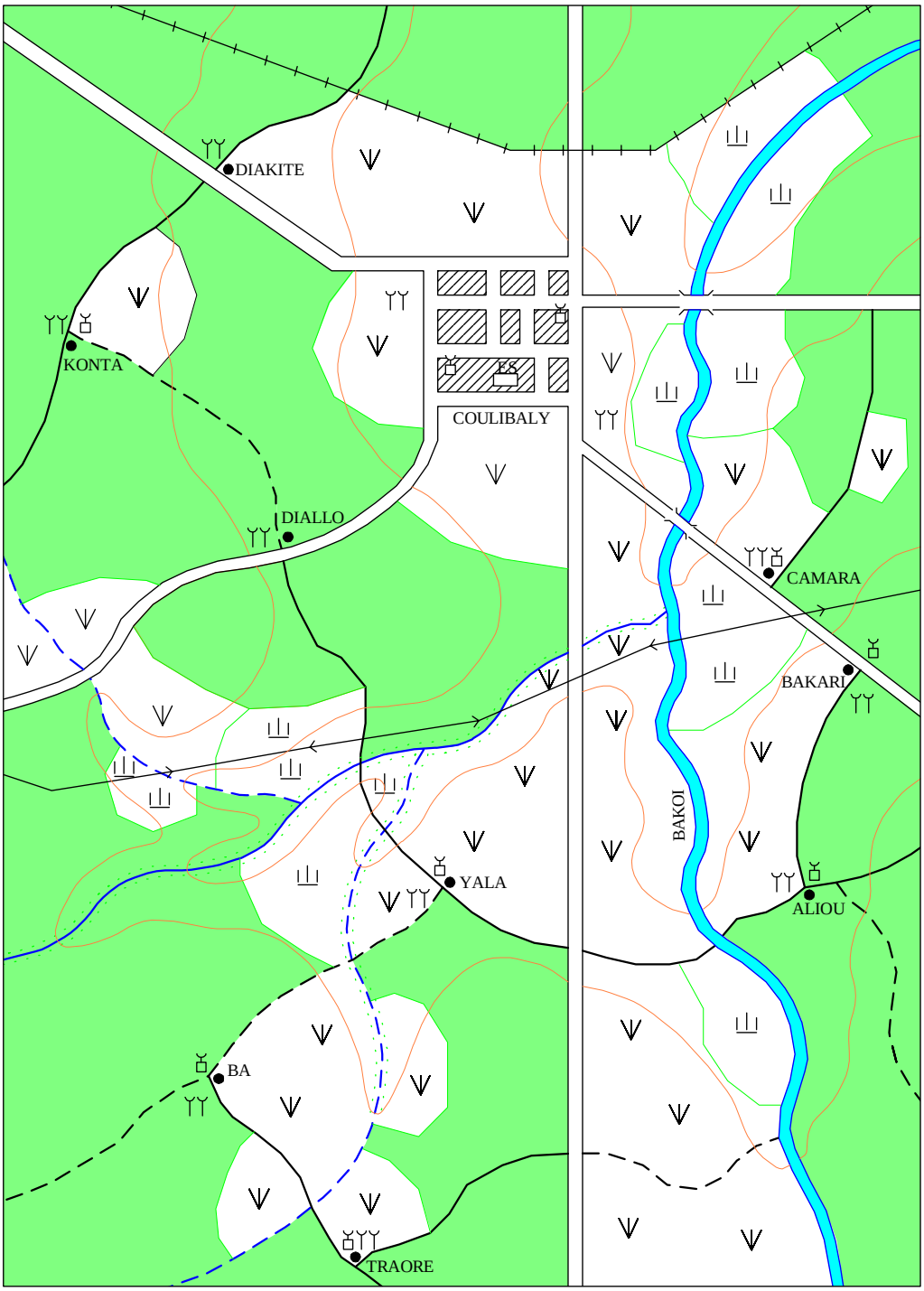
2. The manuscript map for correction will be prepared. The digital data will be obtained by scanning the manuscript map for correction. And overlapped to the map to be corrected.

3. The manuscript map for correction will be prepared. The digital data will be obtained by digitizing of the manuscript map for correction.

Attachment Sample of Digital Map

Sample of Digital Map

Sample of Digital Map

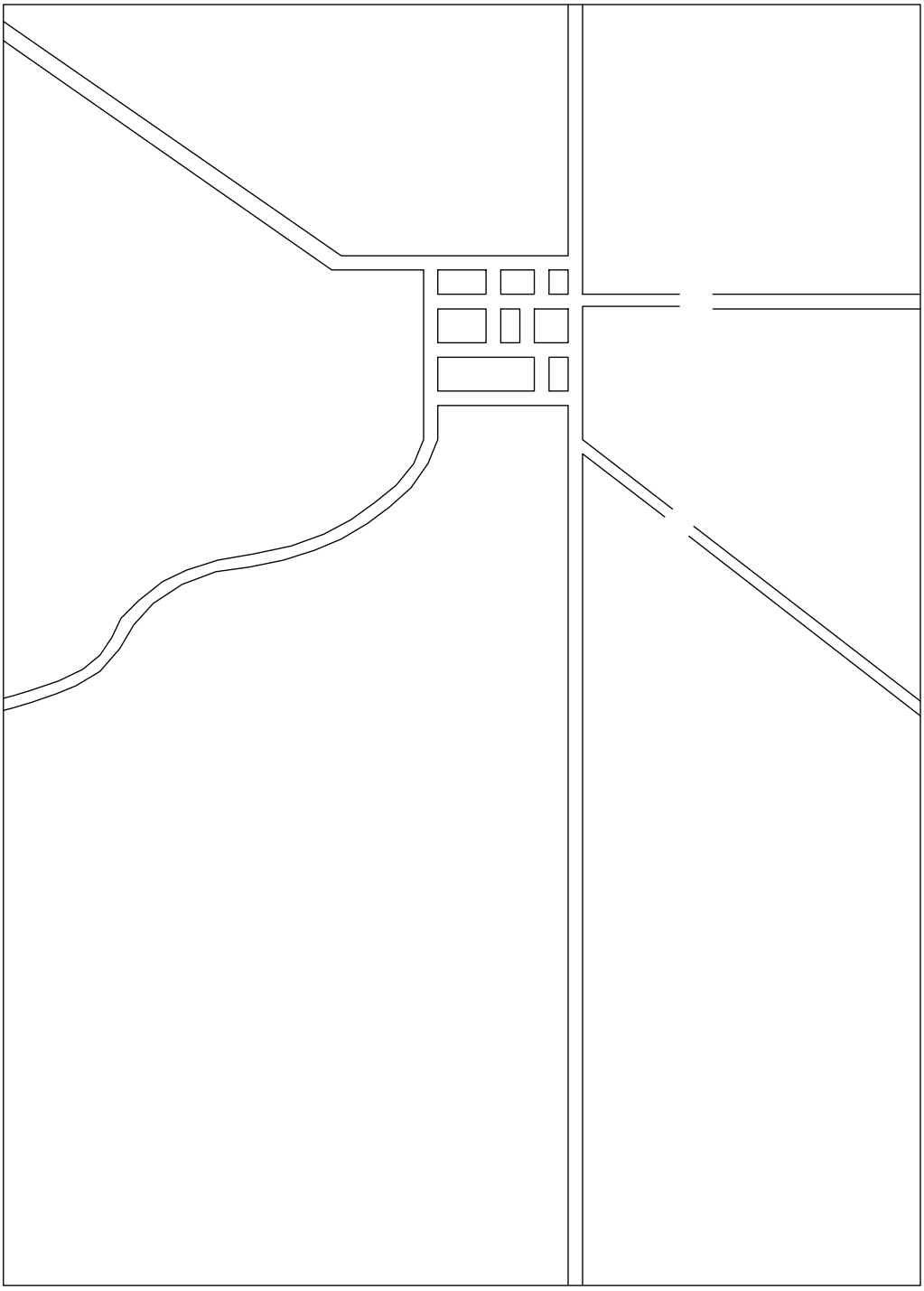


Layer Structure of Sample Digital Map

Level 1	Double Line Road Data
Level 2	Single Line Road Data
Level 3	Dotted Line Road Data
Level 4	Double Line River Data
Level 5	Single Line River Data
Level 6	Dotted Line River Data
Level 7	Fill for Double Line River
Level 8	Patterning for River
Level 9	Vegetation Boundary Data
Level 10	Vegetation Symbol (Cultivation Land)
Level 11	Vegetation Symbol (Paddy Field)
Level 12	Fill for Bush
Level 13	Hatching for Town Area
Level 14	Symbols
Level 15	Transmission Line
Level 16	Railway
Level 17	Annotation
Level 18	Contour Lines

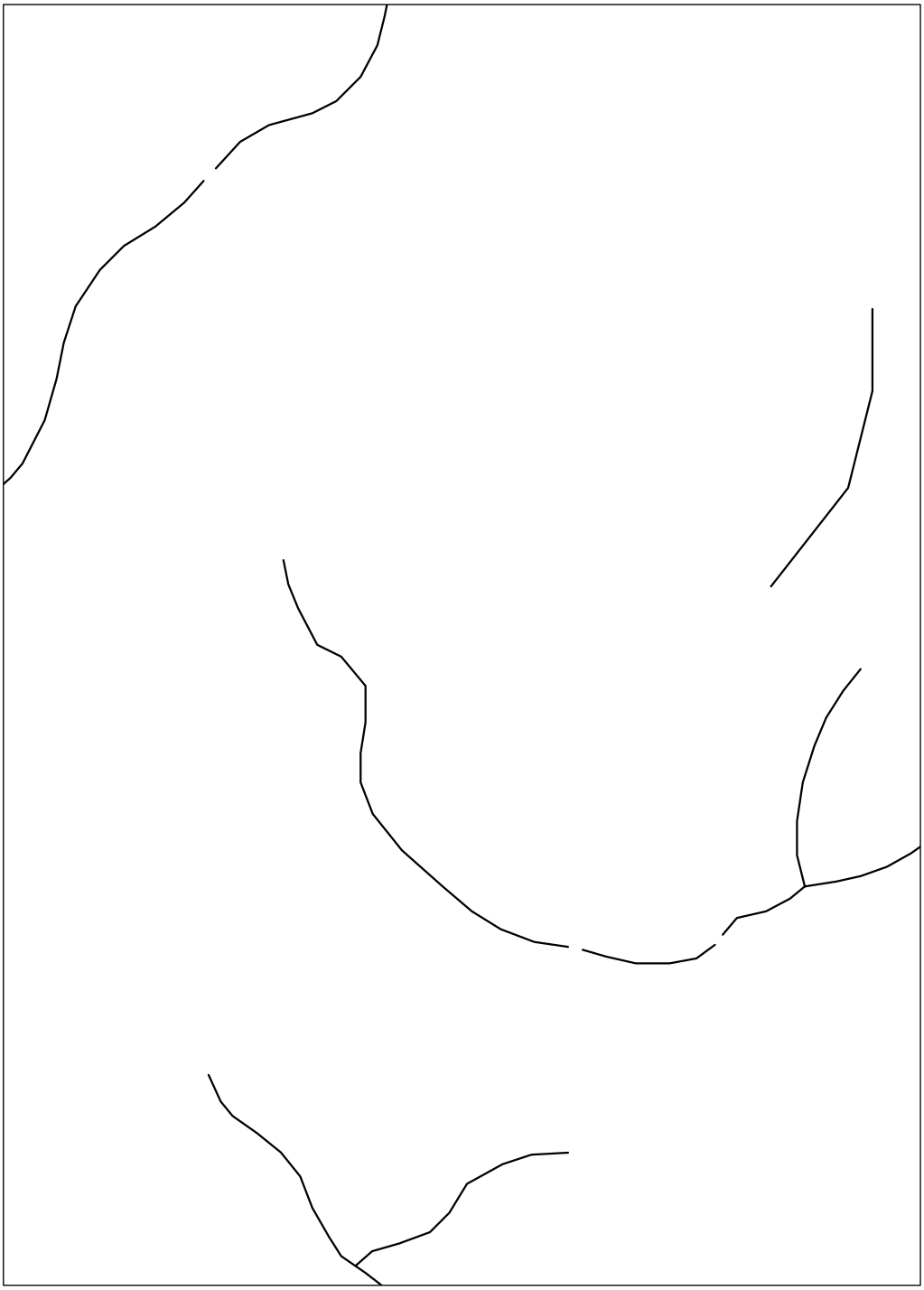
Level 1 Double Line Road Data

Niveau 1: Donnees de Route ayant Deux Lignes



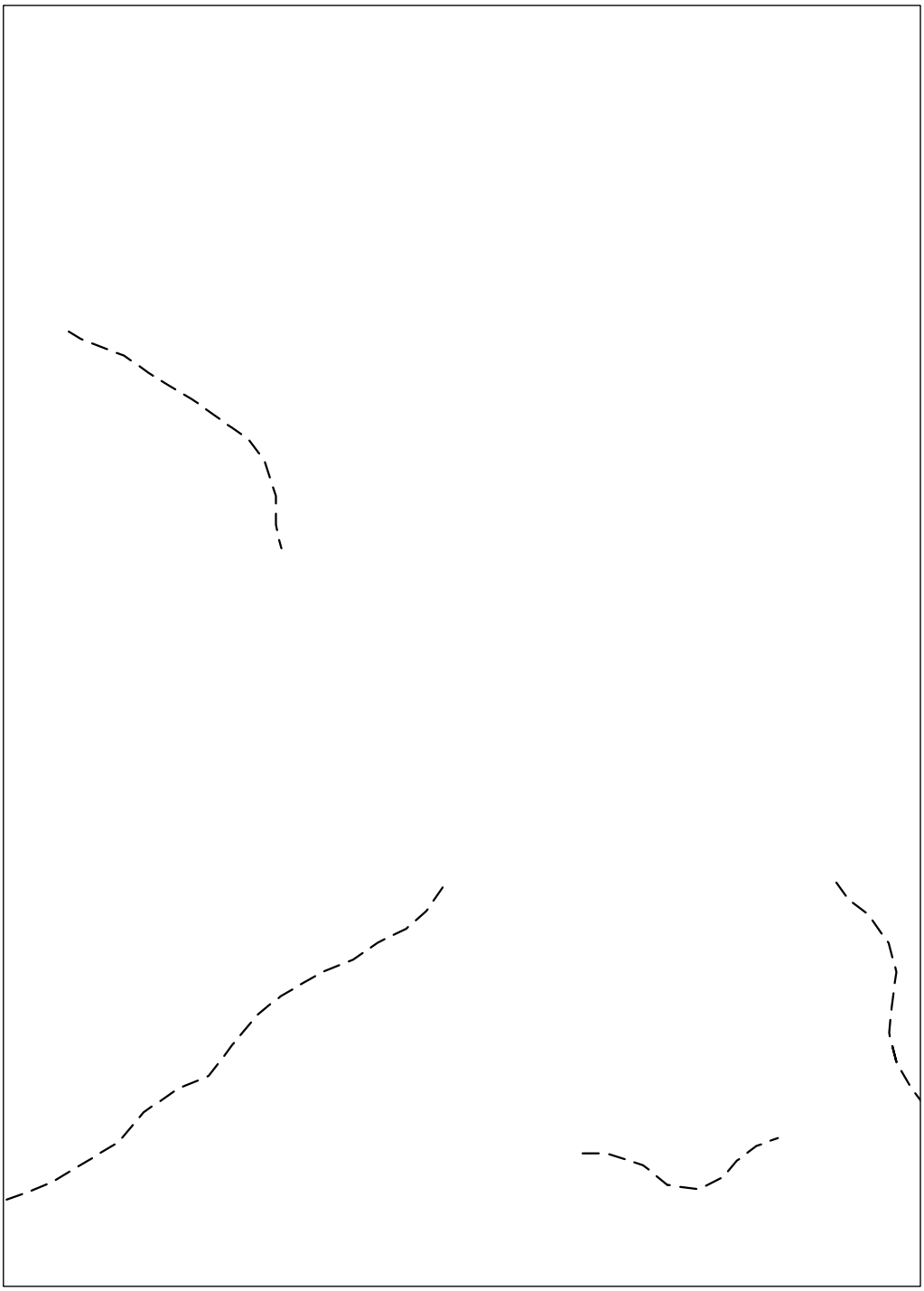
Level 2 Single Line Road Data

Niveau 2: Donnees de Route avec une Ligne Unique



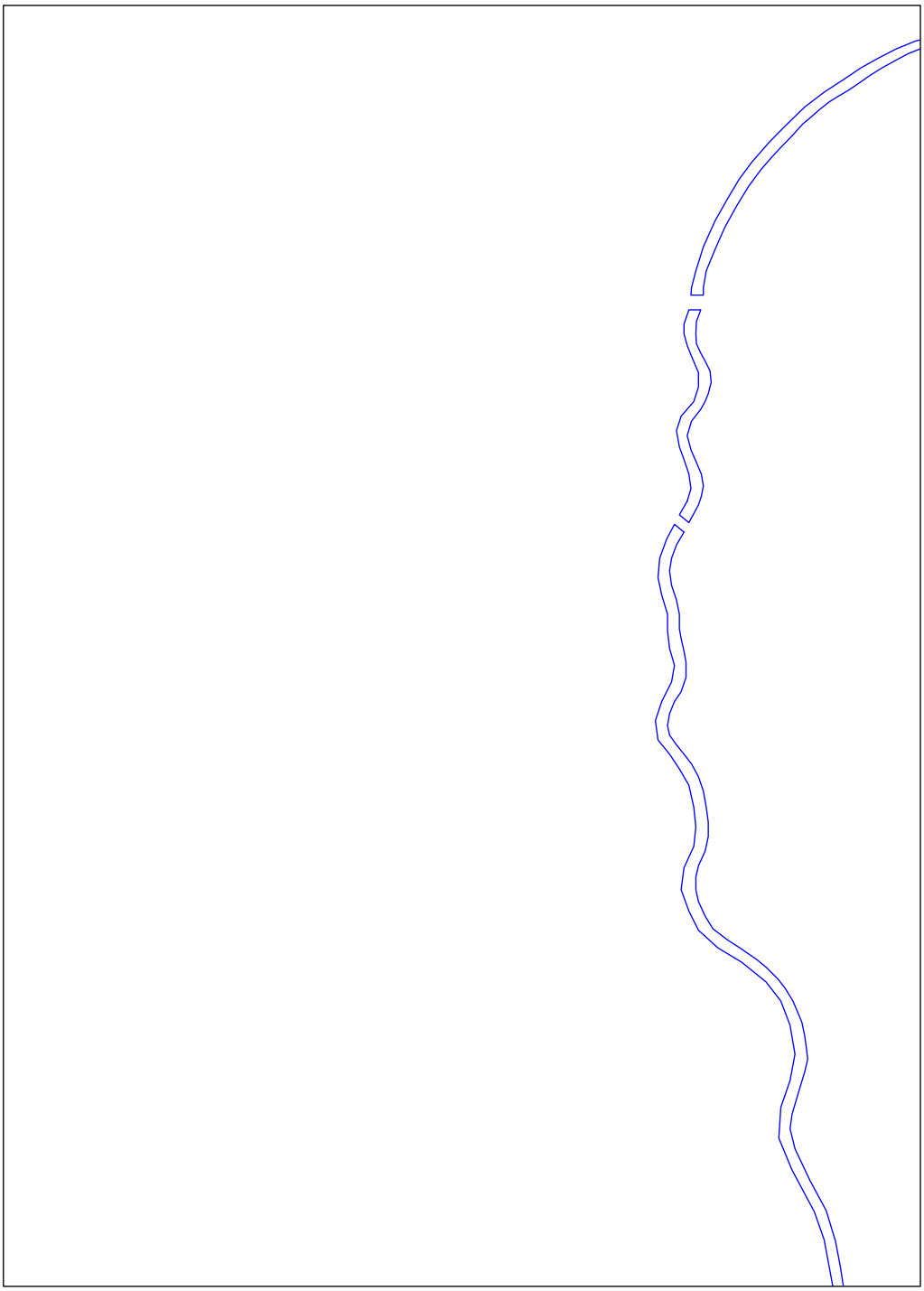
Level 3 Dotted Line Road Data

Niveau 3: Donnees de Route en lignes discontinues



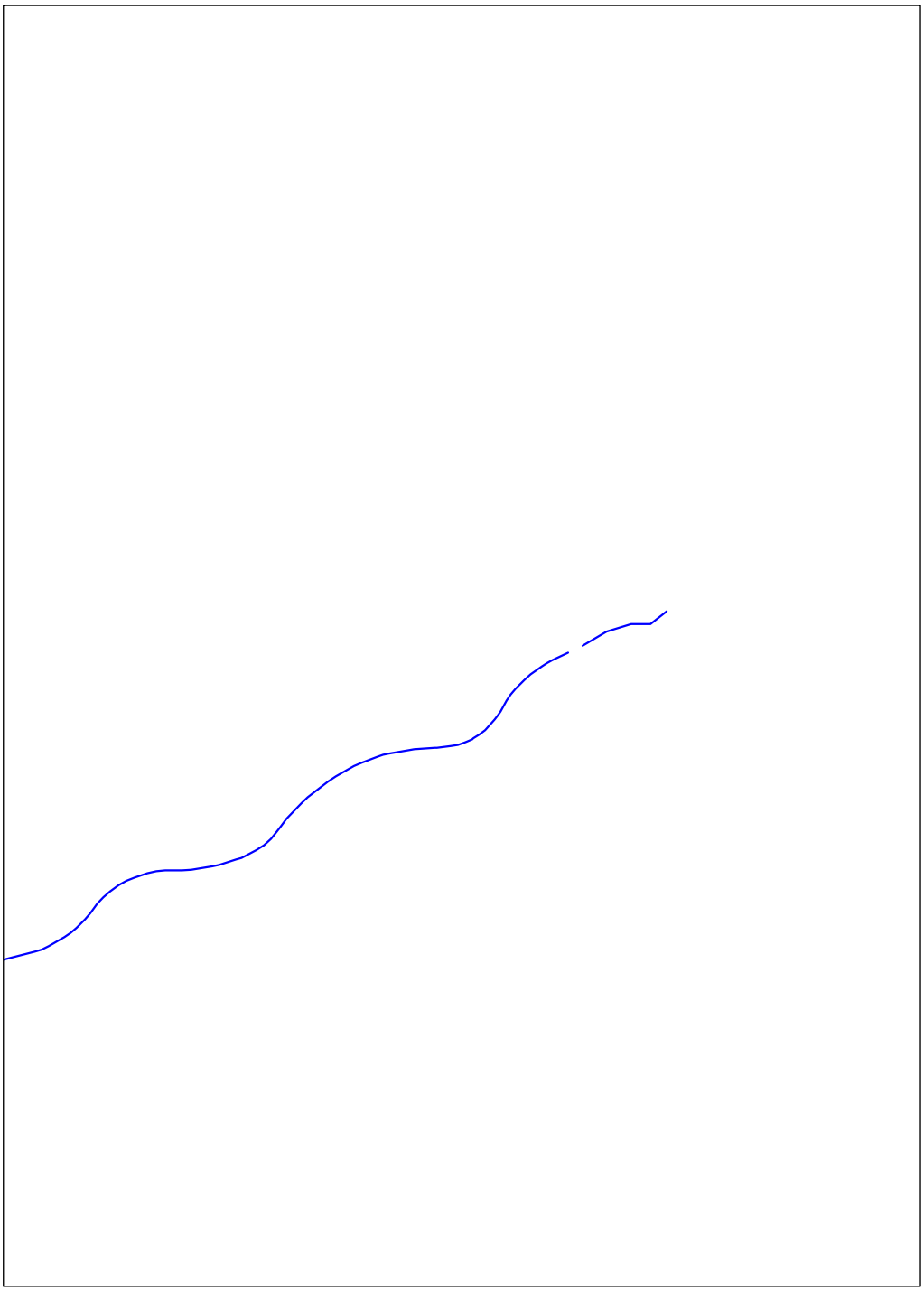
Level 4 Double Line River Data

Niveau 4: Donnees de Riviere a double ligne



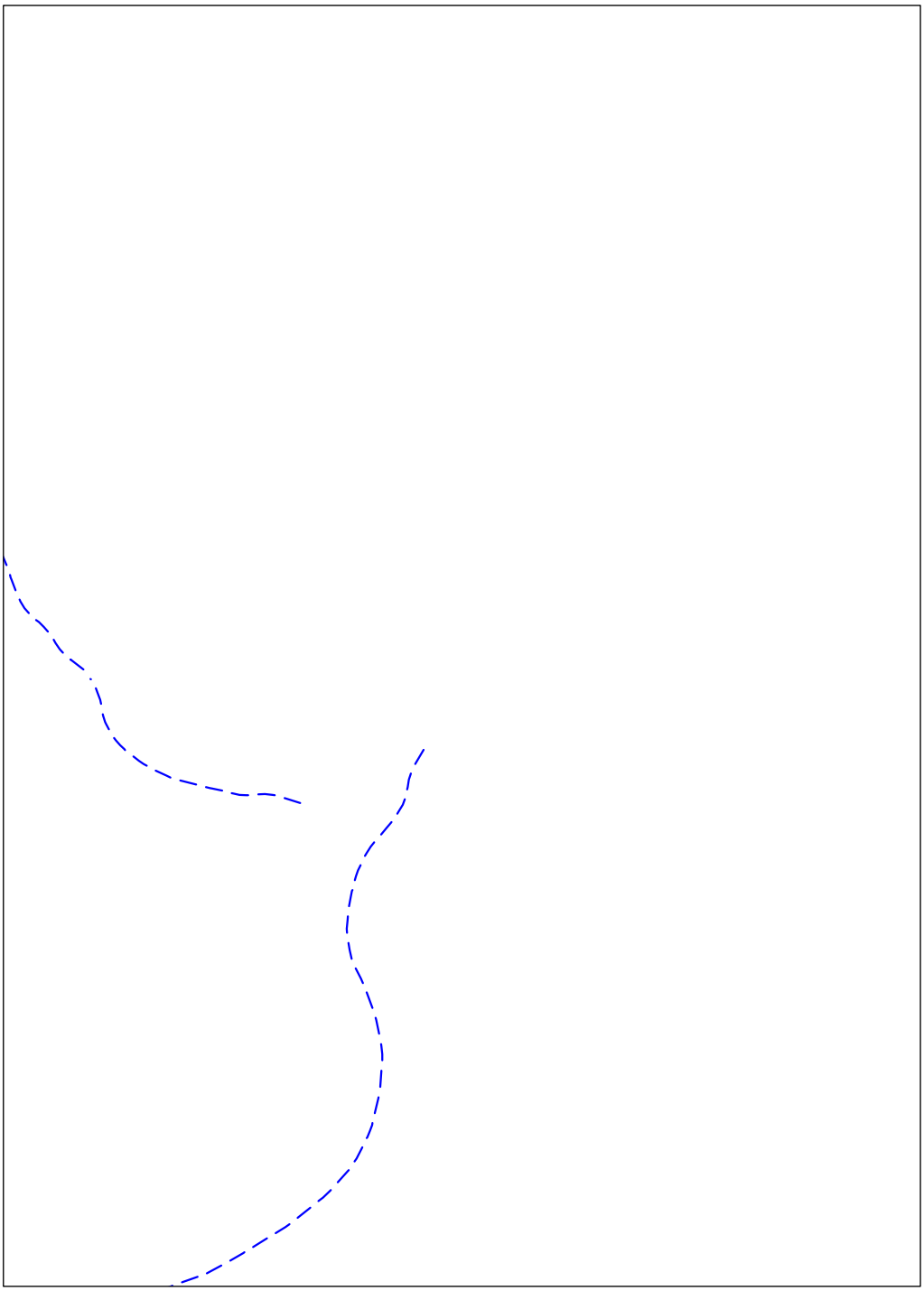
Level 5 Single Line River Data

Niveau 5: Donnees de Riviere a une Ligne



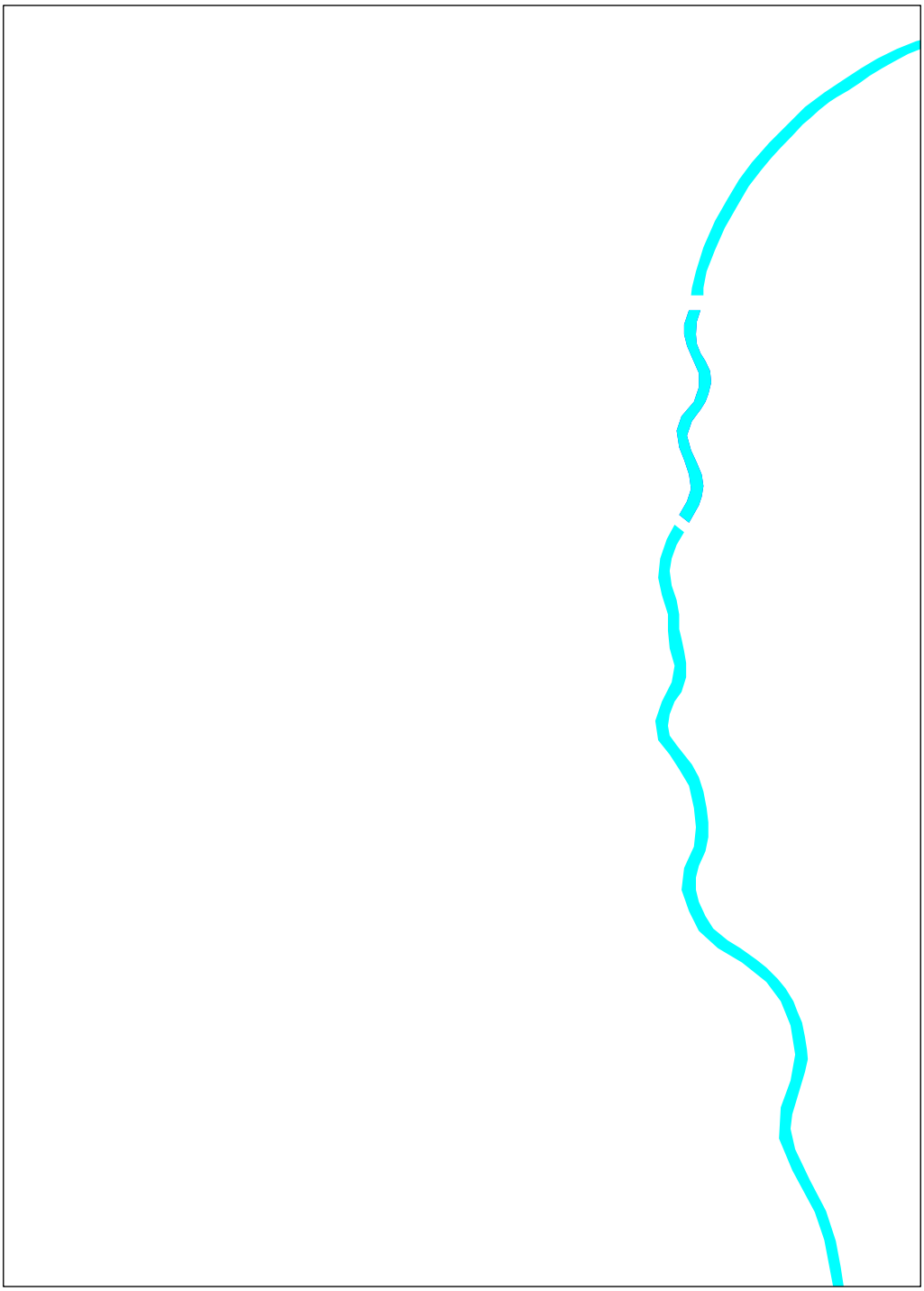
Level 6 Dotted Line River Data

Niveau 6: Donnees de Riviere en Ligne discontinue



Level 7 Fill for Double Line River

Niveau7: Fond pour Riviere a double Ligne



Level 8 Patterning for River

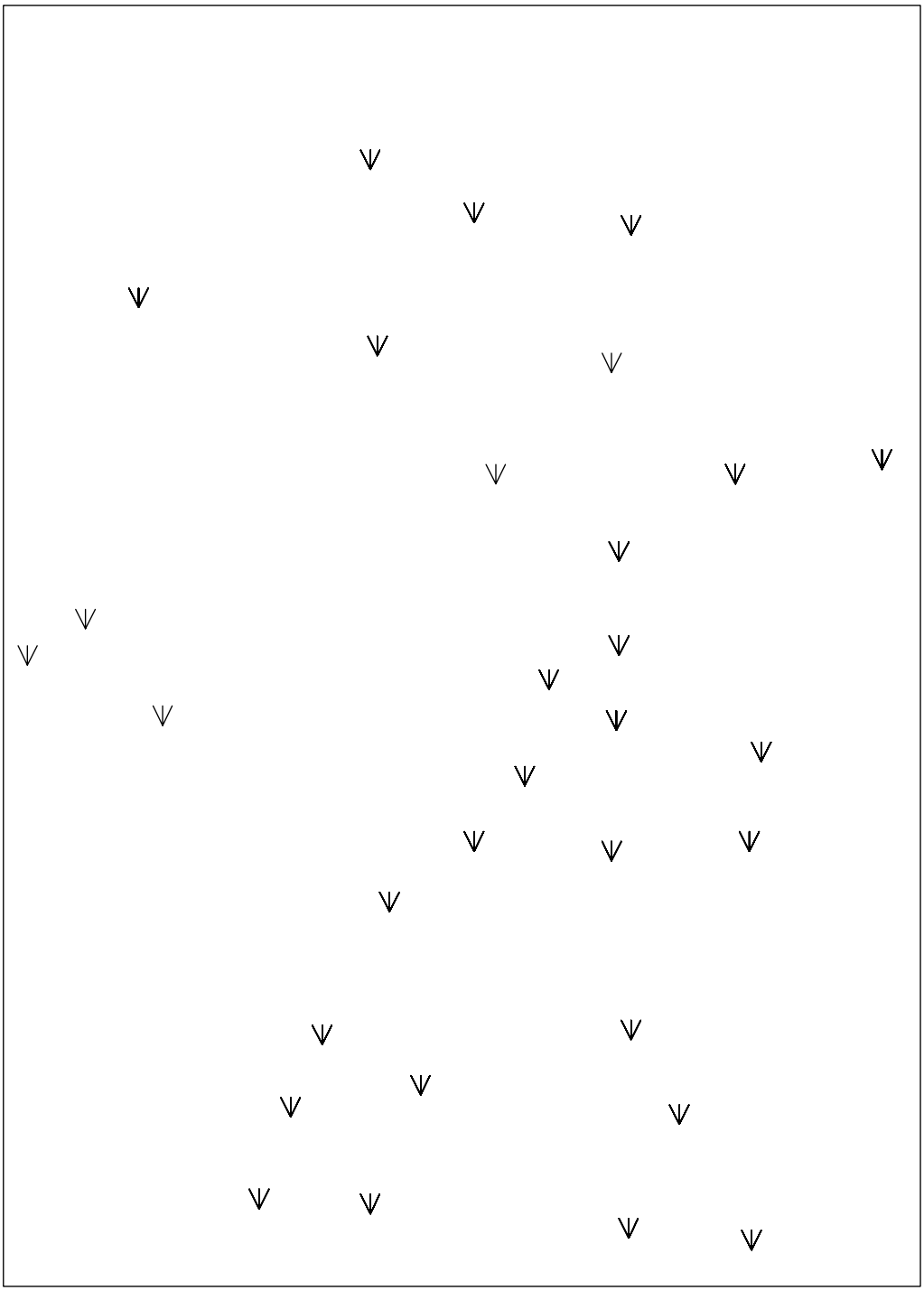
Niveau 8: Modele pour Riviere

Level 9 Vegetation Boundary Data

Niveau 9: Donnees de Limites de Vegetation

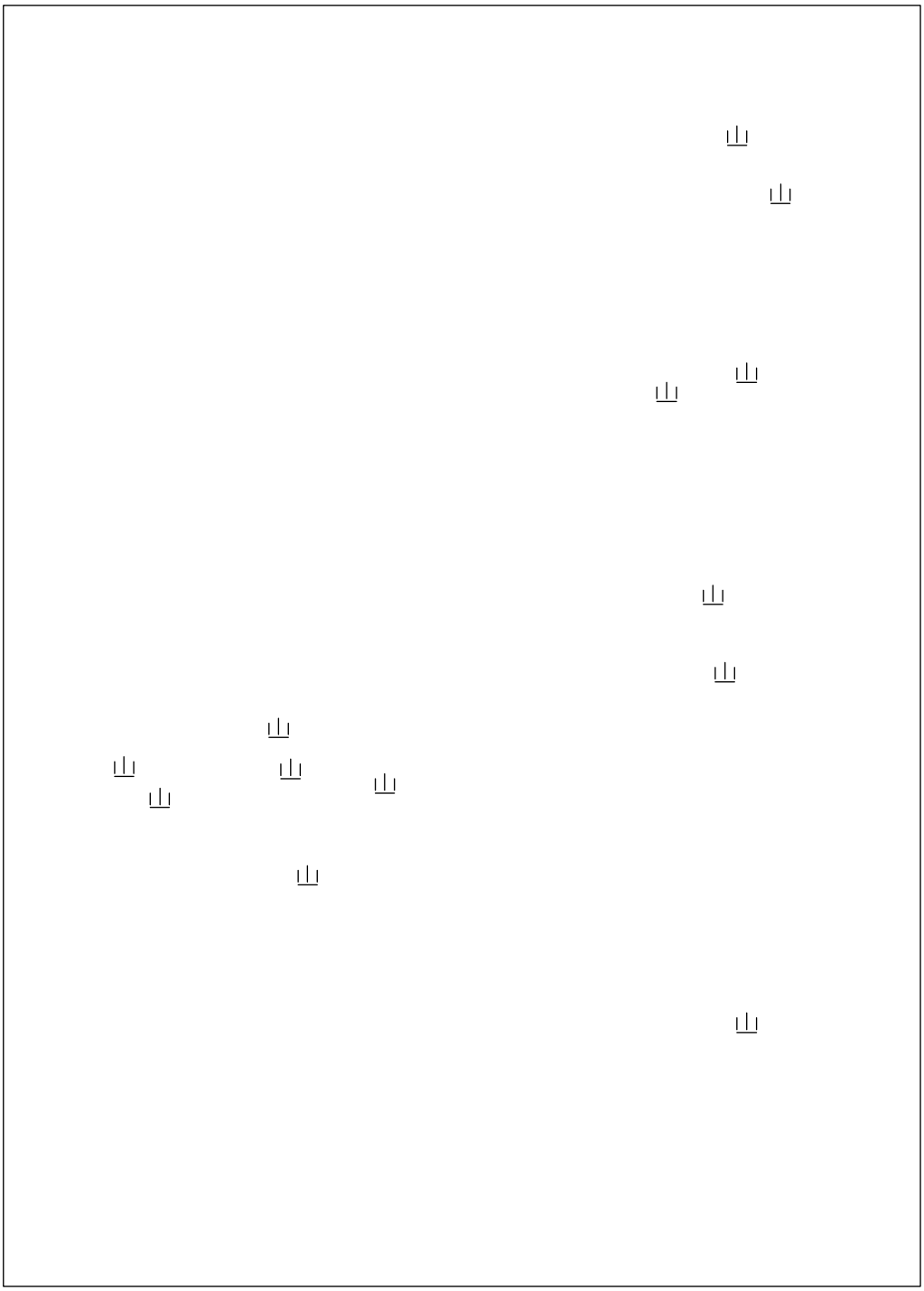
Level 10 Vegetation Symbol (Cultivation Land)

Niveau 10: Symboles de Vegetation (Terre de Culture)



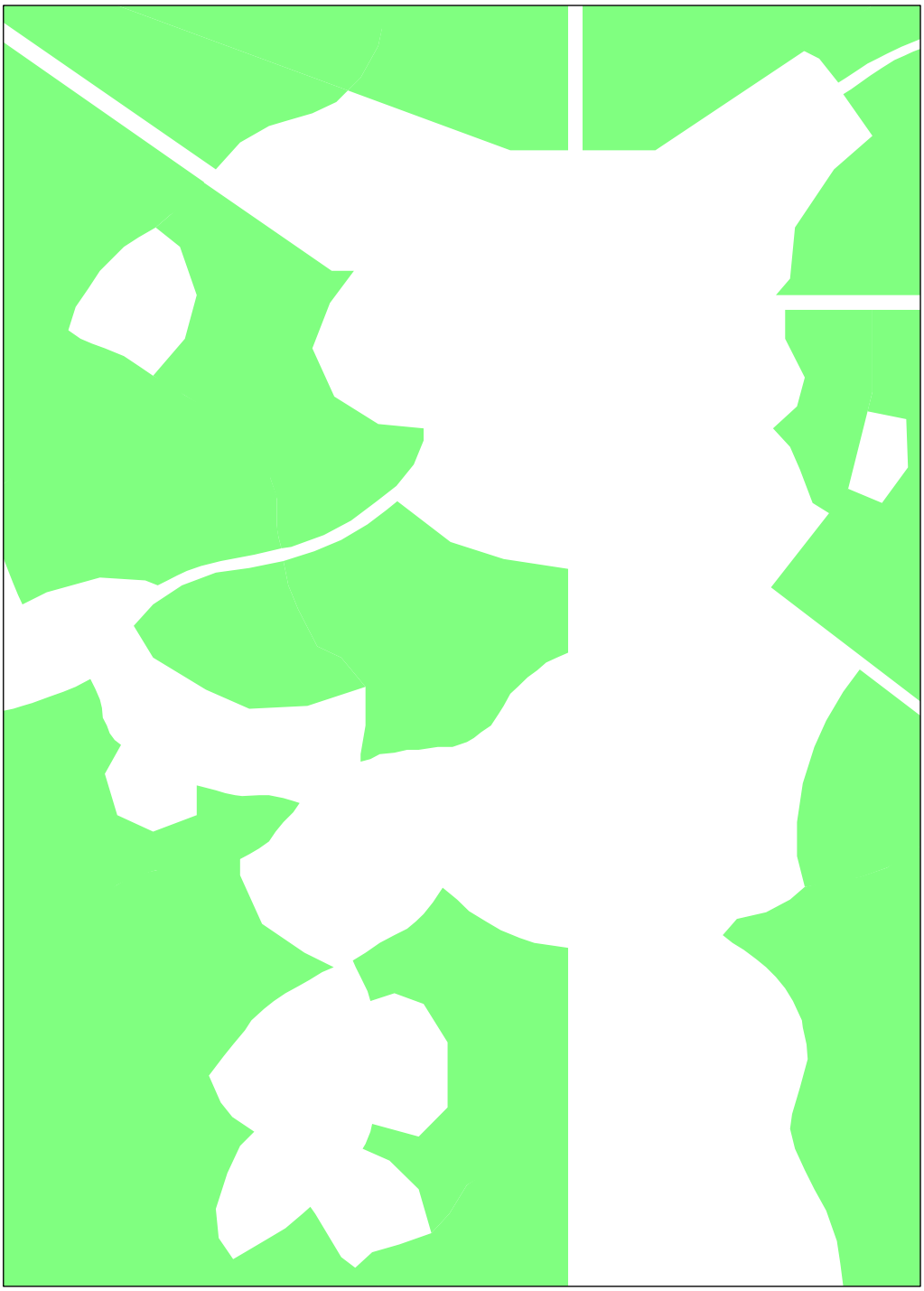
Level 11 Vegetation Symbol (Paddy Field)

Niveau 11: Symboles de Vegetation (Champs de Paddy)



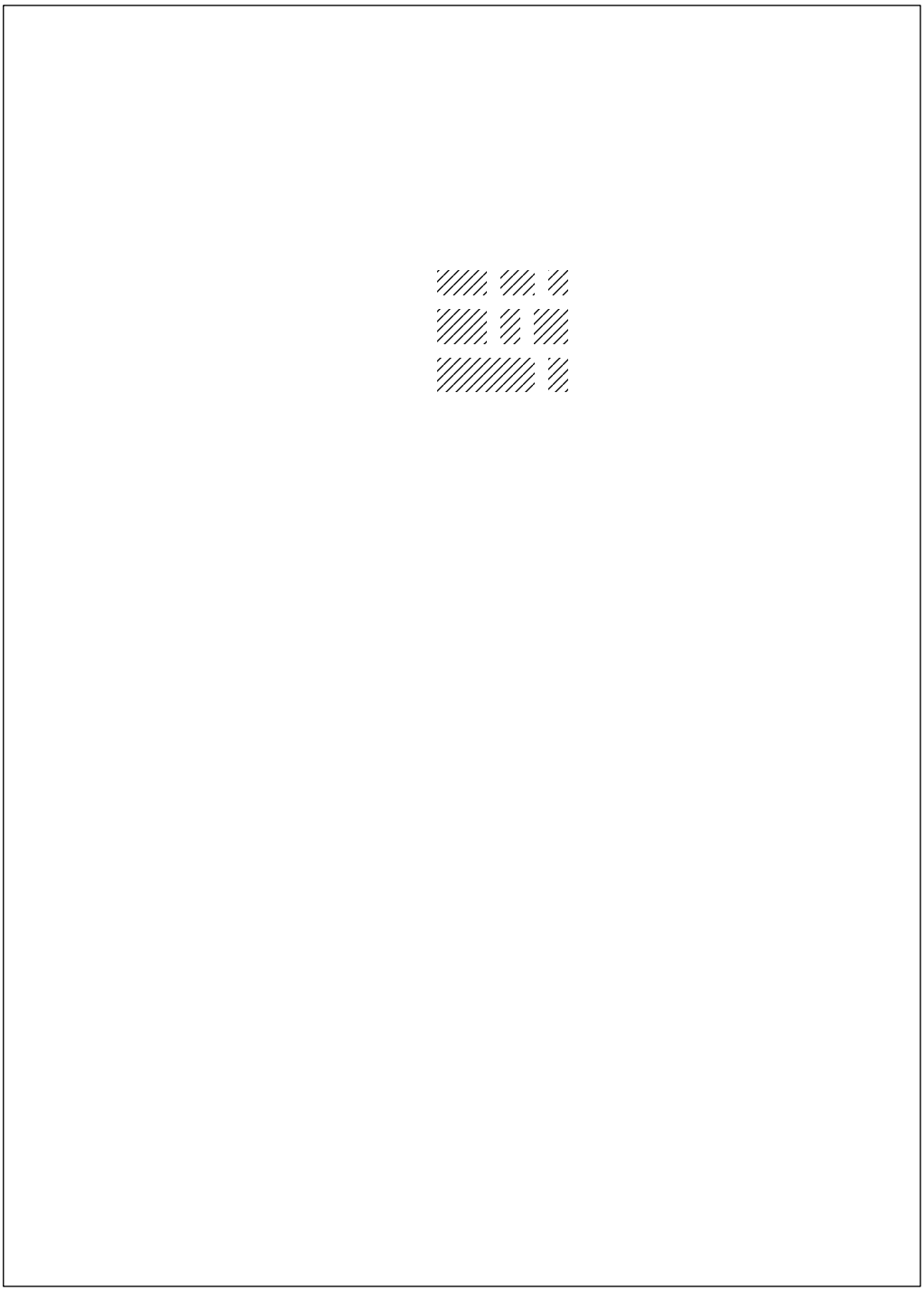
Level 12 Fill for Bush

Niveau 12: Fonds pour la Brousse



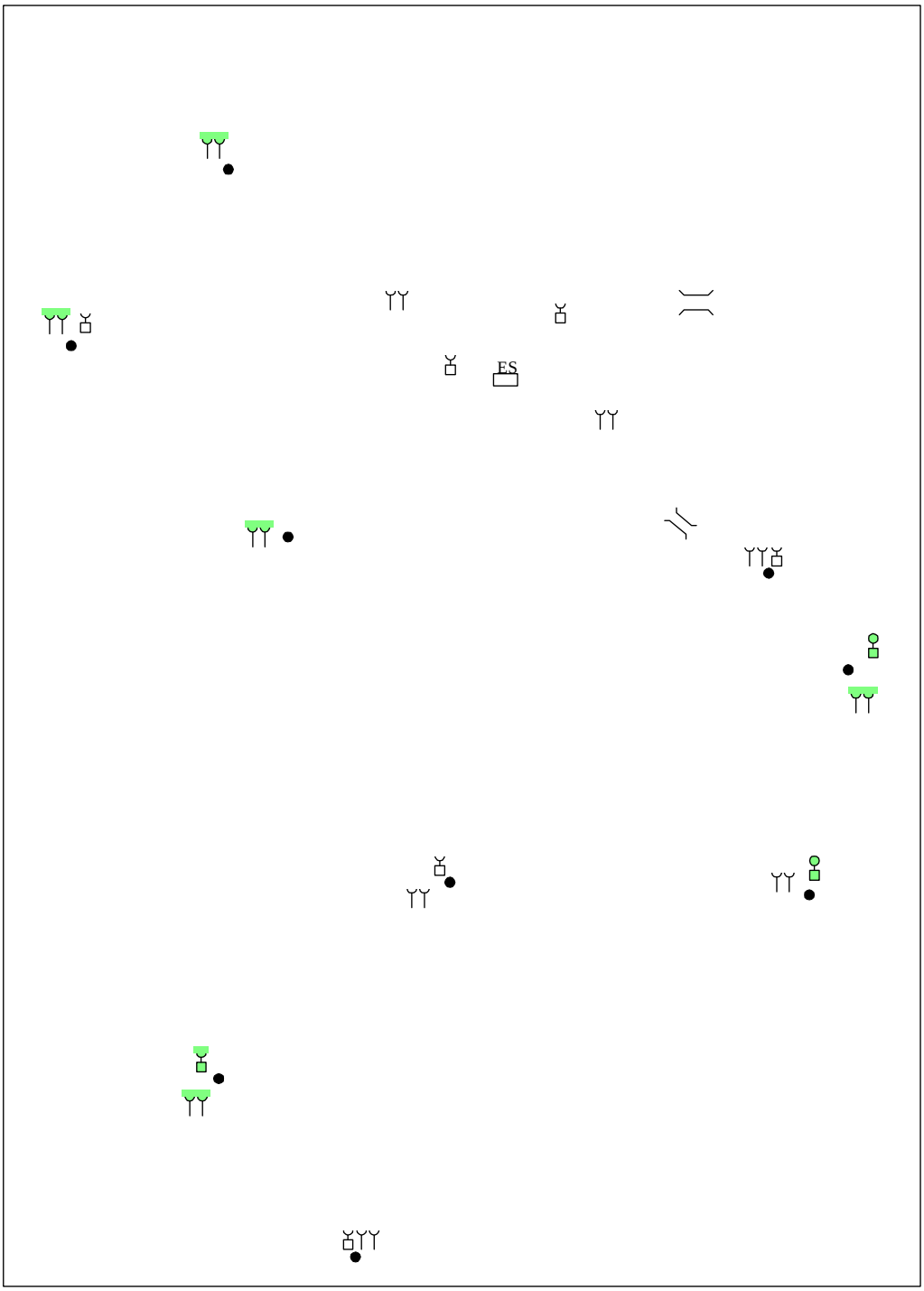
Level 13 Hatching for Town Area

Niveau 13: Hachures des Zones Urbaines



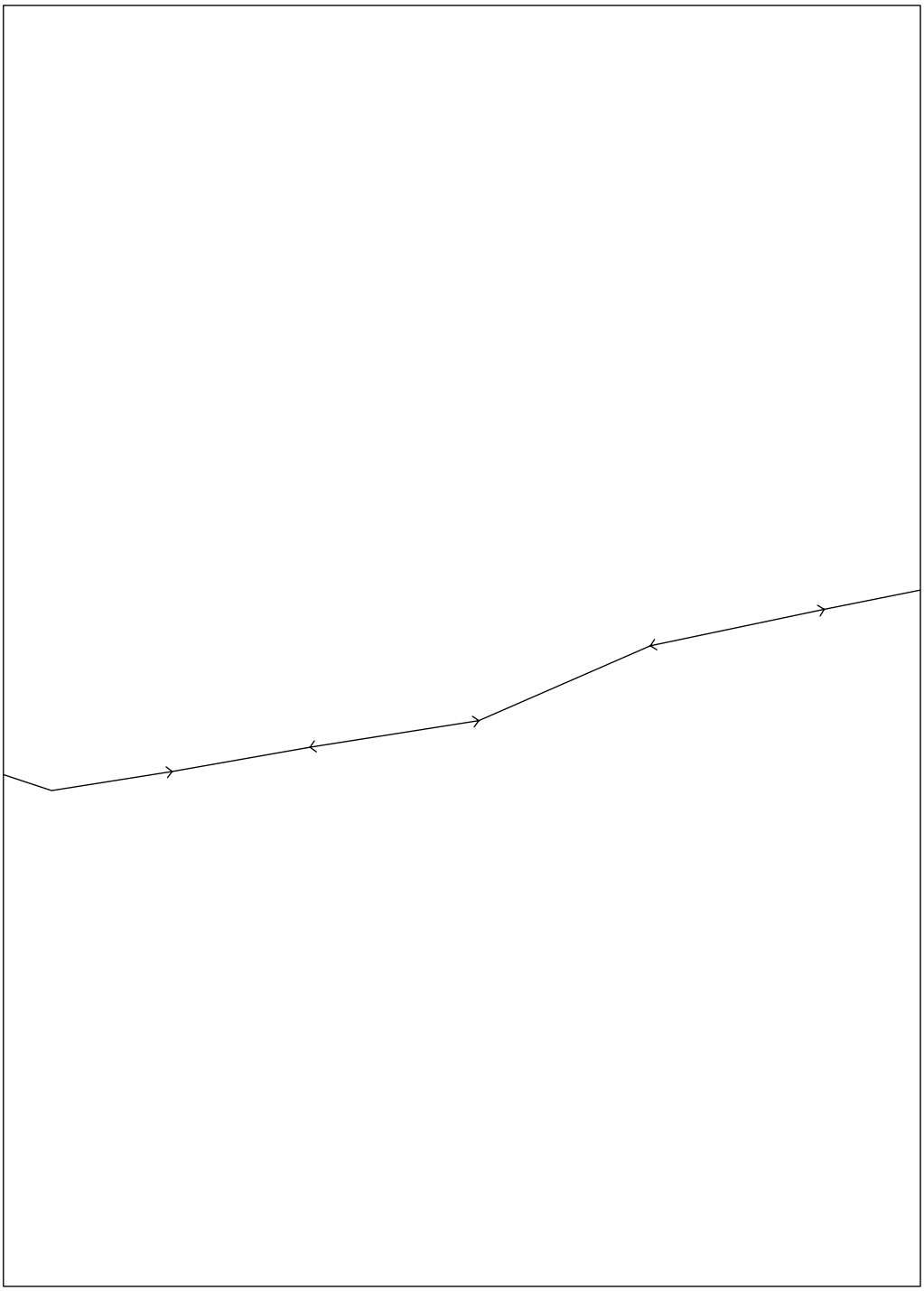
Level 14 Symbols

Niveau 14: Symboles



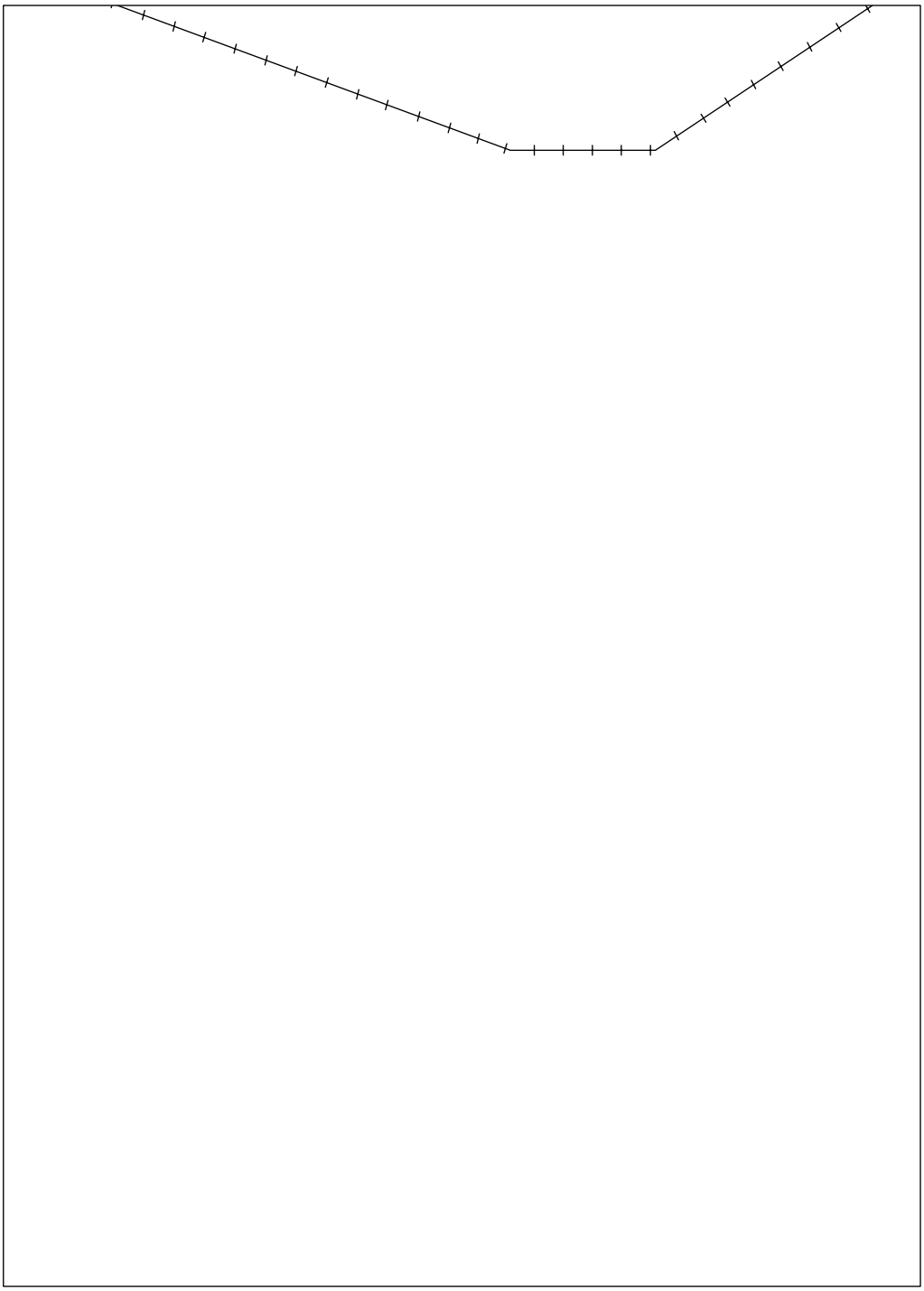
Level 15 Transmission Line

Niveau 15: Ligne de Transmission



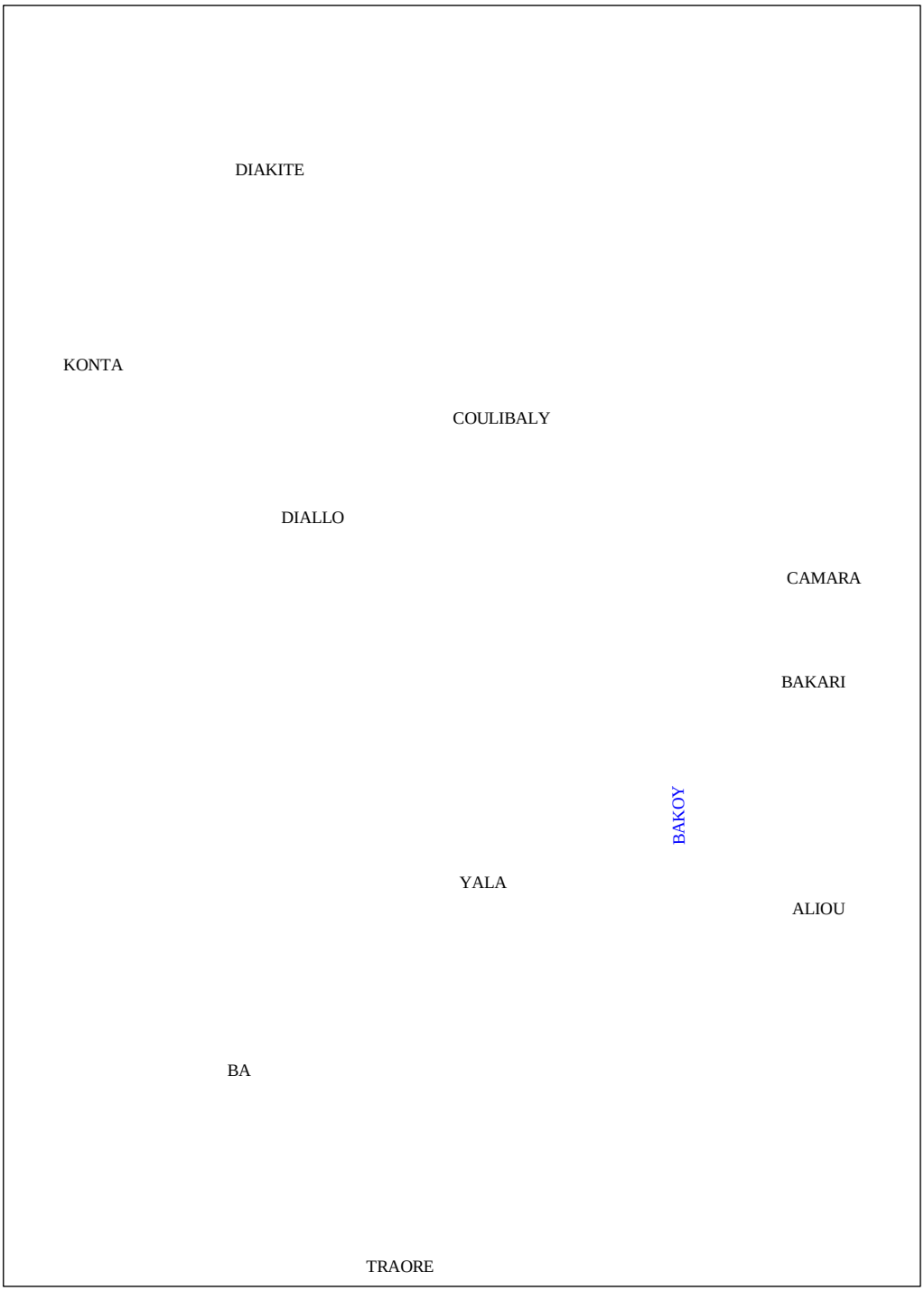
Level 16 Railway

Niveau16: Chemin de Fer



Level 17 Annotation

Niveau 17: Annotation



Level 18 Contour Line

Niveau 18: Courbes de Niveau

National Topographic Mapping of the Kita Area in the Republic of Mali (Fourth-Year Work)

Training Manual

July 2001

JICA Study Team

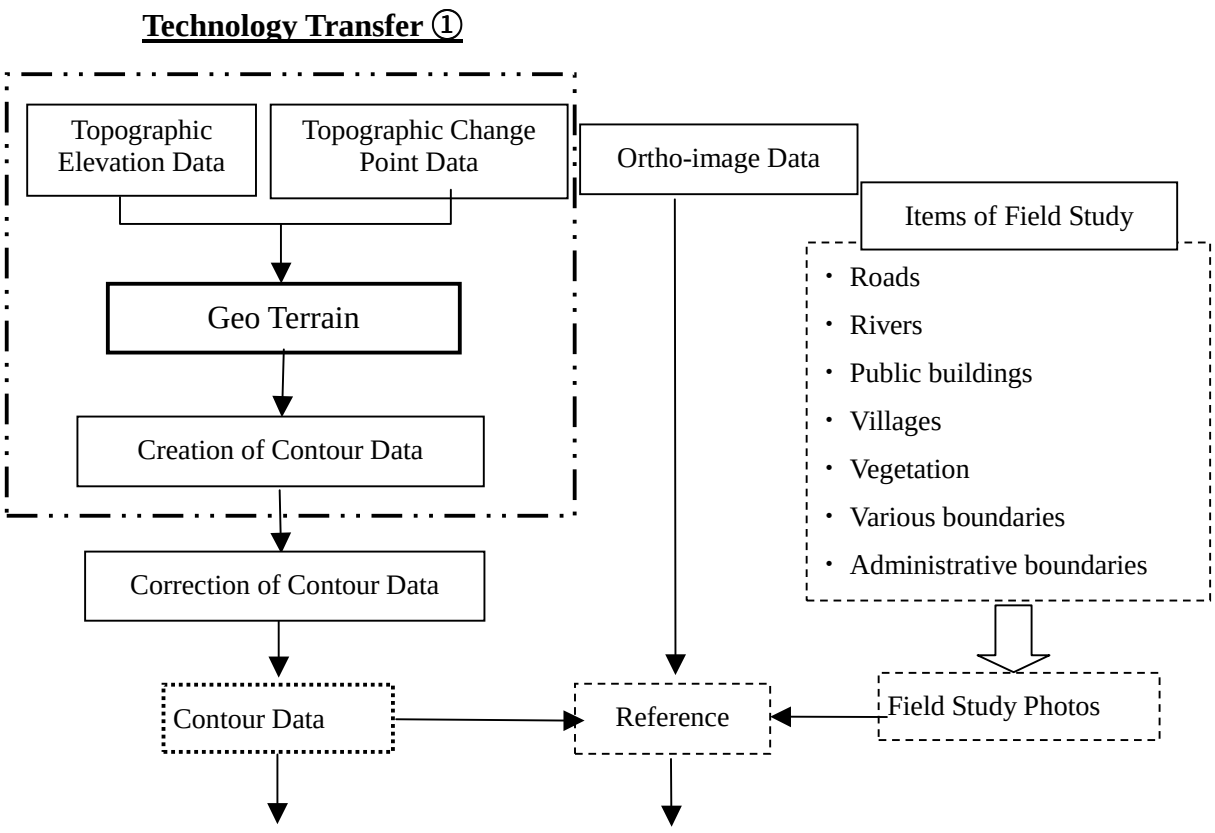
Work Flow

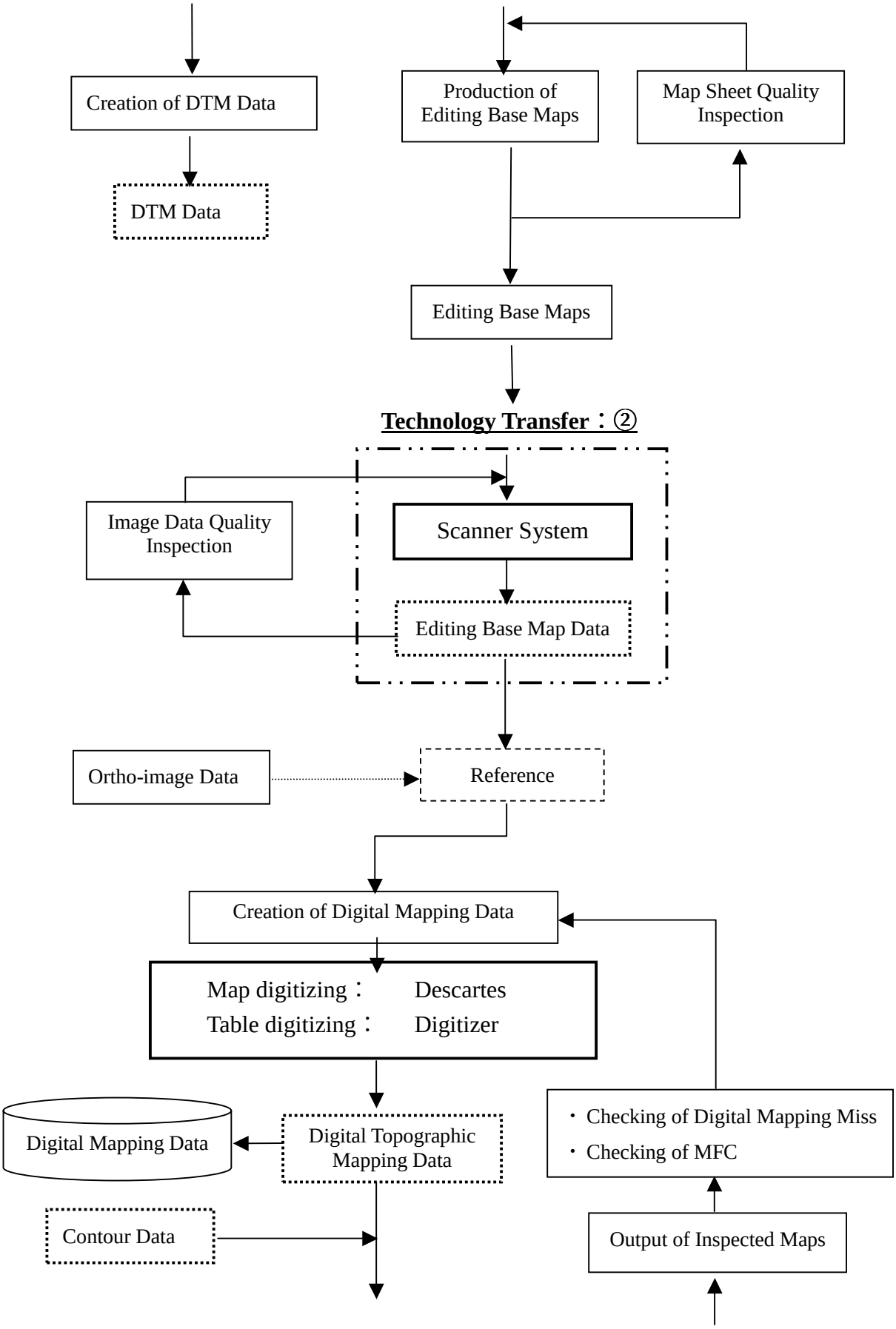
The technology transfer in this work will be implemented on the technologies of the digital mapping and compilation processes that could not be transferred to the counterparts due to delay in introduction of the equipment and materials at the time of technology transfer in the third year and on the technology of operation of the peripheral equipment therefore.

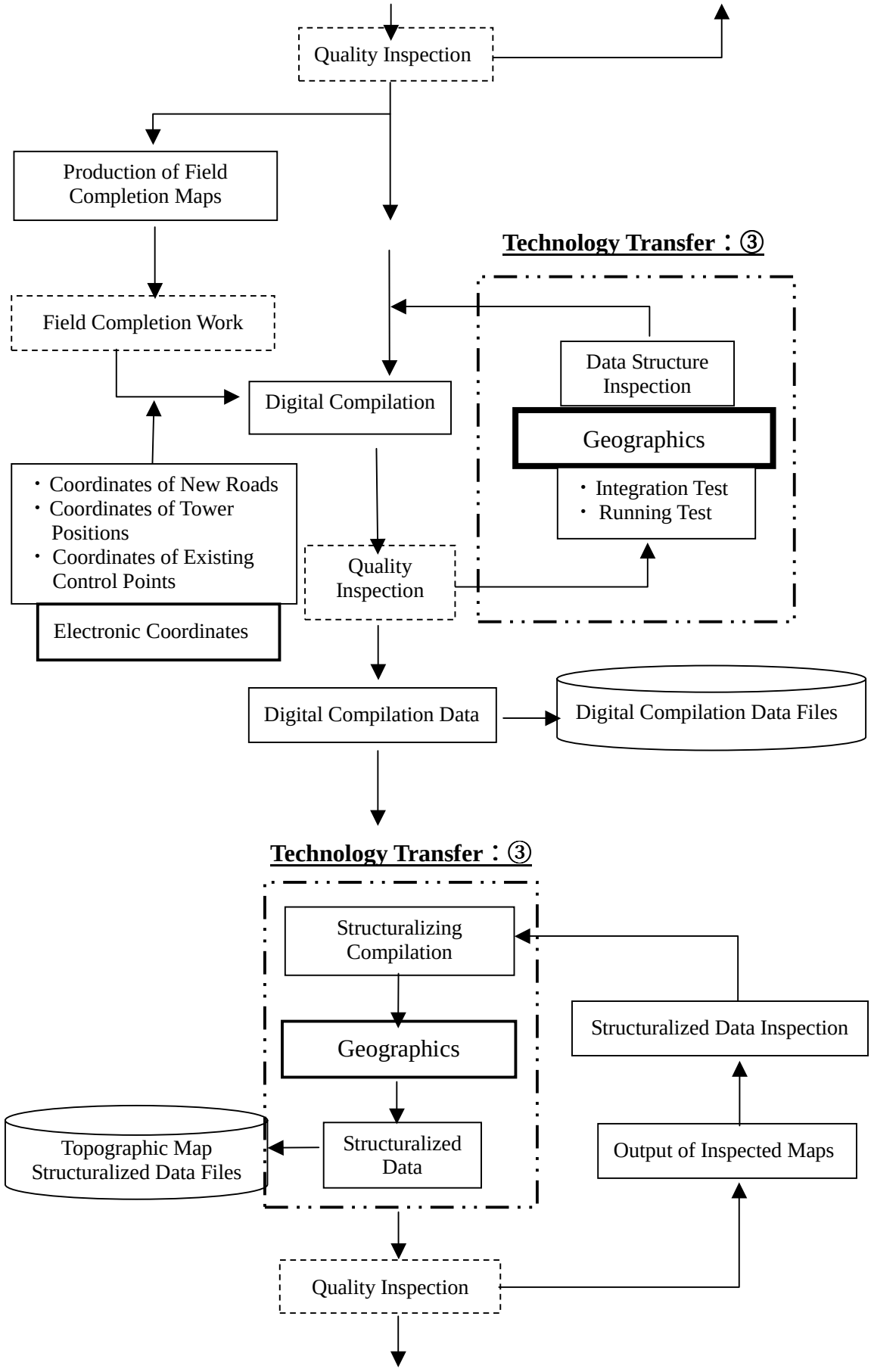
The technology transfer in the fourth year will be made using digital data of two map sheets (mapping sheet indexes of 22 and 23). The outline of the technology transfer work for the fourth year will be described below in accordance with the work flow chart of digital mapping and compilation for the National Topographic Mapping of the Kita Area in the Republic of Mali.

1. Work Flow of National Topographic Mapping of the Kita Area in the Republic of Mali

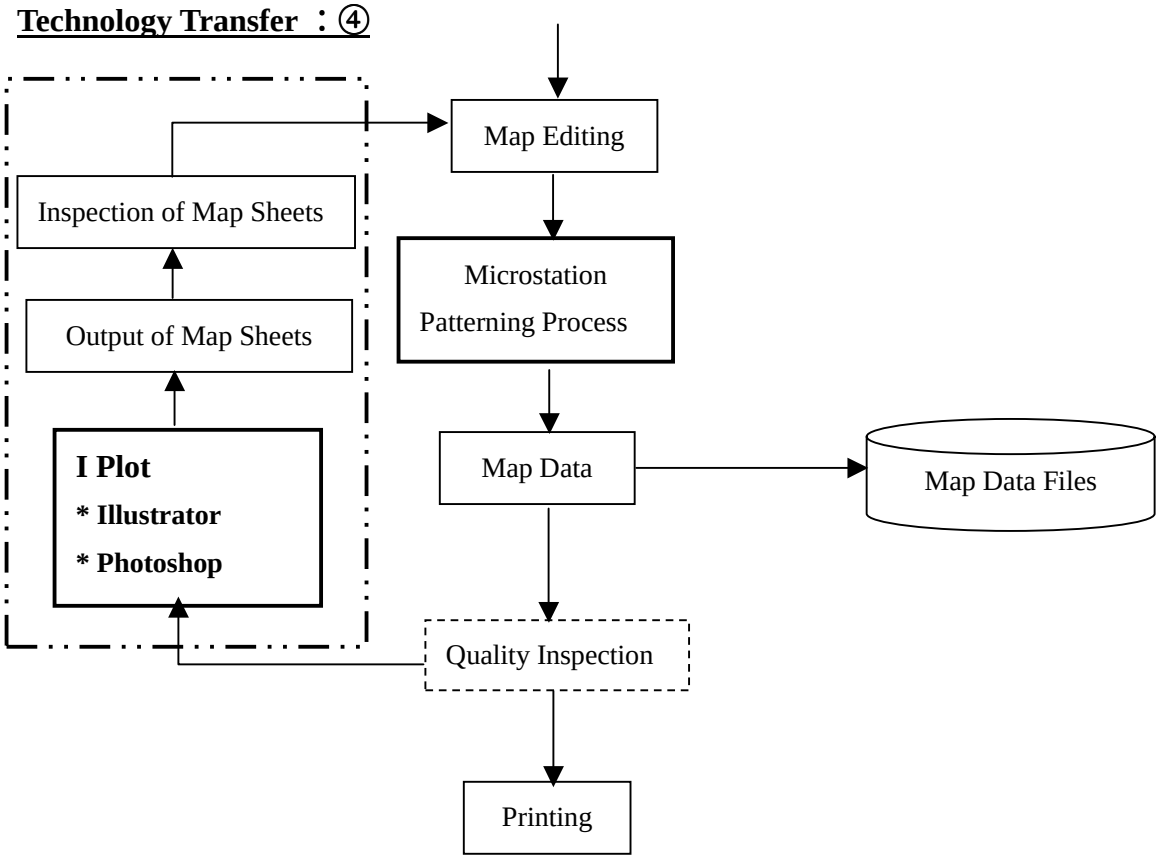
The education plan in the technology transfer in this work will be practiced on the process shown by




Creation of DTM Data
DTM Data
Production of Editing Base Maps
Map Sheet Quality Inspection
Editing Base Maps
Technology Transfer：②
Image Data Quality Inspection
Scanner System
Editing Base Map Data
Ortho-image Data
Reference
Creation of Digital Mapping Data
Map digitizing： Descartes
Table digitizing： Digitizer
Digital Mapping Data
Digital Topographic Mapping Data
Contour Data
・Checking of Digital Mapping Miss
・Checking of MFC
Output of Inspected Maps


Quality Inspection
Production of Field Completion Maps
Technology Transfer：③
Field Completion Work
Data Structure Inspection
Geographics
・Integration Test
・Running Test
Digital Compilation
・Coordinates of New Roads
・Coordinates of Tower Positions
・Coordinates of Existing Control Points
Electronic Coordinates
Quality Inspection
Digital Compilation Data
Digital Compilation Data Files
Technology Transfer：③
Structuralizing Compilation
Geographics
Structuralized Data Inspection
Topographic Map Structuralized Data Files
Structuralized Data
Output of Inspected Maps
Quality Inspection

Technology Transfer ：④



Technology Transfer ① (Entry of Digital Data and Creation of Contour Data)

The topographic elevation data created in the third-year work in Japan will be used to deploy the contour data and single elevation points. When creating contour data, the method of creating contour data taking into account the special topographic data such as cliffs (natural terrain) will be explained. In addition, the processing method to be used in adding the survey results of the existing ground control data (such as astronomical points, parallel points and bench marks) will also be explained.

Technology Transfer ② (Creation of Editing Base Map Data)

The technology transfer will be conducted by the following methods: The editing base maps that have been created will be read out with a monochrome scanner (analog/digital) to make analog-to-digital conversion to ensure the basic data storage for digital mapping. The existing cadastral maps and aerial photos will also be scanned similarly for A/D data conversion and the image data will be stored.

Technology Transfer ③(Digital Data Quality Inspection and Creation of Structuralized Data)

In this technology transfer, the method of checking whether the digital data in digital compilation is logically correct or not is explained using the topographic data displayed on the Microstation. In addition, polygon data such as two-line rivers, two-line roads and vegetation ranges will be created using the Microstation. In the digital data quality inspection, the methods of checking the digital data continuity and connection conditions and the adjoining conditions of the map sheets will be instructed in taking into account the use of GIS database.

Technology Transfer ④ (Output of Digital Data)

The method of creating the plot tables using the map data files that have been created will be instructed. The map data files will be converted into the plotter output image files on the Microstation, to which the image data of the existing maps will be pasted as background data in order to ensure both map data and background data to be outputted simultaneously.