BEST PRACTICE GUIDELINE G2

WATER AND SALT BALANCES

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Role of Water & Salt Balances

- most important and fundamental tool for water management
- provides the info for defining & driving water management strategies
- auditing and assessment of water systems
- assist with design of storage systems
- use as management tool - simulation and evaluation of alternative strategies

Objectives of BPG G2

- present a practical procedure to develop balances
- define what should be contained in balances
- give guidance on required level of detail
- define best practice for design, implementation and management of a water and salt balance
- provide assessment of tools that can be used
- provide a practical worked example of a water and salt balance

General Principles of Water and Salt Balances

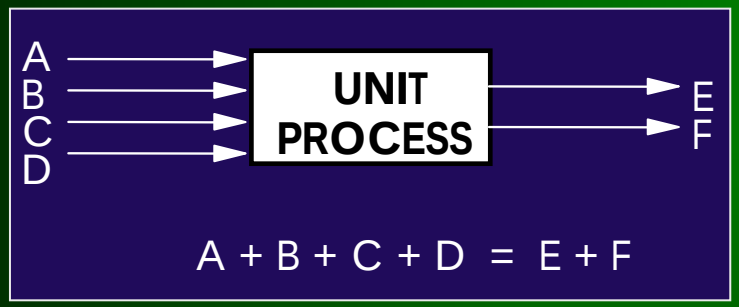
PROCEDURAL ASPECTS

- clear objectives must be defined
- large complex mines should be divided into smaller manageable units
- delegate responsibilities to smaller units but retain overall co-ordination function
- resolution of 1 - 5 %; accuracy of 85 - 90 %
- develop and use uniform formats & procedures
- regular updating of circuit and data
- must be flexible enough for changes

General Principles of Water and Salt Balances

TECHNICAL ASPECTS

- Basic principle of conservation of mass



- Use of conservative salts such as Na and Cl to construct the balance before developing the balance for pollutants such as sulphate
- Do water and salt balances together to solve unknowns - save on monitoring costs
- Consider seasonal effects

PRACTICAL STEPS IN PRODUCING A WATER AND SALT BALANCE

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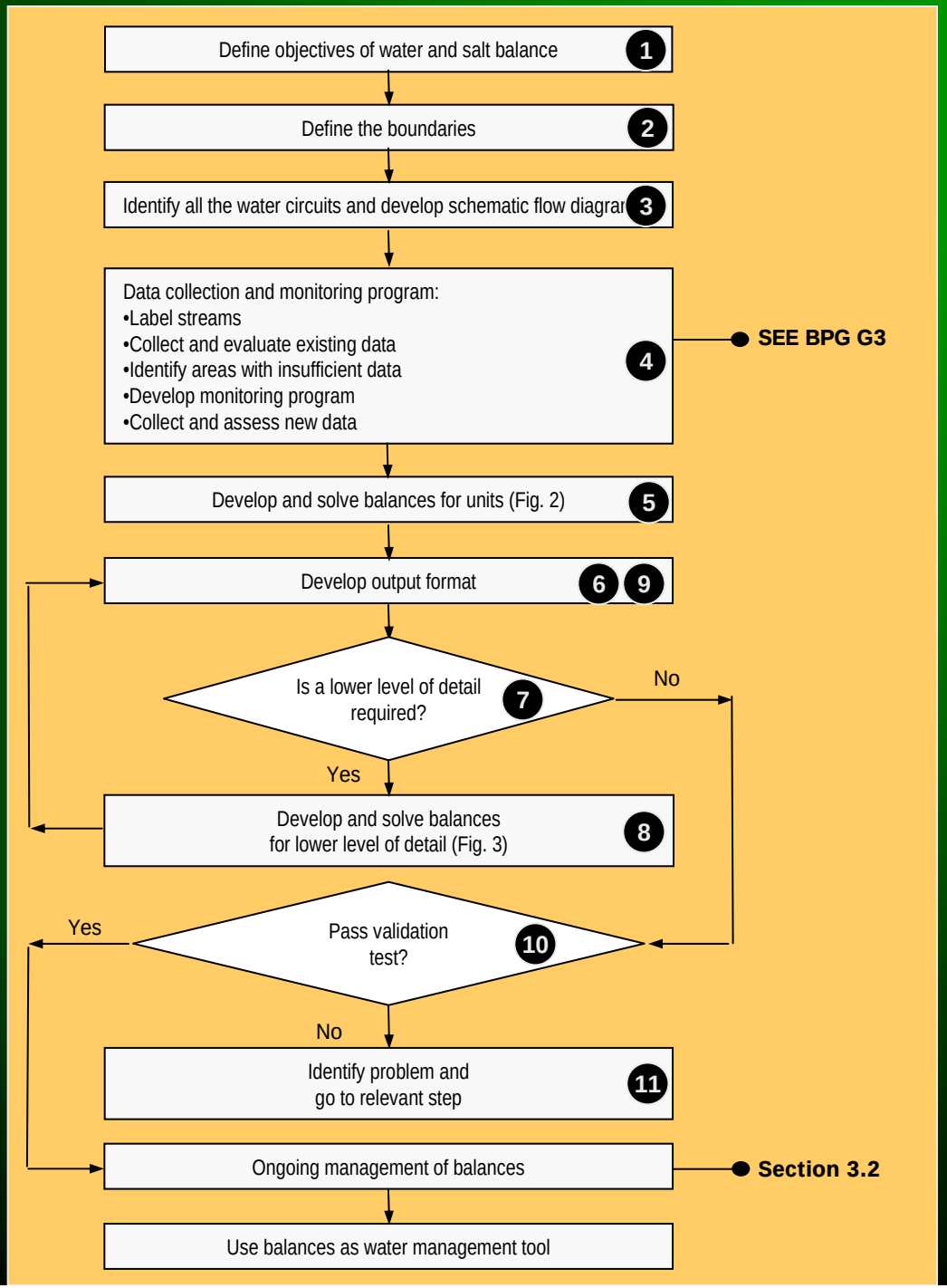

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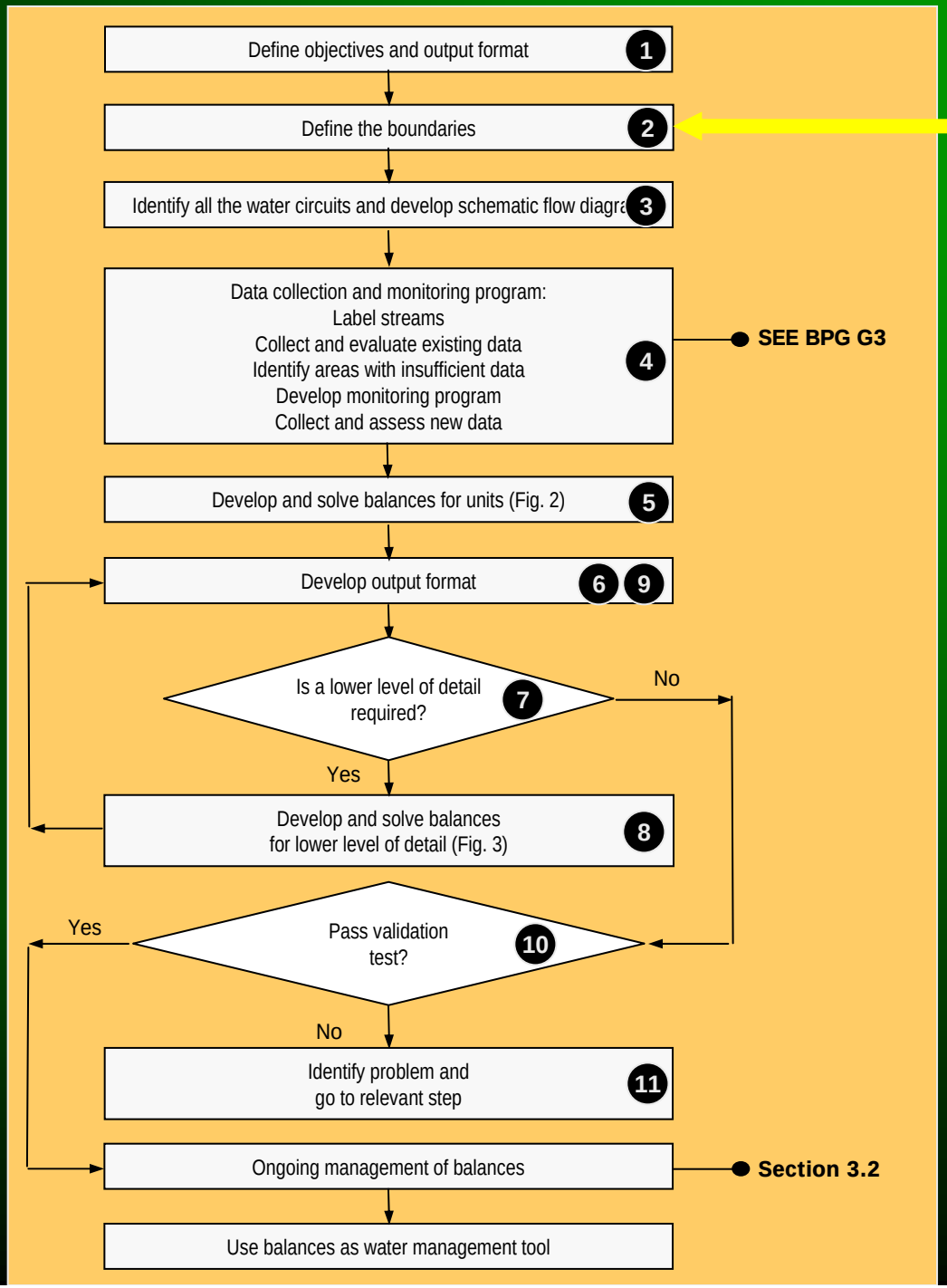
1. Define Objectives of Balance

- define the intended purpose of the balance, i.e. management tool or auditing function
- define area for which balances are to be developed
- who will use the information, e.g. management or authorities
- reassess objectives on a regular basis



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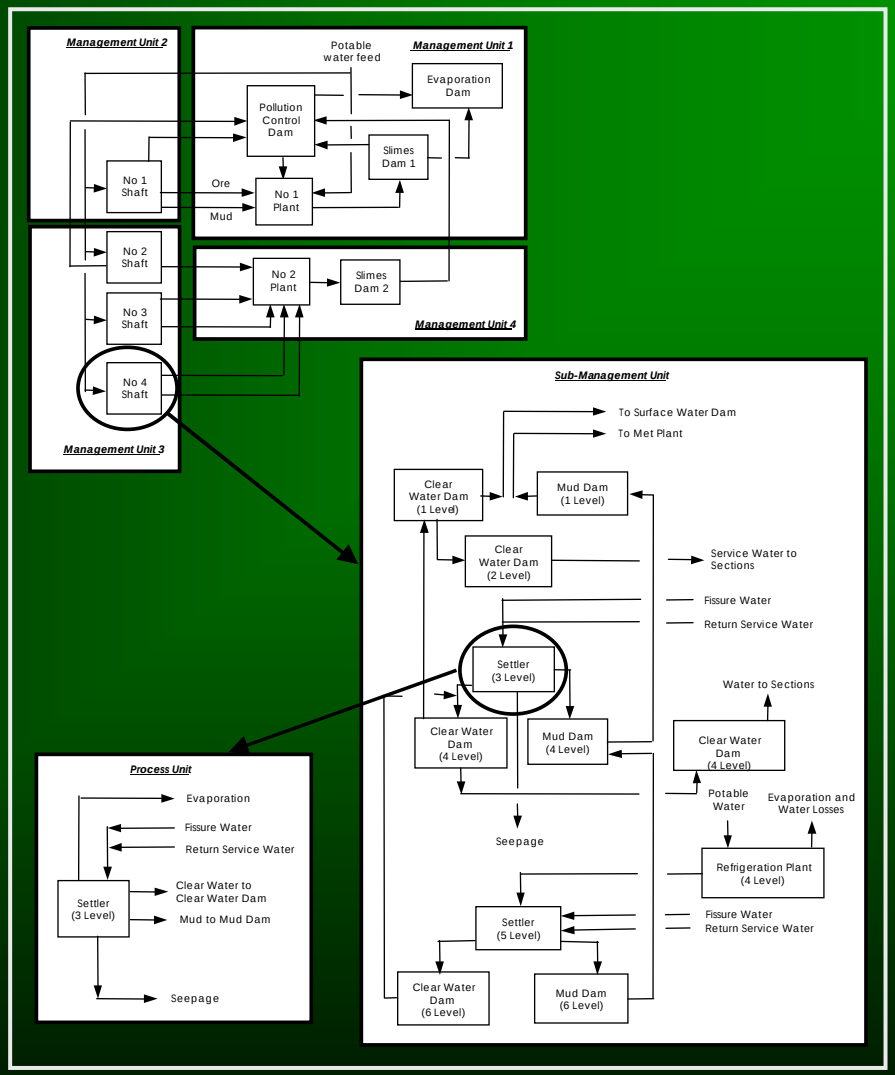
2. Define Boundaries of Balance

- generally defined on the basis of natural phenomena, e.g. catchment, topography, underground or surface
- required level of detail will also dictate boundaries
- beneficial to divide very large complex systems
- need to ensure that sub-sections can integrate properly

Subdivision of balance



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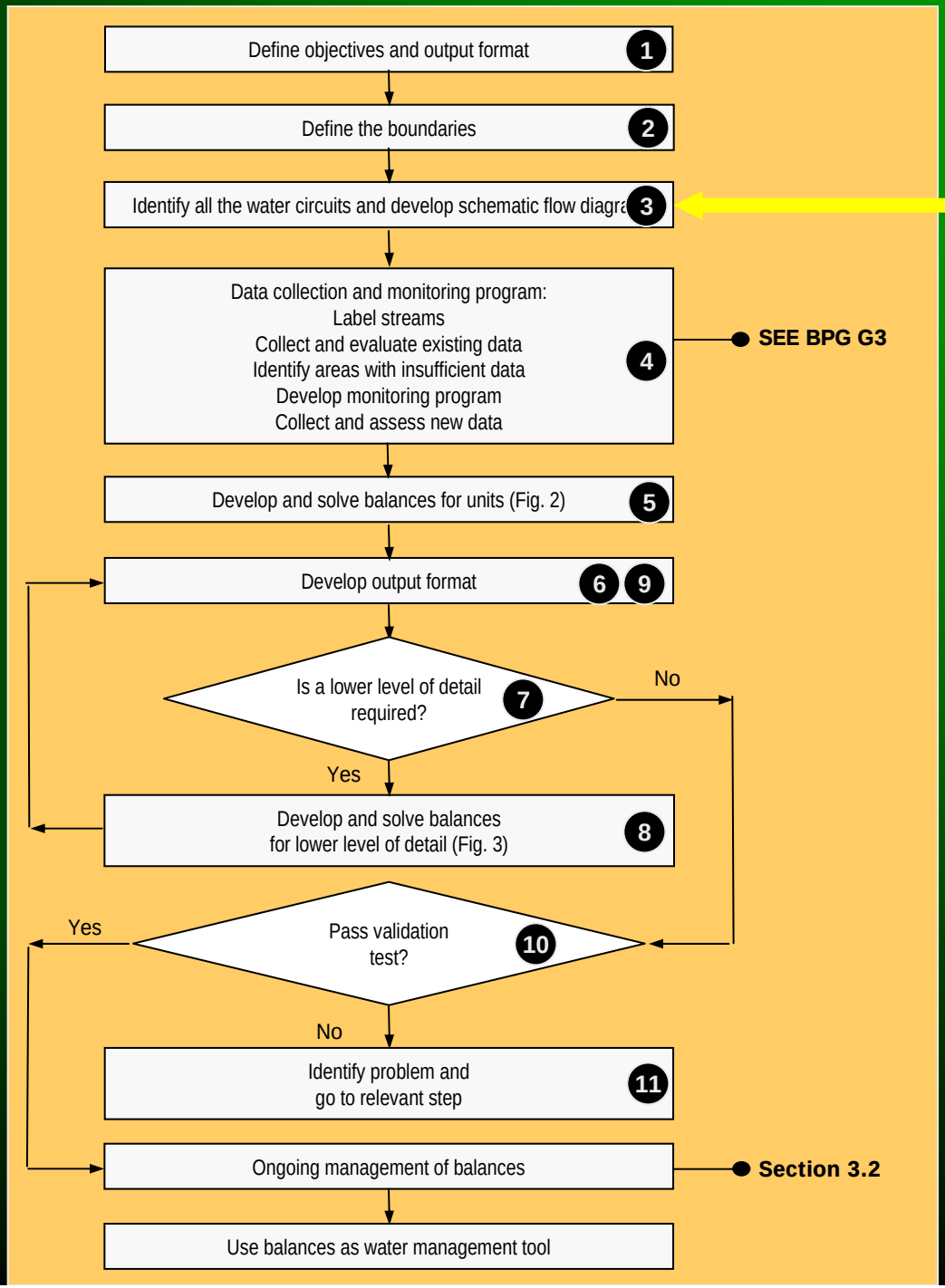

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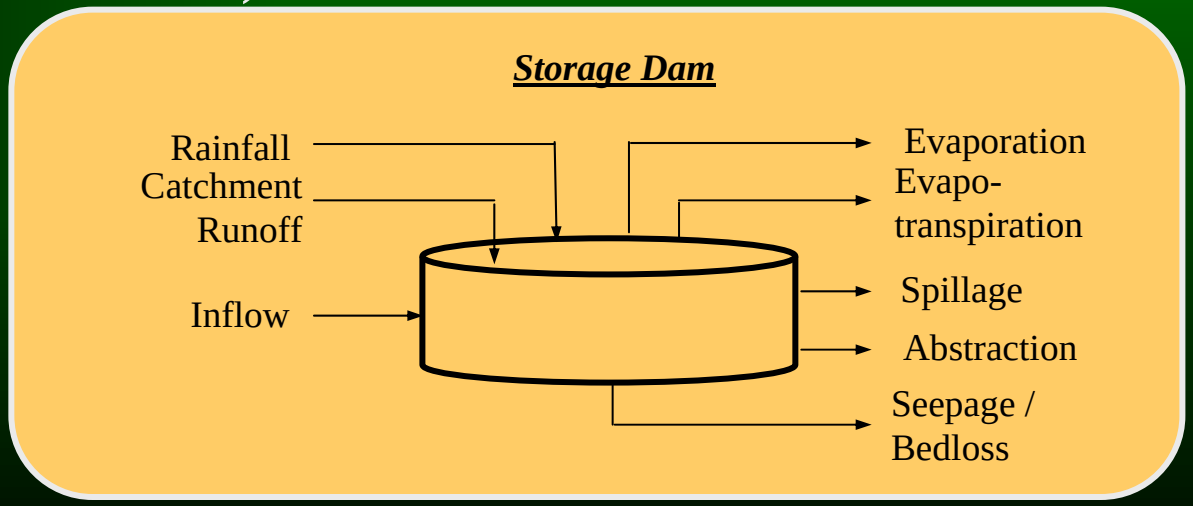
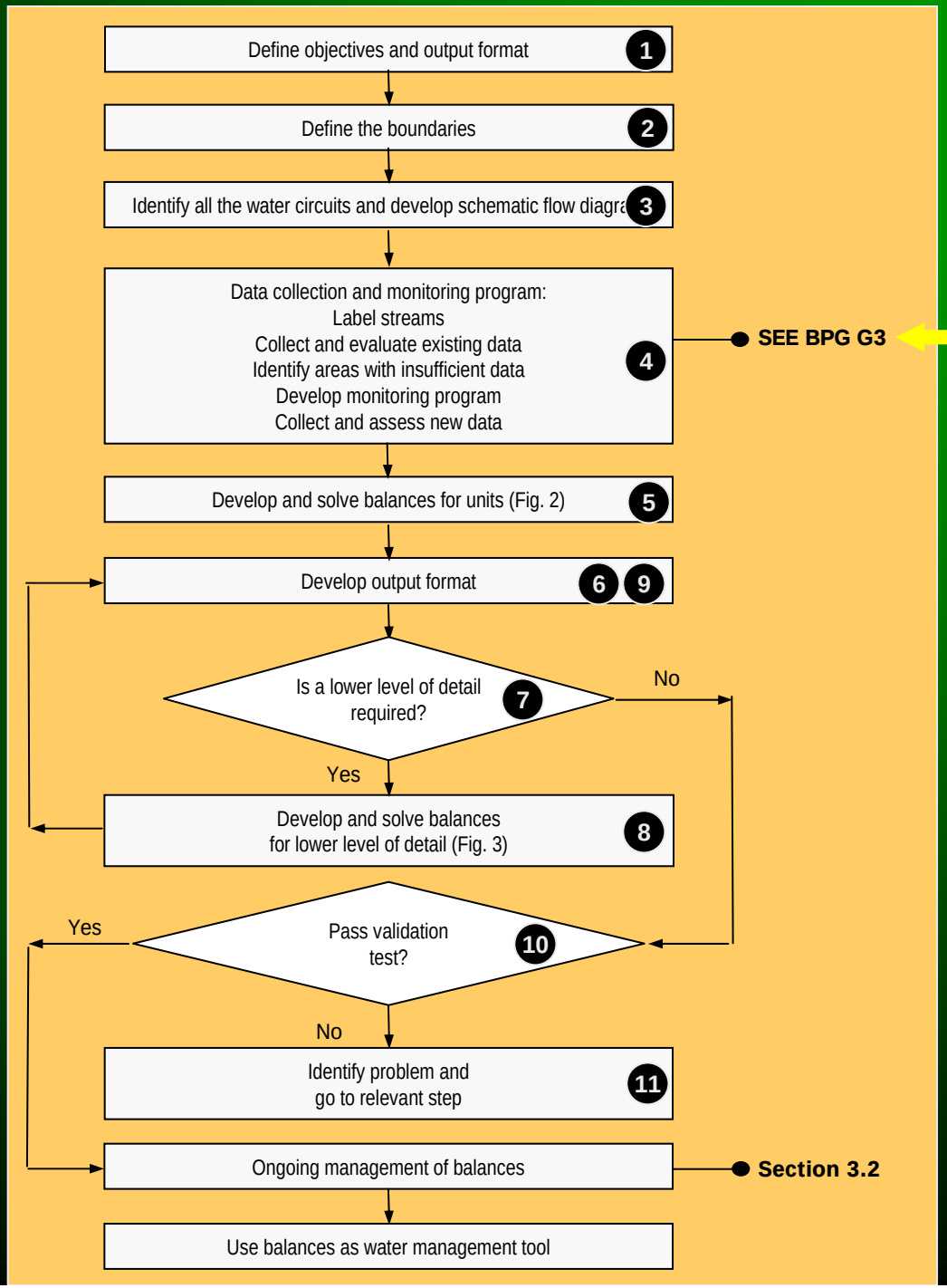
3. Develop Schematic Flow Diagram

- identify all process units and flow paths
- develop a schematic representation to indicate flow paths and monitoring points
- include natural flow paths such as rain, runoff, seepage, etc. (min level of detail required – see Appendix B)





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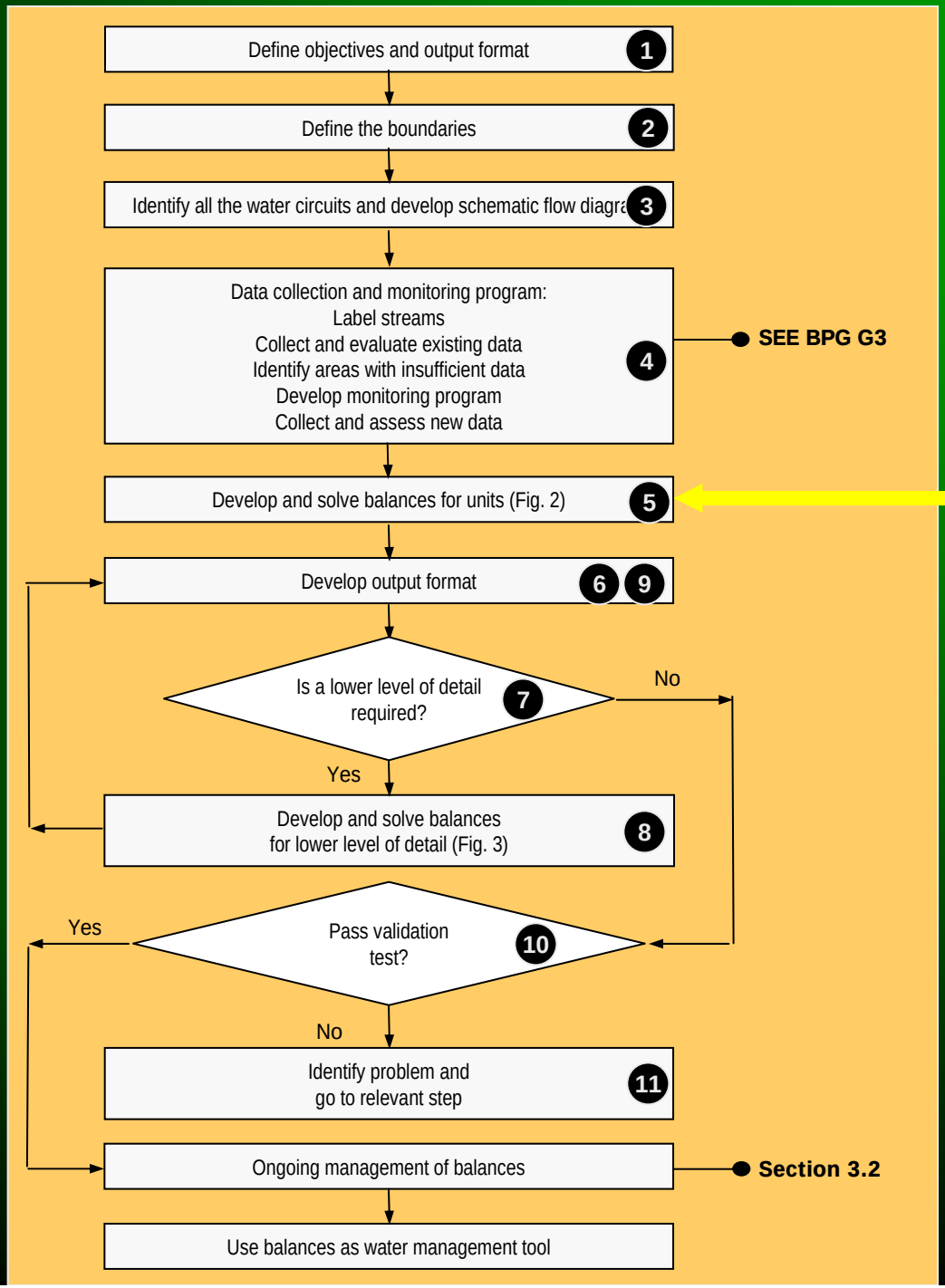
4. Data Collection and Monitoring

- evaluate existing data and existing monitoring network
- identify data and monitoring gaps
- evaluate where simultaneous water and salt balances can fill in data gaps
- design modified monitoring network (BPG G3)



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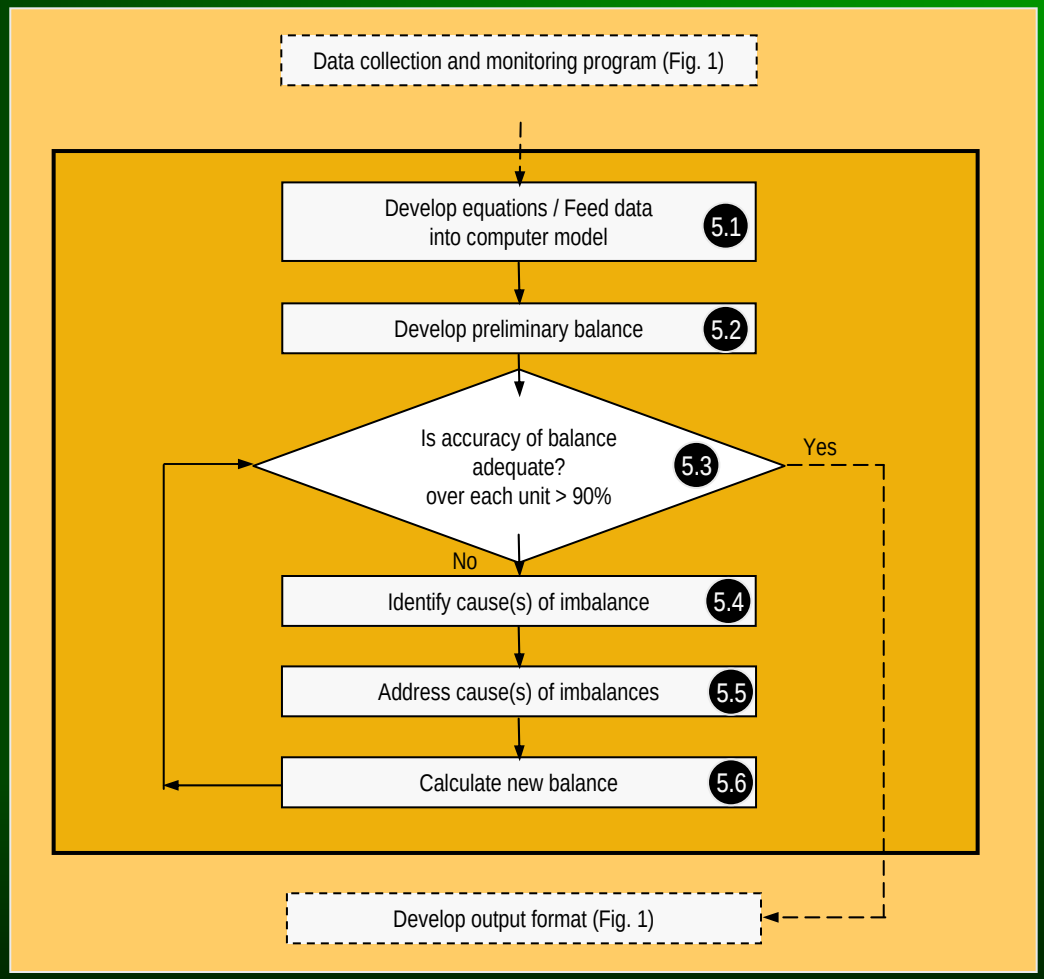
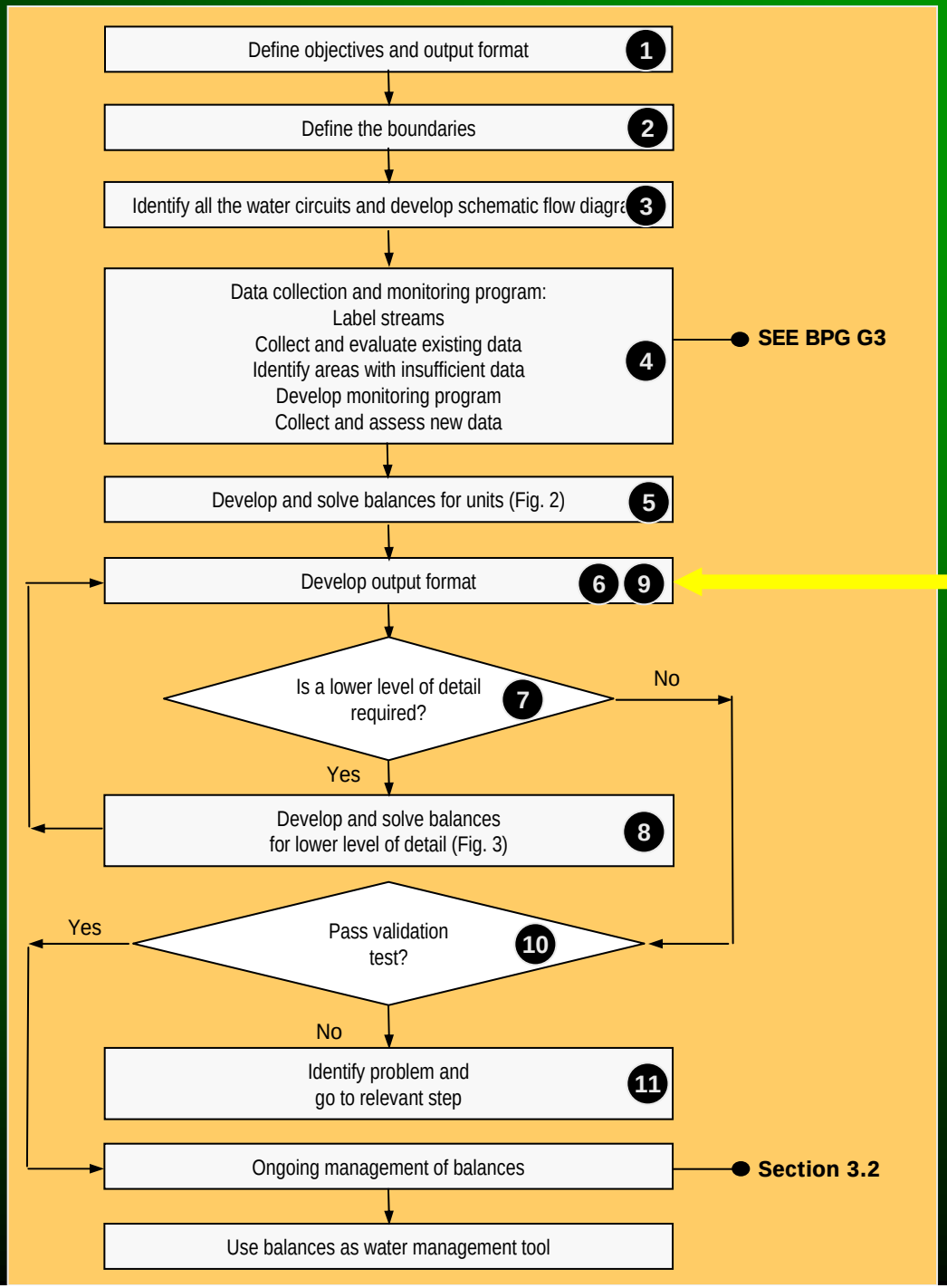
5. Develop and Solve Balances

- manual system possible for very simple networks, otherwise make use of computerised systems
- iterative procedure to be solved
- identify units not in balance, identify cause (missing stream, wrong data, etc.) and rectify
- repeat process for all sub-systems and integrate

Develop and Solve Balances





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6. Define and Develop Output Formats

- define target audience
- give appropriate level of detail for different target audiences
- develop user friendly format (make use of graphics)

Output Format Example

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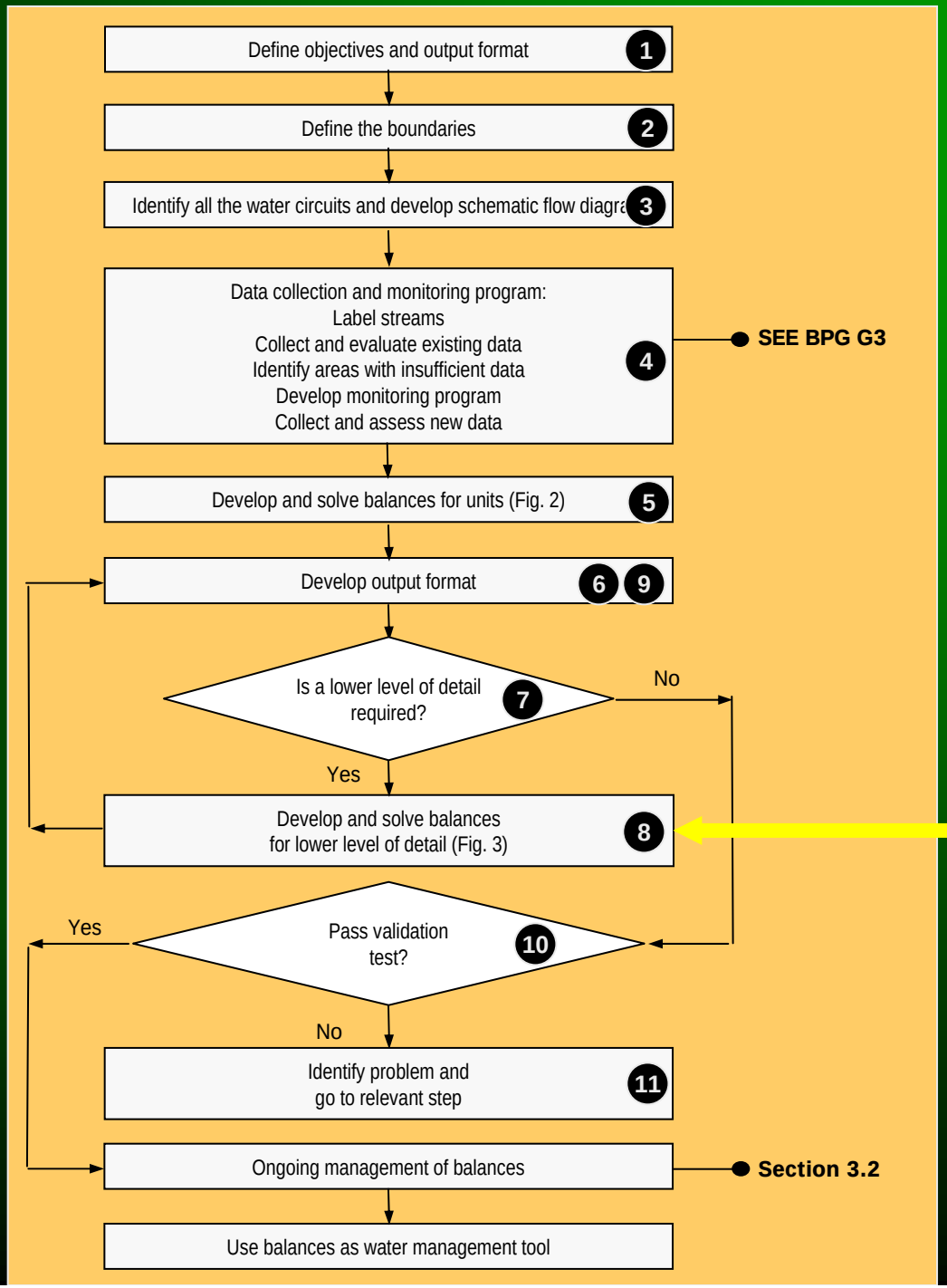

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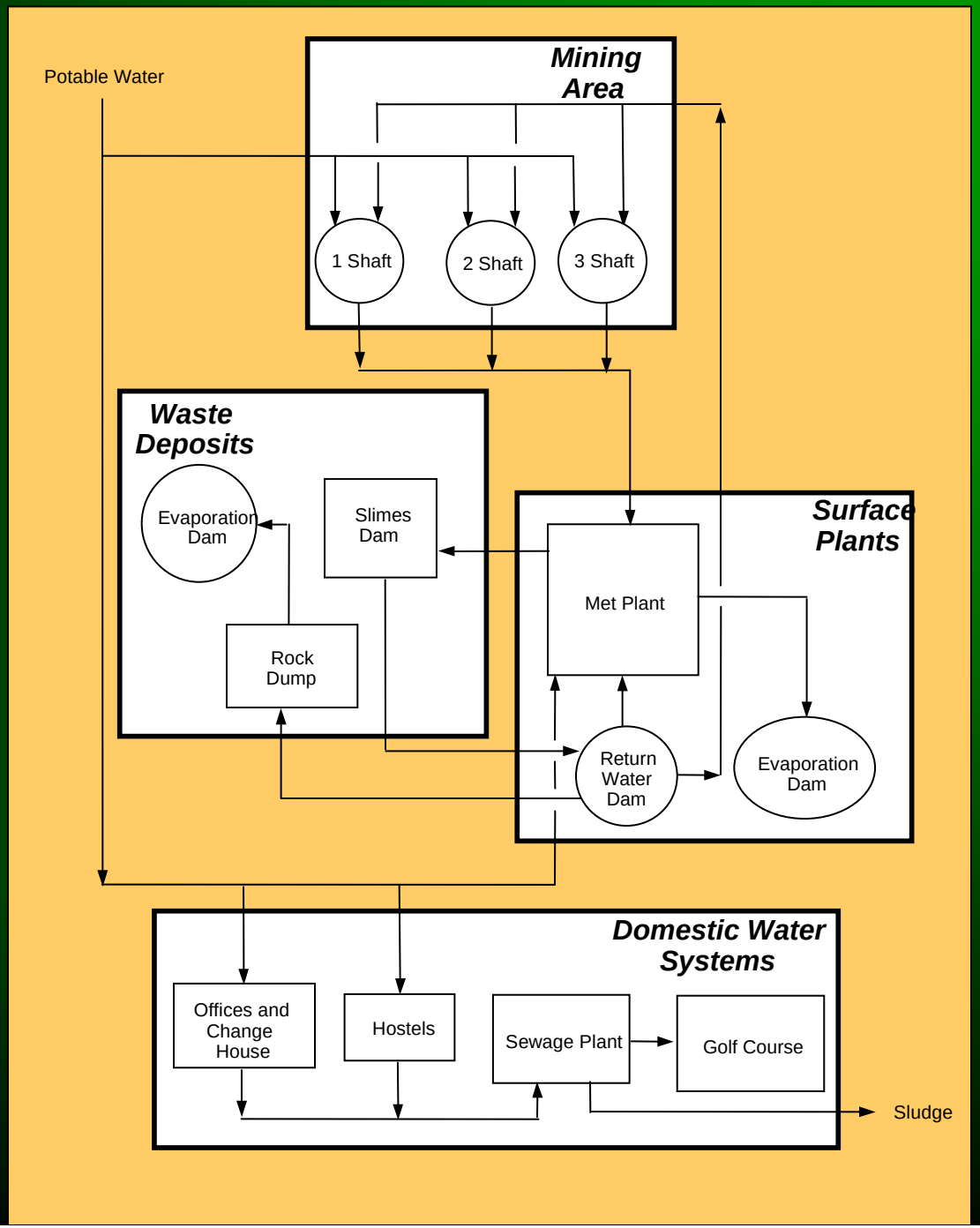
8. Develop & solve balances for lower level of detail

- If complex system was subdivided in Steps 1 and 2 then confirm linkages between components
- Apply procedure set out in Figure 3.3



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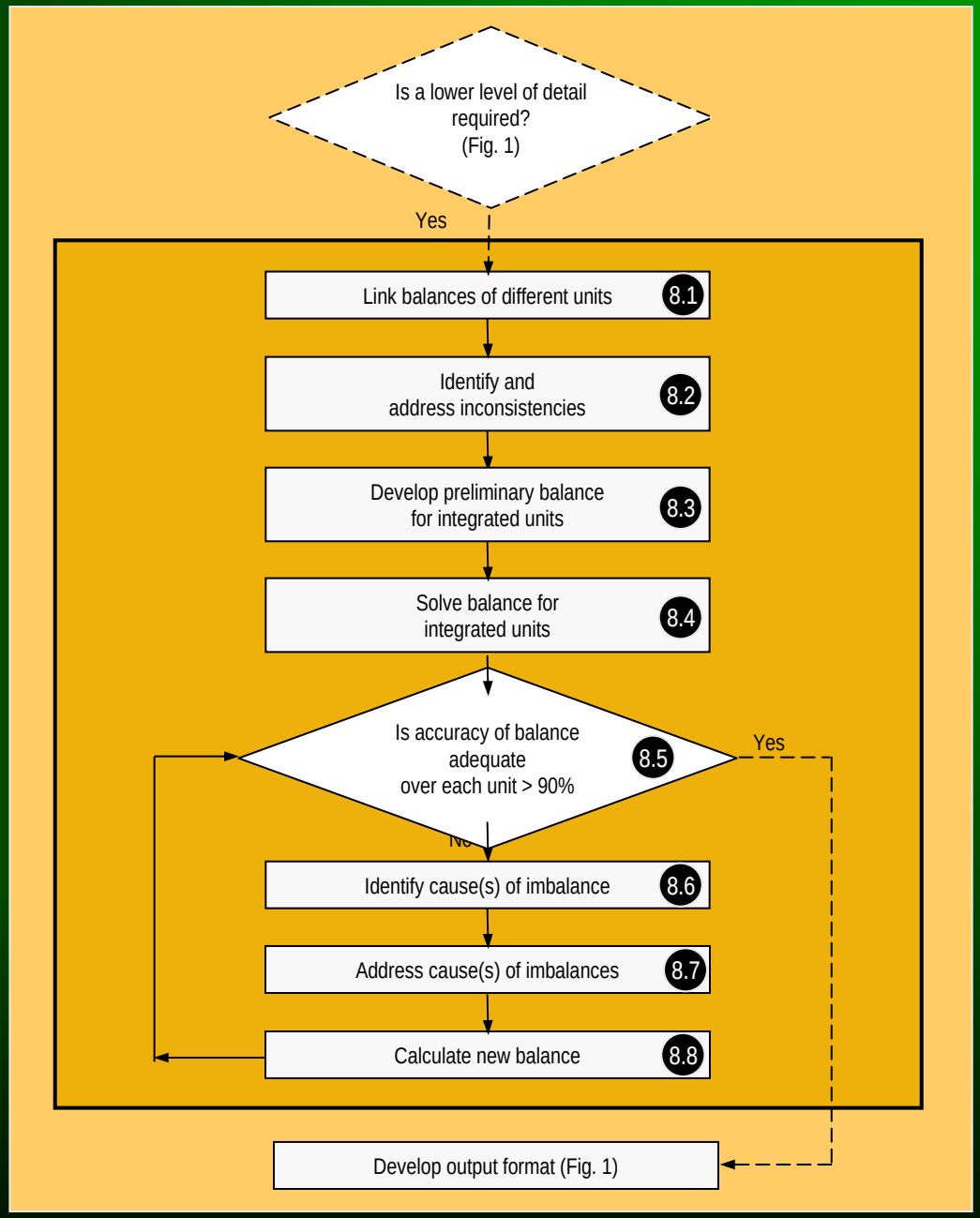

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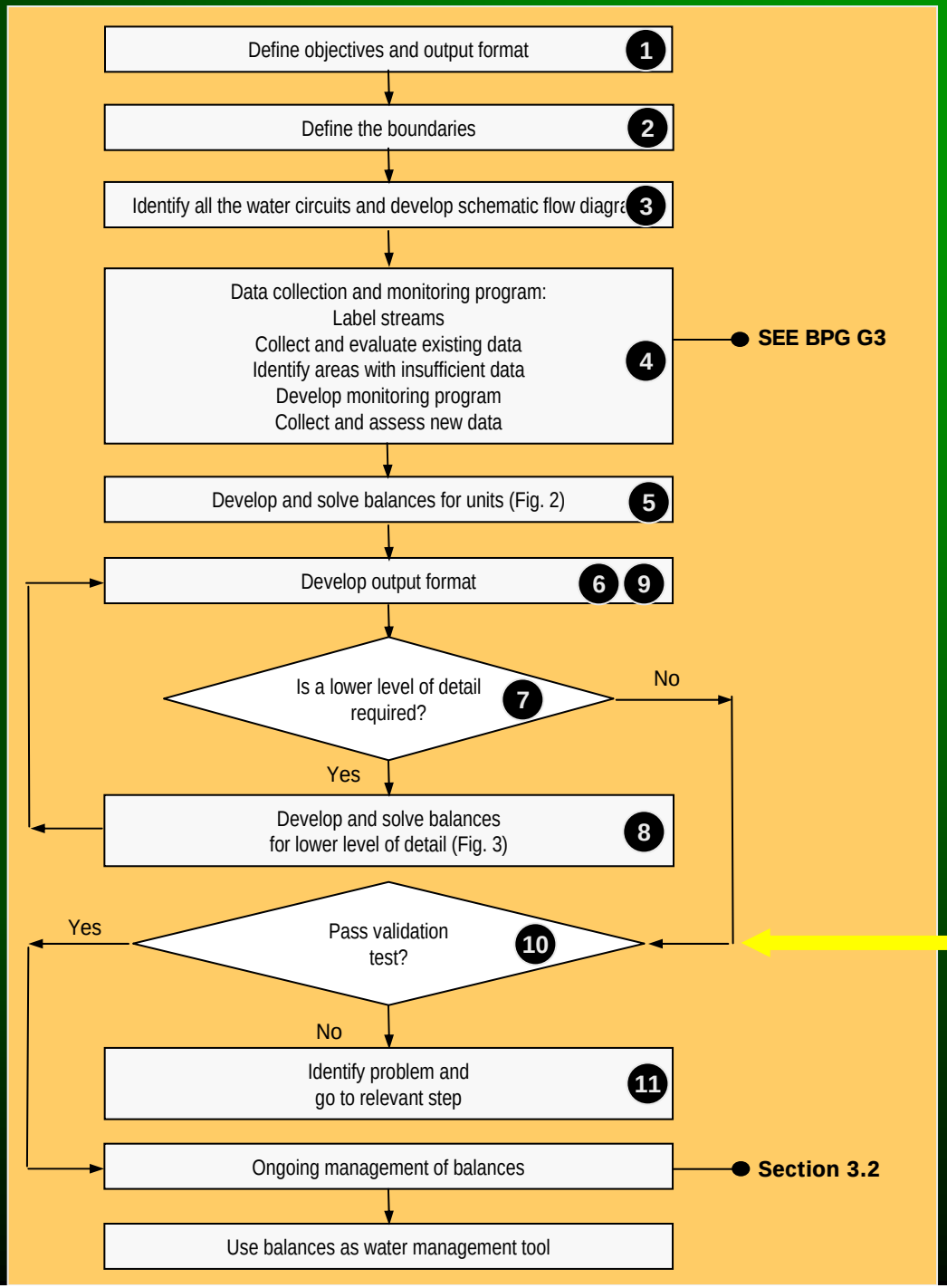

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10. Validate the Water & Salt Balance

- compare measured and calculated data on a regular basis
- regularly calibrate monitoring instruments
- check for unauthorised changes to the water reticulation network over time

Use of Balances for Management

- use as a regular auditing function to track compliance with targets and standards
- develop and implement management structures, responsibilities and reporting systems to support the balances
- develop action levels for key balance outputs
- use as an active management tool (need versatile computerised software) for simulating alternative management options

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Methods for Calculating Balances

- manual system - only for very simple systems
- spreadsheet systems - very good for auditing purposes and producing graphical outputs but are generally inflexible and not suitable for simulating alternative management options that require network changes
- water and salt balance software - cheap and easy to use for auditing and especially for evaluation of alternative water management options

Things to look for

- Confirm which streams are measured, which are calculated and which are estimated
- Confirm calibration status of flowmeters
- Confirm that balances are being updated regularly and used as management tool
- REMEMBER: You cannot manage what you cannot measure!

Final points

- Detailed practical worked example presented in Appendix A
- Prescribed level of detail in terms of inflows and outflows given in Appendix B for 25 unit processes
- Guidance on quantifying complex water balance components (evaporation, evapotranspiration, runoff, groundwater and RDFs) given in Appendix C