

**Forest Service Handbook
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Forest Service Handbook 7409.11 – Sanitary Engineering and Public Health Handbook

Chapter 10 - Planning

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Responsible Staff:

Explanation of changes: Following is an explanation of the changes throughout the directive by section.

Posting Instructions: Amendments are numbered consecutively by Handbook number and calendar year. Post by document; remove the entire document and replace it with this amendment. Retain this transmittal as the first page(s) of this document. The last amendment to this Handbook was 7409.11-2004-3 to 7409.11_zero_code.

10: Updates the chapter in its entirety. Incorporates requirements of current regulations and engineering standards; makes additional style, nomenclature and format changes throughout.

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10.2 - Objectives

The purpose of this chapter is to provide detailed planning direction to assist in meeting the objectives of FSM 7410, and to provide criteria and standards for performance and documentation of public health and pollution control planning, construction, operation, and maintenance.

Solid waste management objectives are set out in FSM 7460. Specific planning and system design direction for solid waste management are set out in chapter 80 of this Handbook.

11 - Basic Planning Considerations

Overall planning for water or wastewater project, from the initial project proposal to planning for the operation and maintenance of the facilities, requires a careful analysis of present and future needs and the consideration of alternative methods to ensure efficiency, economy, and effectiveness. Regardless of the size or cost of a facility, ensure that:

1. Programming and budgeting provide adequate time allowances and funds to complete each phase of the project in an orderly manner.
2. Skilled people are utilized in all phases of the project related work, such as engineering, soils, hydrology, and geology.
3. All phases of the project are in compliance with required Federal, State, and local codes and regulations. See 40 CFR part 141 and 40 CFR parts 100-140 for Federal drinking water and wastewater requirements, respectively.
4. Facilities are located outside flood plains. See FSM 7114 for further guidance.
5. Occupational Safety and Health Administration (OSHA) standards, such as confined space requirements (29 CFR 1910.146), lock out/tag out procedures (29 CFR 1910.147) and bloodborne pathogens (29 CFR 1910.1030, for wastewater) are considered for operation and maintenance needs.
6. Water conservation practices are considered. Examples include use of low-volume fixtures and xeriscaping (landscaping practices that conserve water, such as use of native drought-resistant species, mulch to limit evaporation, and efficient irrigation practices).
7. Water for human consumption (such as for drinking, cooking, bathing or handwashing) is treated as necessary to comply with the Safe Drinking Water Act (SDWA) and State regulations.

For example, the Long Term 1 Enhanced Surface Water Treatment Rule (40 CFR parts 9, 141, and 142) contains requirements for filtration and disinfection of surface water and groundwater under the direct influence of surface water, to protect drinking water from microbial pathogens. Groundwater potentially under the influence of surface water must be classified by the

appropriate State or county regulatory agency. Additional tests, such as pH, temperature, dye tests or microscopic particulate analysis, may be required to classify the source.

8. Economics, comprehensive area planning, environmental compatibility, public health, safety, reliability, cost, operations, maintenance, and future expansion are considered in facility selection.

9. The facility construction drawings, specifications, and construction supervision and inspection are adequate to describe and control its construction.

10. Sufficient funds are programmed for skills and resources to properly operate and maintain the facility.

11. The project size and scope meet the unit's facility master plan and/or the recreation site alignment process for present and future functional needs.

12 - Planning Sanitary and Public Health Developments

Planning for a water or wastewater facility in conjunction with site planning is an orderly process, beginning with the original project proposal, through the evaluation of alternatives, to a final decision on a course of action. It includes a conceptual design of the project.

12.1 - Project Scheduling

Project scheduling is the orderly planning and development of the several phases of work, beginning with the project proposal and continuing through the end of construction. Scheduling is usually categorized as planning, design, or construction.

1. Planning. This phase includes the project proposal, the engineering report, the environmental analysis, and any required permit application.

2. Design. This phase includes project survey, detailed design, construction drawings, construction specifications, cost estimates, and preliminary construction staking.

3. Construction. This phase includes construction staking, bid advertisement, award, construction, final project acceptance, and final construction report.

Because of wide variations in size and complexities of Forest Service facilities and overlapping between the planning, design, and construction phases, it is not always possible to separate projects into these three phases for programming purposes. Each project needs to be analyzed for a logical separation of phases. If projects can be separated into these three phases, scheduling each phase in a separate fiscal year improves project quality by allowing better scheduling of permit requests, interdisciplinary input, internal and external reviews, and cost estimating.

Projects that may require the preparation of both an Environmental Analysis Report (EAR) and Environmental Impact Statement (EIS) should be programmed over more than a 3-year period.

12.2 - Project Proposal

As the first step in planning a project, the proposal should contain a clear statement of objectives. It should be prepared by a multidisciplinary team so that all efforts are focused on mutually agreed and understood objectives. In addition to the basic planning considerations in section 11, a project proposal should include:

1. An introduction that summarizes what is proposed and where the project will be located.
2. A statement of need for the system and the facilities the system will serve both present and future (Facility Master Planning/Rec Site Alignment).
3. A statement of the compatibility of the project with comprehensive area planning. As appropriate, this should include a discussion of cooperation and cost sharing (FSM 1589 and Pub. L. 94-148) with municipalities, water and sanitation districts, special use facilities, local regulatory agency, and other agencies to ensure use of best available technology.
4. An evaluation of the site, including a site development plan, showing proposed and existing facilities.
5. The skills needed for the various planning phases, and the availability of these skills.
6. A projection of how and when the different phases of the project should be funded and completed and a preliminary cost estimate.

12.3 - Planning Reports

The environmental and engineering reports in sections 12.31, 12.32, and 12.33 contain interrelated factors that may affect conclusions and recommendations in each document. Drafts of the reports should be prepared concurrently and appropriate adjustments made in each final document, using an integrated approach to planning.

12.31 - Environmental Analysis Report or Environmental Impact Statement

Reference Forest Service Handbook (FSH) 1909.15, Environmental Policy and Procedures for direction on conducting and documenting environmental analyses.

12.32 - Sanitary Survey

A sanitary survey must be made for each proposed water supply system. The Forest Service official or contractor who conducts the survey should have a technical background in basic sanitary sciences and engineering and a broad knowledge of sanitary facilities and physical features of drinking water supplies and their sources. The survey considers effects of land use, land condition, development of the source, its capacity to meet existing and future needs, and the detection and evaluation of all existing and potential hazards within the watershed. Coordinate with the local regulatory agency in meeting the groundwater protection requirements of the State Wellhead Protection Program. See chapter 70 for further details.

12.33 - Engineering Report

The engineering report, required by FSM 7413, assembles basic information; presents design criteria and assumptions; analyzes alternative proposals; compares costs of alternative developments; and offers conclusions and recommendations for a proposed project. The study should be complete and used as a basis for selecting the alternative for a particular installation. It also forms the technical basis for detailed design and preparation of construction drawings and specifications.

The information in the report should be presented briefly and concisely, but in sufficient detail to provide a reliable planning aid. Any engineering report for a specific water or wastewater facility should be an outgrowth of, and consistent with, the comprehensive master/site alignment plan for the areas in which the project is being considered. The report should include a life cycle cost analysis, ordinarily using a 25-year design life and the current discount rate.

The sample engineering report outlined in exhibit 01 may be used for either a drinking water or wastewater system. The format and length of the report is flexible and should be adjusted to be commensurate with the scope of the specific project. The outline can be modified according to the complexity of the proposed facility. Minor modifications to existing systems may not require an engineering report. A sanitary survey, or a short report (one to three pages), documenting the considered alternatives and design considerations, may be sufficient.

12.33 - Exhibit 01

Sample Engineering Report for Drinking Water and Wastewater Systems

ENGINEERING REPORT FOR (name) POTABLE WATER SYSTEM

- I. Title Sheet.
- II. Table of contents.
- III. Body of report.
 - A. Executive summary of conclusions and recommendations -- Highlight, briefly, what was found from the study.
 - B. Introduction.
 1. Purpose -- A brief statement of what the report will accomplish.
 2. Scope -- How the project fits in with comprehensive master plan or site alignment for the area.
 - C. Location -- State, County, Forest, Ranger District, latitude and longitude, basin and watershed code (FSM 2570).
 - D. Site description.
 1. Type of site -- picnic ground, campground, administrative site, etc.
 2. Size and general shape of site -- type, capacity, condition.
 3. Existing drinking water or wastewater (collection, treatment, and disposal) facilities -- Condition, capacity, use received, and location.
 4. Existing utilities at or near site.
 5. Existing access routes and/or rights-of-way required.
 - E. Water Rights (for drinking water systems) -- Legal status of all potential sources, including rights and ownership of land which would influence development or use.
 - F. Complete sanitary survey of all potable water sources, as outlined in chapter 70.
 - G. Salient design data.

12.33 - Exhibit 01--Continued

DRINKING WATER SYSTEMS:

1. Quantity.
 - a. Domestic requirements -- present and future daily use -- maximum, average flow rates (based on fixtures to be served).
 - (1) Type and number of fixtures to be served -- residences, campsites, comfort stations, trailer sites, etc.
 - (2) Number of people to be served, at present and in future.
 - (3) Seasonal, monthly, daily use variations that can be anticipated.
 - b. Fire requirements.
 - c. Irrigation requirements.
 - d. Commercial requirements.
2. Pressure requirements.
3. Quality requirements.

WASTEWATER SYSTEMS:

1. Waste source.
 - a. Type and number of fixtures to be served -- residences, campsites, comfort stations, trailer sites, etc.
 - b. Number of people to be served, at present and in the future. Include seasonal, monthly and daily use variations that can be anticipated.
2. Wastewater quantities - measure, if possible, or estimate discharge per person per day or discharge per unit per day.
3. Wastewater flow rate. Infiltration should be considered in sewage quantities and flow rates.
 - a. Total daily flow rate.
 - b. Average hourly flow rate.
 - c. Minimum hourly flow rate.

12.33 - Exhibit 01--Continued

- d. Maximum hourly flow rate.
 - e. Peak hourly flow.
 - 4. Type of wastes.
 - a. Domestic, including garbage grinders and laundry.
 - b. Pumped wastes from vaults, holding tanks, septic tanks, etc.
 - c. Nondomestic, such as oil and fish renderings from fish cleaning stations.
 - d. Institutional.
 - 5. Waste characteristics.
 - a. 5-day biochemical oxygen demand (BOD5), in mg/l or pounds per capita per day.
 - b. pH.
 - c. Solids, in mg/l or pounds per capita per day (total solids, total suspended solids, total volatile solids, total volatile suspended solids).
 - d. Temperature of waste.
 - e. Chemicals which may be contained in waste--(zinc sulfate, formaldehyde, etc.). See FSH 7409.11, chapter 50.
 - 6. Effluent and sludge disposal requirements as mandated by EPA, State, sanitation district, etc.
- H. Alternatives considered.
- 1. Managerial alternatives which may be considered.
 - a. Eliminate facility.
 - b. Change or control use of facility to eliminate problem or need.
 - c. Cooperating with utility district, other agencies, etc., if feasible.
 - 2. Technical alternatives (repeat for each alternative).
 - a. Description.

12.33 - Exhibit 01--Continued

DRINKING WATER SYSTEMS:

- (1) Source and its development.
- (2) Treatment processes and components. (Evaluate adequacy of the proposed treatment.)
- (3) Waste disposal. Include description, volume, proposed treatment, and disposal.
- (4) Storage facilities and distribution system.
- (5) Pumping facilities.

WASTEWATER SYSTEMS:

- (1) Collection or transportation method.
 - (2) Treatment processes and components. (Evaluate adequacy of the proposed treatment.)
 - (3) Effluent disposal method.
 - (4) Sludge disposal method. Include description, volume, proposed treatment, and disposal.
 - (5) Effluent quality anticipated to be produced by process.
 - (6) System advantages, disadvantages, and reliability.
 - (7) Special problems associated with alternative.
- b. Design life of system.
 - c. Operation and maintenance considerations.
 - (1) Operation requirements.
 - (a) Training required.
 - (b) Duties and man hours required.
 - (c) Emergency or malfunction impacts to users.

12.33 - Exhibit 01--Continued

- (2) Maintenance requirements.
 - (a) Routine maintenance.
 - (b) Man hours required.
- (3) Testing and monitoring.
 - (a) Facilities, tests, and equipment required and available.
 - (b) Skills required.
 - (c) Man hours required.
- (4) Reports and forms required.
- d. Economic considerations.
 - (1) Initial capital cost estimates.
 - (2) Operation and maintenance costs.
 - (3) Other annual costs.
 - (4) Amortized cost.
 - (5) Total annual cost.

I. Comparison of alternatives.

1. Discussion.

2. Table of comparative factors, including cost, O&M, area required system reliability, and effluent quality.

J. Alternative proposed and why.

IV. Appendices. Environmental Analysis Report; water quality analysis, soil description, maps, site plans, etc.

13 - System Design

Technological advancements in drinking water and wastewater engineering have provided environmental engineers with many methods for design of Forest Service water and wastewater facilities. Design qualifications can be obtained through actual experience in planning, construction drawings and specifications preparation, construction, and in the operation and maintenance phases of water and wastewater facilities. Designers with these qualifications should be utilized in the design of water and wastewater facilities to obtain effective and economical operation for the design life of the facility. Independent peer review is an essential step in the design process.

13.1 - Construction Drawing and Specifications

Construction drawings should show the form of construction that will be done. Specifications should establish quality, the results to be achieved, and how they are to be accomplished. Information should not be duplicated in the construction drawings and specifications. See FSM 7413.4 for additional direction.

13.11 - Construction Drawings

Construction drawings are graphic documents that show the size and extent of construction and geometric relations between the various construction components. The following is a guide for construction drawing preparation.

1. Title sheet. Title sheet should include a location map, a vicinity map, the project title, and the index of sheets.
2. Project layout sheet. Show all proposed construction, as well as all existing features that are pertinent to the project. If necessary for clarity, put utilities on a separate sheet from other facilities to be constructed. Future construction should not be shown. Project layout sheets should include:
 - a. A title block, which includes the Forest name, appropriate signatures, dates, project title, sheet title, and sheet numbers.
 - b. A scale, which should be as large as possible to fit the sheet, not smaller than 50 feet to the inch, and the same on all layout sheets.
 - c. A North arrow.
 - d. Contours.
 - e. A legend.
 - f. Pertinent natural features.
 - g. Pertinent existing facilities.

- h. Property corners, boundaries, permanent bench marks and base lines.
- i. Match lines.
- j. Disposal and stockpile sites.

3. Waterline/sewerline/powerline plan and profile sheets. Prepare plan and profile sheets for all waterline/sewerline construction, except short ties for building construction. Prepare powerline plan sheets and include trench sections (not profiles) and any necessary appurtenances and construction details.

a. Plan sheets should include:

- (1) A scale, which is not smaller than 50 feet to the inch, and should be the same as the horizontal scale on the profile sheet.
- (2) A North arrow.
- (3) Pertinent natural features.
- (4) Pertinent existing and proposed facilities.
- (5) Waterlines or sewerlines with pipe sizes and powerlines with number, sizes, and types of cable.
- (6) Pipe material.
- (7) Waterline and sewerline appurtenances and structures.
- (8) Waterline, sewerline, or powerline stationing to the nearest tenth of a foot for the following:
 - (a) Waterline and sewerline at maximum 100-foot intervals, powerline at 200-foot intervals.
 - (b) Angle joints.
 - (c) Junctions.
 - (d) Waterline or sewerline appurtenances and structures.
 - (e) Points of tie and ends of lines.
- (9) Points of tie to existing waterlines, sewerlines, or powerlines. Show material and size of existing waterline or sewerline.
- (10) Thrust block and anchor sizes, type, and location for waterlines and sewerlines.
- (11) Benchmarks and survey reference points.

b. Profile sheets should include:

- (1) A scale, with horizontal relation not smaller than 50 feet to the inch and vertical relation not smaller than 10 feet to the inch.
- (2) The original ground line.
- (3) Waterlines or sewerlines to be constructed.
- (4) Waterline or sewerline appurtenances and structures.
- (5) The depth of cover and slope of waterline or sewerline, if specifically required.
- (6) Crossings (roads, streams, fences, and utilities), existing and proposed.
- (7) Stationing to the nearest tenth of a foot for the following:
 - (a) Waterline or sewerline at 100-foot maximum intervals.
 - (b) Junctions.
 - (c) Crossings; roads, fences, utilities, etc.
 - (d) Waterline or sewerline appurtenances and structures.
 - (e) Points of tie and ends of lines.
 - (f) Thrust blocks.

Stationing should increase from left to right on sheet.

- (8) A title block with the Forest name, appropriate signatures, dates, project title, sheet title, and sheet numbers.

4. Waterline and sewerline construction details. Prepare detailed construction drawings for all waterline or sewerline structures and appurtenances, all on one sheet if space permits. Place construction details on construction detail sheet or standard drawings, not on layout or plan and profile sheets. Details should include:

- a. Location, dimensions, and elevations of all work to be done.
- b. Type, size, and description of all manufactured products not covered by the specifications.
- c. Description of any features not covered by the specifications.

5. Electrical and mechanical systems. All power-distribution and generation-control systems, heating, ventilating, air conditioning, lighting, building wiring, building plumbing,

and related electro-mechanical system drawing layouts should be determined by the electrical and mechanical engineers.

6. Site grading sheets. Site grading drawings should be prepared for structures when clearing, grading, utility hookups, or other work is required that cannot be shown on the layout sheet. Site grading drawings should be oriented the same as layout sheets and should include:

- a. A scale that is not smaller than 50 feet to the inch.
- b. A North arrow.
- c. Structure orientation.
- d. Finish floor and grade elevations.
- e. Property lines, base line, and corners.
- f. Benchmarks and elevations.
- g. Existing and finish grade contours.
- h. Existing and proposed utility locations, sizes, and material, if specifically required.
- i. Points of tie or ends of all utilities and stationing of these points.
- j. Clearing and grubbing limits and dimensions of these limits.
- k. A structure plan number, if applicable.

7. Buildings and other structures. Prepare design drawings for all buildings and other structures to be constructed. See FSH 7309.11 for additional direction.

13.12 - Specifications

Use the Construction Specification Institute (CSI) format in accordance with Federal Acquisition Regulations.

13.2 - Cost Estimates

Cost estimating for construction of drinking water and wastewater facilities requires experience. Factors affecting costs include, but are not limited to, availability of materials specified, labor sources and costs (prevailing wage), contractor availability and experience, location of project, cost trends for long-term projects, seasonal influences, and elements of risk. Cost guides and current bid tabulations may be used to assist the designer with cost estimating.

Preliminary cost estimates are usually developed during the preparation of the engineering report (sec. 12.34). Final cost estimates should be developed after construction drawings and specifications are prepared (sec. 13.1). Cost estimates should have the following supporting information:

1. Labeled as preliminary or final.
2. Date prepared and by whom.
3. Period of time estimate is valid, for example, fiscal year 1998.
4. Items included in estimate (such as construction, overhead, Contracting Officer's Representative (COR)).

14 - Construction Engineering

14.1 - Construction Inspection

Quality construction inspection is necessary for each drinking water and wastewater construction project to ensure that construction is completed in full compliance with the approved drawings and specifications. Construction inspection personnel are to be certified in accordance with FSM 7115 and FSH 7109.17.

14.2 - Final Construction Report

For a complex project, a final construction report provides a summary of the significant activities or changes which took place during the construction. Its primary value to engineers is to provide feedback from construction personnel to designers and operation and maintenance (O&M) personnel. A well-prepared final construction report can facilitate improved designs for future projects and increased efficiency in construction, and additions to the O&M plan.

When preparing final construction reports, keep them brief, but include the following applicable items:

1. Name, location, and description of the project.
2. Description of work performed.
3. A narrative containing brief comments and recommendations on construction features of interest and conditions encountered which may be of value in preparing designs, construction drawings, specifications, and cost estimates for future projects and changes to the project O&M plan.
4. Actual costs, compared with initial bid costs, including significant overruns or underruns and a brief explanation of the cause. Include overhead assessments to the extent they can be determined.
5. A brief narrative of significant construction operations, including organization, methods, and effectiveness.
6. Recommendations for future projects.
7. One set of "as-built" specifications and drawings.

8. Progress photographs, dated and titled. Include photographs of facilities before backfill of components, which may require repair or are vulnerable to damage.

15 - Operation and Maintenance

The operation and maintenance (O&M) plan for drinking water and wastewater facilities should address the following:

1. Budgeting and cost control.
2. Management and technical supervision and organization.
3. Operator qualification and training requirements.
4. Relief and support personnel availability.
5. System and equipment manufacturer's requirements.
6. System complexity and vulnerability.
7. Continuous or seasonal operations.
8. Laboratory requirements and services.
9. Monitoring and reports.
10. Emergencies.
11. Safety considerations.

A drinking water or wastewater system must be operated by qualified personnel who are trained to manage the degree of treatment and sanitation provided by the system's design, and to maintain and protect the Forest Service investment in the system. Even the simplest system will not operate continuously or reliably without surveillance. The need for personnel certification and experience increases with the size of the system as well as the degree of treatment for which the plant has been designed, and the standards to be met. Operators must comply with certification requirements imposed by Federal or State regulations.

15.1 - Records

Accurate and useable records are also necessary for proper system management. They are valuable in guiding O&M personnel towards locating and solving O&M problems. The records should include the primary documentation of relative equipment performance and serve to help justify decisions, expenditures, and recommendations for future modifications or expansions. Refer to chapter 70 for additional direction on operation and maintenance of drinking water and wastewater systems.