Hydrology Report Components for CE 4330 Fall 2023

10 Oct 2023

- What should a hydrology "report" contain in regard to a development design?
- Significance of Hydrology Reports in Civil Engineering
- Minimal Site Plan Data
- Evaluating Projects for Hydrologic Impacts
- Submittal Checklist for Hydrologic Evaluation

What should a hydrology "report" contain with regards to a development design? (1 of 4)

- From the mighty internet!
  - A hydrology report for a development design is a critical document that provides essential information about the impact of the proposed development on water resources and the surrounding environment. It typically contains a comprehensive analysis of the site's hydrological characteristics and offers recommendations to mitigate potential negative impacts. Here are the key components that should be included in a hydrology report for a development design:

1. Executive Summary:
    1. A brief overview of the report's main findings and recommendations.
2. Introduction:
    1. A description of the development project, its location, and its objectives.
    2. The purpose of the hydrology report and its relevance to the project.
3. Site Description:
    1. Detailed information about the project site, including topography, soil types, land use, and existing water features (e.g., rivers, lakes, wetlands).

What should a hydrology "report" contain in regard to a development design? (2 of 4)

4. Regulatory Framework:
    1. A summary of relevant local, state, and federal regulations and permits related to water resources and environmental protection.
5. Data Collection and Analysis:
    1. Collection of meteorological data, including rainfall patterns and historical records.
    2. Hydrological data such as streamflow measurements, groundwater levels, and soil properties.
    3. Analysis of the existing hydrological conditions and potential impacts of the development.
6. Runoff Analysis:
    1. Calculation of pre-development and post-development runoff volumes and rates.
    2. Evaluation of peak flows and flood risks.
7. Stormwater Management:
    1. Design and description of stormwater management measures, including retention basins, swales, and other drainage infrastructure.
    2. Compliance with stormwater quality and quantity regulations.

What should a hydrology "report" contain in regard to a development design? (3 of 4)

7. Stormwater Management:
    1. Design and description of stormwater management measures, including retention basins, swales, and other drainage infrastructure.
    2. Compliance with stormwater quality and quantity regulations.
8. Erosion and Sediment Control:
    1. Measures to prevent erosion during construction and post-construction phases.
    2. Sediment control plans to protect water quality.
9. Water Quality:
    1. Assessment of potential impacts on water quality due to the development.
    2. Strategies for water quality protection and improvement.
10. Floodplain Analysis:
    1. Identification of floodplain boundaries and analysis of flood hazards.
    2. Mitigation strategies for flood-prone areas.

What should a hydrology "report" contain in regard to a development design? (4 of 4)

11. Environmental Impact Assessment:
    1. Evaluation of potential impacts on aquatic ecosystems, wetlands, and wildlife habitats.
    2. Mitigation measures to protect sensitive environments.
12. Recommendations and Mitigation Measures:
    1. Specific recommendations for minimizing the project's impact on hydrology and the environment.
    2. Engineering and design solutions to address water-related challenges.
13. Conclusion:
    1. A summary of the main findings and recommendations of the report.
14. Appendices:
    1. Additional data, charts, maps, and calculations used in the analysis.
15. References:
    1. Citations of all data sources, studies, and regulations referenced in the report.

- A well-prepared hydrology report is essential for obtaining necessary permits, ensuring compliance with environmental regulations, and designing a development project that minimizes its impact on water resources and the surrounding environment. It should be prepared by qualified hydrologists or engineers with expertise in hydrological analysis and environmental impact assessment.

Significance of Hydrology Reports in Civil Engineering

A hydrology report is important in civil engineering because:

- It helps hydrologists and engineers establish the relation between underground water resources and surface water.
- It's essential for establishing the maximum flood a construction project can cause/endure.
- It allows engineers to determine the flow over different hydraulic structures like urban storm drainage systems, spillways, and highway culverts.
- It determines the reservoir capacity that will ensure an adequate water supply for domestic, industrial, and other purposes.
- Applications of engineering hydrology provide the nature of rainfall patterns, water flow, and more.
- Lastly, hydrology is important for analyzing the on-site seepage and drainage condition before any engineering project commences.

Hydrology plays an important role in a development project, especially in civil engineering structures. Therefore, hydrology reports are needed to help alert or reassure planners and developers regarding potential issues of concern. More importantly, this will help to establish effective strategies for controlling and reducing water flows resulting from the new project.

Minimal Site Plan Data

- The site plan plays an important role in helping reviewers (and the client) understand what activities are being proposed on a site and what the potential impacts of these activities will be.
- Reviewers (people who issue permits) evaluate whether the plan contains sufficient information to allow the evaluation of potential hydrologic impacts and the development of appropriate permit conditions.

Minimal Site Plan Data (Project Area)

- The boundaries of all development areas, and any associated regulatory buffer zones, should be clearly delineated on the plan.
- When applicable, the 100-year floodplain boundary should be clearly identified on all grading plans.
  - Reviewers will typically verify that the boundaries accurately represent the conditions on site, and that all relevant areas have been identified, to ensure that all areas of jurisdiction have been addressed.

Minimal Site Plan Data (Topography)

- Site plans should show the existing and proposed grades within the proposed limit of work.
  - Typically, plans should be prepared with contour intervals of two feet or less, to adequately evaluate the hydrologic impacts. One-foot contours may be required in very flat areas, to clearly indicate drainage patterns. Spot-grades, which typically mark elevations to the nearest tenth of a foot, are very helpful in sensitive areas or in areas where complex grading is proposed.
  - Where limited topographic information is available, data from United States Geological Survey (USGS) topographic maps may be substituted. These maps are often useful for obtaining information about drainage patterns for areas outside of the project site. However, these maps typically show only 10-foot or 3-meter contours and may only provide limited detail.
  - Topographic information from more detailed sources may sometimes be needed to fully evaluate hydrologic conditions. Designers should pay particular attention to the scale of USGS maps, as many are now published in metric units, instead of English units of measurement.
- Topographic depressions should be identified on the plans. Additional information, such as field observations or hydrologic calculations, may be required to determine whether these areas may constitute land subject to flooding (These added data features are typically placed as notes on the design plans).

Minimal Site Plan Data (Soil Data)

- For most projects, hydrologic calculation procedures will require the data about the site's soils. In particular, many procedures require information about soils classification according to NRCS Hydrologic Soils Groups.
  - The site plans should include information regarding the existing hydrologic soils groups located on the site.
- This information may generally be obtained from the United States Natural Resources Conservation Service (NRCS) using the Web Soil Survey tool; County soil surveys, or SCS Soils Maps.

Minimal Site Plan Data (Conveyance)

- The plans should show all existing and proposed drainage structures, closed stormwater conveyance systems (pipes and culverts), open conveyance systems (ditches and channels), impoundments, and natural drainage systems.
  - When applicable, the plans should note the elevations of drainage structures' rims and inverts and identify pipe sizes.
  - Existing and proposed water quality structures, such as detention and retention basins, should also be clearly identified.
- The inlets, outlets, overflow structures, and elevations of these facilities should be noted on the plans.

Minimal Site Plan Data (Drainage Patterns)

Designers must demonstrate familiarity with the existing and proposed drainage patterns on a site. These drainage patterns include the paths of water entering, crossing, and leaving the site, as well as the areas where water may be stored on the site. Remember that movement of water includes both surface and subsurface components.

- In the site plan submittal package, the applicant should provide a plan delineating the existing and proposed drainage areas. It is important to realize that it may or may not be possible to use a property line as a watershed/drainage area boundary. It may be necessary to refer to a topographic map or a USGS map to identify the off-site contributing drainage area, if this information effects the analysis. If possible, municipal drainage information should be consulted to identify any discharge pipes that may also contribute flow to a site. Similar sources of data may need to be used to follow the path of water downstream of the site, when downstream impacts may be of concern.
- Applicants should identify "design points", which serve as the locations where existing and proposed peak discharge rates will be calculated and impacts will be assessed. These points are typically the points of discharge leaving the site, the down-gradient property boundary, or the boundary of a resource area.
    - Depending on the topography and size of the site, there may be more than one design point leaving the site. In some cases, a feature outside of the property boundaries (i.e., a culvert) may be deemed as a more suitable design point. Intermediate watershed areas (sometimes referred to as sub-areas or sub-catchments) may also be delineated to intermediate design points within the overall drainage area, such as catch basins or culverts.
- The pre- and post-development watersheds and drainage patterns should be compared to determine if substantial hydrologic alterations are proposed as a result of the project. Applicants should provide adequate information to allow reviewers to evaluate the impacts to the drainage patterns on site, the water regime of a project area, and groundwater recharge

Minimal Site Plan Data (Erosion Control)

- The submittal package should generally provide a plan denoting the proposed erosion and sediment control practices to be implemented during the construction phase of the project to protect resource areas.
  - These practices may include the use of hay bales, silt fences, temporary drainage swales and detention basins, temporary sediment traps, stabilized construction entrances, and slope stabilization practices.
  - Link to Water Systems Lessons

Evaluating Projects for Hydrologic Impacts (1 of 2)

This is a basic list of questions reviewers typically consider in the hydrologic review.

- Have all applicable areas on the site been correctly identified and delineated?
- Have Critical Areas (as defined in a stormwater management plan) downstream of the project site been correctly identified?
- Have the existing drainage patterns on the site been accurately represented?
- Has the Applicant used acceptable methods/models for hydrologic calculations?
  - Are the values used for soils, land cover, and other factors required for the calculations consistent with actual field conditions?
- Is the project subject to compliance with various stormwater management standards?
  - Has applicant verified its status with respect to development/redevelopment and the required water quality volume?
- Are the design points used in hydrologic calculations adequate to assess impacts on individual resource areas?
  - The design points should be the same under existing and proposed conditions.
  - The total drainage area analyzed should also be the same under existing and proposed conditions (although individual sub-areas may differ in size between the two conditions).
- How will the drainage patterns on the site be altered by the project (e.g., with respect to the volume, location, or rate of discharge)? Is this likely to impact individual resource areas or their functions?

Evaluating Projects for Hydrologic Impacts (2 of 2)

- Will the existing peak flow rates from the site be replicated under proposed conditions for at least the 2-year and 10-year storm events?
  - How will they be controlled?
  - If peak rates are not controlled, has the applicant submitted documentation to show that such controls are not necessary?
- Have the impacts of the proposed project on downstream flooding in the 100-year frequency event been adequately assessed and mitigated?
- What impact will the proposed project have on groundwater recharge?
- Does the proposed project use appropriate BMPs to treat site runoff?
  - Has the applicant documented that all stormwater runoff from impervious surfaces (except roof drainage that will be infiltrated) will be treated to achieve 80 percent removal of the TSS? (or whatever standard applies locally)
  - Has the applicant sized facilities according to the appropriate sizing rules?
- Does the proposed project constitute a land use with higher potential pollutant?
  - If so, are source reduction and pretreatment provided?
- If the project discharges to a critical area
  - does the applicant propose one or more of appropriate types of BMPs?
- Does the proposed project provide compensatory flood storage for any filling within the floodway?

Checklist for Hydrologic Evaluation (1 of 3)

1. Site Plans showing all Wetlands Protection Act resource areas and applicable buffer zones, existing and proposed topography, all proposed structures, and existing and proposed land cover (e.g., woods, lawn, impervious surface, etc.).
2. Critical Areas (if any) are identified; if none explicit statement in plan notes.
3. Areas of Higher Potential Pollutant Loads (if any) are identified; if none explicit statement in plan notes.
4. Hydrologic calculations for existing and proposed conditions.
5. Maps showing analysis points (same for existing and proposed conditions), existing and proposed drainage areas, and time-of-concentration paths, consistent with the drainage calculations.
6. Hydrologic soil groups from applicable U.S. Natural Resources Conservation Service (NRCS) County Soil Survey.

Checklist for Hydrologic Evaluation (1 of #)

7. Calculations of existing and proposed peak runoff rates for the 2, 10, and 100-year, 24-hour storms.
8. Documentation that proposed peak discharge rates do not exceed existing rates for the 2 and 10-year storm events (typical design standards, sometimes 25-yr; varies by locale).
9. Documentation that proposed stormwater design does not result in increased flooding off-site for the 100-year, 24-hour storm event.
10. Calculation of runoff “water quality treatment volume”, based on the correct sizing rules.
11. Documentation that Total Suspended Solids (TSS) removal rate has been calculated using a locally acceptable methodology (if water quality is an identified control issue) #
12. Calculations of volume of runoff to be recharged to groundwater, as specified in appropriate Stormwater Management Plan.

Checklist for Hydrologic Evaluation (1 of #)

13. Sizing calculations for all stormwater BMPs (e.g., detention ponds, water quality swales, other BMPs).
14. Documentation that BMPs have been sized according to an acceptable sizing methodology.
15. Calculations for sizing of proposed conveyance systems (e.g., culverts, storm-drain pipes, open channels).
16. Calculations of compensatory flood storage for floodway, if applicable.
17. Other calculations as warranted by unique characteristics of project.
18. Stormwater Management Facilities Operation and Management (O & M) Plan for proposed stormwater management system.
19. Sediment Erosion & Control Plan.