

NC Policy Collaboratory Project Report: Increasing Access to Certain North Carolina Environmental Monitoring and Natural Resource Data

Submitted on behalf of the NC Policy Collaboratory by

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1 April 2018

Preface

This report came about as a project between staff of the Renaissance Computing Institute (RENCI) and the North Carolina Policy Collaboratory and represents a unique opportunity to integrate research knowledge and professional experience in the service of a public policy discussion.

The authors would like to thank the Collaboratory for the opportunity to work on this report. We would also like to acknowledge the contributions of Lisa Stillwell of RENCi who did research and contributed content. Finally, thanks to DEQ staff who willingly took time to answer our questions and provide additional information.

The findings and suggestions are the opinions of the authors and do not represent the Collaboratory or the University. We also acknowledge as ours any factual errors that may be in this document in spite of our best efforts to avoid them.

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Executive Summary

Approach to this Study

- The authors of this study conducted extensive review of existing online resources for water pollution permitting, related information, and environmental data and information at the federal and state level.
- Similar resources were identified for other US states for additional comparison purposes.
- As part of the process, relevant DEQ experts and DIT staff were consulted.
- There was additional consultation with other entities such as a private sector vendor and a water resource expert.
- The authors reviewed the available resources against a set of exemplar use case scenarios.
- Recommendations followed based on the review analysis.

Current Situation

- We found that at both the federal and state levels there was a wealth of information and data related to these topics.
- Online permit-related information includes, in many cases, permit and facility attributes, as well as data about permit enforcement and compliance.

- The situation in other states differed widely, but in general was fairly consistent to the North Carolina situation in terms of approaches, availability, and organization of online data and information.

Challenges

- The large array of available resources and interfaces combined with the complexity of the topic, regulation, policies, and science make for an, at times, confusing array of resources for an end-user.
- Multiple pathways are mixed together in interfaces at the federal level to retrieve information. At the state level, the array of nomenclature, jurisdictions, and permit types creates what can sometimes seem like multiple interconnected pathways.
- The provenance and update cycle for available data is not clear in the available resources. When searching for information through a given interface the user does not know whether they are searching the universe of available information or a subset for example.

Core Problem

- The topic is incredibly complex and difficult to organize in a way that can carry a user through a data or information access scenario.
- The existing online resources likely grew up somewhat organically according to something of a top-down framework, topic, division, type of permit.
- Existing landscape does not incorporate a knowledge management or curation-based approach to the organization and presentation of the data and information.

Addressing the Charge

- Identification and acquisition of digital data relevant to environmental monitoring and natural resource management
 - A wealth of online resources already exists related to this aspect of the charge.
 - These resources include information about the permitting process, extant permits, facility information, effluent information, geographic information, and more.
- Creating an online permitting system for various types of permits to support the end-to-end process
 - DEQ is in the midst of developing this type of resource.
 - EPA is requiring states move to full online reporting by 2020.
- The digitization of analog records
 - Given the potential costs involved and the potential for quality issues, we do not recommend digitization of analog records beyond what is currently in process unless there is a clear and compelling policy or scientific reason to do so.
- Transferring these data to a central, searchable, and publicly accessible digital database
 - Centralizing the content runs counter to current information technology trends which are trending towards decentralization.

- Centralizing risks an overly rigid architecture and data model.
- The emphasis should be on an effective knowledge and curation strategy that supports interoperability, findability, and access.

Recommendations

Near-term

1. Where possible, accelerate existing efforts moving to digital reporting.
2. Investigate rationalizing the organization of existing permitting resources into a workflow decision-tree; i.e. rethink approaches to curation and knowledge management of data and information objects to move from treating each as a distinct entity, to cataloging and interoperability.
3. Ensure consistency of terminology and representation of updates and quality of the data and information presented.
4. Look into ways to increase online user support resources, e.g. online glossaries or through implementing an online knowledgebase FAQ system (N.B.: Again, the key cost driver for something like this is not the capability, it's the committed human resources to populate and oversee the system.)
5. Enrich the metadata and structured information related to the various data and information resources to allow for increased findability and accessibility.
6. Investigate creation of a searchable data, tools, and services catalog or set of catalogs.

Longer-term

7. Recommend forming a group or task force similar to the Center for Geographic Information and Analysis (CGIA) but for NC government-funded data and information.¹ The group would benefit from a makeup that engages the cross-section of data creators, data curators, and data users. A suggested charge for the group might include activities to investigate and make recommendations regarding:
 - a. Developing a knowledge management strategy across agencies.
 - b. Developing an NC data commons and a North Carolina environmental information commons. For example create and populate a 'data.nc.gov' portal and a 'data.deq.nc.gov' portal.
 - c. Potential regional engagement, i.e. southeast states, to pool resources for joint development of catalogs and tools.
 - d. Ways to leverage the variety of potential partnerships within North Carolina to bring unique and innovative approaches and solutions to address the other elements and with a goal to maximize the return on the North Carolina's investment in its data and knowledge resources.

¹ <https://files.nc.gov/ncditi/documents/files/GICC-Data-Sharing-Report-11-07.pdf>

Introduction

Charge

This report responds to a request made to the North Carolina Policy Collaboratory by the North Carolina General Assembly (NCGA) pursuant to Session Law 2017-209 (Section 20.1). It addresses the four tasks assigned to the North Carolina Policy Collaboratory (Collaboratory) per Session Law 2017-57 (Section 13.7) and as amended by Session Law 2017-209 (Section 20.1). These tasks are:

- Identification and acquisition of digital data relevant to environmental monitoring and natural resource management, including, but not limited to, the digitization of analog records.
- The creation of online public access to National Pollutant Discharge Elimination System (NPDES) and other water quality permits, permit applications, and relevant supporting documents.
- Creation of a system for electronic filing of applications for such permits and relevant supporting documents.
- The Collaboratory shall assess the feasibility of transferring these data to a central, searchable, and publicly accessible digital database as well as how and where the database could be managed.

Approach

In the research and preparation of this report, a range of expert and published resources were consulted. The authors met with the NC Division of Environmental Quality (NC DEQ) staff who oversee data management and information technology resources related to permitting, and held conversations with NC DEQ Division of Environmental Assistance and Customer Service (DEACS) staff including the Acting Director and an Environmental Assistance Coordinator. Online resources consulted included relevant EPA and NC DEQ websites. For comparative purposes, online resources on water and pollution permitting in other states were also reviewed. Other materials were consulted as noted in footnotes and references. The team also had an opportunity to meet with a private sector vendor of information technology systems, and we consulted other experts as available (for example, a drinking water sourcing expert to provide potential contextual information).

The general methodology consisted of information gathering about the permitting process, identifying potential use cases, comparing the potential use cases to existing available resources, and analyzing the gaps and barriers illuminated during the comparison. The resulting recommendations are presented as guides for consideration and discussion in the context of planning for future systems development or data and information reorganization.

Report Organization

To address the tasks described in the charge, this report focuses on two main areas of analysis:

1. the current data and information landscape as related to wastewater permitting and related environmental data; and
2. a discussion of the positive elements and challenges presented by the current situation that may inform potential recommendations.

Understanding existing policy goals and requirements related to water permitting and environmental data, as well as surveying the available online resources was necessary to provide context and to inform the analysis. Federal programmatic elements provide the framework for operationalization at the state level. The identified available resources were evaluated against a set of hypothetical questions or scenarios related to water permitting. These scenarios are based on suggestions from stakeholders and a hypothetical, but realistic, consideration of reasonable ways to slice through the available information. The report provides an analysis based on considering the scenarios and concludes with a set of recommendations for near-term and longer-term consideration.

EPA NPDES Water Permitting

NPDES Background

The National Pollutant Discharge Elimination System (NPDES) was created in 1972 and is the program by which the United States Environmental Protection Agency (EPA) oversees the discharge of pollutants from point sources into waters of the US. NPDES is one of the mechanisms used by the EPA to operationalize the goals of the Clean Water Act (CWA). The NPDES process facilitates the goal of clean water and requires all point source discharges to obtain permits. Permits specify effluent limitations based on available technology or the quality of the receiving waters. The NPDES extends across a range of programmatic areas related to pollutant discharges. For the complete list of program areas as defined by EPA, see Appendix A.²

Pollutants, Conventional and Toxic

Under the CWA, a pollutant is defined as anything discharged that is not naturally occurring or in quantities above what might be found in nature. This broad category is further broken down into ‘conventional pollutants’ and ‘toxic pollutants’. All other pollutants are considered to be nonconventional. Examples of conventional pollutants include effluent pH, fecal coliform, and oil and grease. Toxic pollutants include a list of 65 compounds or groups of compounds (Toxic Pollutant List see Table 1, at 40 CFR 401.15), heavy metals (mercury and lead), and organic

² <https://www.epa.gov/npdes>

compounds (PCBs and dioxane). In addition, 126 compounds have been listed as priority toxic pollutants (Priority Toxic Pollutant list see Appendix A, at 40 CFR Part 423,). Priority toxic pollutants are EPA-regulated chemicals for which the EPA has published analytical testing methods.³ Examples of nonconventional pollutants include chlorine, ammonia, nitrogen, phosphorus, and solids.

Water Quality Standards and Effluent Guidelines

In addition to the characterization of pollutants in effluents, all waters of the US are classified based on a designated use with water quality standards (WQS) assigned to meet those designated uses and to protect aquatic organisms and human health. The WQS form the basis for determining permit limits for discharges to the receiving body of water.⁴

Effluent guidelines are the regulatory standards applied to pollutants. The guidelines integrate the target levels for a pollutant and the methods for controlling the release of the pollutants. The EPA is required under the CWA to review the effluent guidelines annually. Currently, the EPA conducts an annual guideline review process and publishes updated guidelines on a biennial schedule.⁵ Effluent guidelines are translated into technology-based effluent permit limits for all applicable pollutants of concern. If these limits are not adequate to protect water quality, then water quality-based effluent permit limits must be developed.

Permitting Process

Permits are required when effluent is discharged into waters of the US. In many cases, the EPA delegates management and oversight of the permitting process to individual states or Indian tribes. However, EPA still retains oversight of the delegated program for both permitting and enforcement. Delegated program NPDES permits are submitted to EPA for review and concurrence before issuance. Figure 1 shows the status of EPA permitting delegation to individual states. Table 1 provides the specific timeline for North Carolina. North Carolina has been authorized under NPDES since 1975.

³ <https://www.epa.gov/eg/toxic-and-priority-pollutants-under-clean-water-act>

⁴ <https://www.epa.gov/wqs-tech/water-quality-standards-handbook>

⁵ <https://www.epa.gov/eg>, <https://www.epa.gov/eg/learn-about-effluent-guidelines>

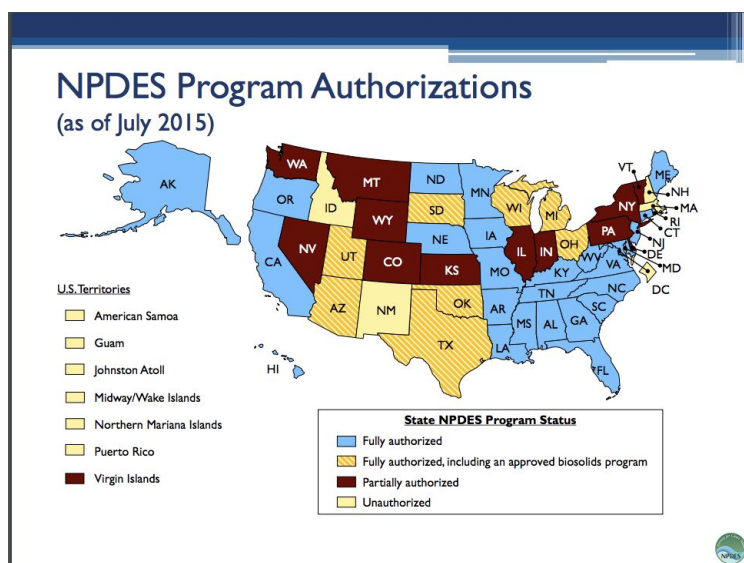


Figure 1. Source: EPA⁶

	Authorized State NPDES Permit Program	Authorized to Regulate Federal Facilities	Authorized State Pretreatment Program	Authorized General Permits Program	Authorized Biosolids (Sludge) Program
North Carolina	10/19/75	09/28/84	06/14/82	09/06/91	--

Table 1. Source: EPA

Oversight and Enforcement

As part of an NPDES permit, acceptable levels of pollutant release are specified along with a testing methodology. Permit holders are responsible for reporting the results from their monitoring and are required to notify the EPA and the state if they are not in compliance with permit requirements. Facilities may also be subject to periodic compliance inspections by EPA and the state. The monitoring reports are public and individuals may access the reports and raise questions regarding noncompliance if the EPA or state has not already done so.⁷ Both the EPA and the delegated state have enforcement authority.

Online Data and Information

EPA has a number of online systems through which individuals can retrieve information about NPDES permits and related information. The primary interface is EnviroFacts (<https://www3.epa.gov/enviro/>). EnviroFacts is an umbrella interface providing access to a

⁶ https://www.epa.gov/sites/production/files/2015-10/documents/state_npdes_program_status.pdf

⁷ <https://www.epa.gov/npdes/npdes-permit-basics>

variety of data collected by EPA related to its mandate. A user has multiple options to search for information including location, facility, facility industrial application, and pollutant (by name or chemical abstract number). The user can also choose to delve into the content thematically, e.g. water (or air). In this case, they are taken to a list of water-related search interfaces including a water permit interface called the Permit Compliance System (PCS) and Integrated Compliance Information System (ICIS) or PCS-ICIS (<https://www.epa.gov/enviro/pcs-icis-search>).

PCS-ICIS allows users to search for facilities with NPDES permits via a rich set of attributes, including geography, permit number, and chemicals. A North Carolina specific-search of the PCS-ICIS system returned records for 7,532 facilities. Search results may be refined by facility attribute including name, permit issue and expiration dates, and chemical. For each record, additional options allow drilling down into the information. For example, the 'MAPPING INFO' option displays location attributes such as administrative units, watershed information, latitude/longitude, and discharge points. Clicking on the 'NPDES ID' option displays detailed permit information such as permit issue and expiration dates, reports, inspections, and violations. See Figures 2 - 4 for example screen captures from the interactive site.

Facility			
FACILITY NAME (1)	NEUSE RIVER RESOURCE RECOVERY FACILITY	NPDES	NCG110001
STREET 1	8500 BATTLE BRIDGE RD	SIC CODE	4952 = Sewerage Systems
CITY		MAJOR / MINOR	
COUNTY NAME	Wake	TYPE OF OWNERSHIP	Municipal or Water District
STATE	NC	ACTIVITY STATUS	Admin Continued
ZIP CODE	27610	INACTIVE DATE	
REGION	Region 4	TYPE OF PERMIT ISSUED	General Permit Covered Facility
LATITUDE	35.723333	ORIGINAL PERMIT ISSUE DATE	01-JUN-2008
LONGITUDE	-78.477778	PERMIT ISSUED DATE	01-JUN-2008
LAT/LON CODE OF ACCURACY	30	PERMIT EXPIRED DATE	31-MAY-2013
LAT/LON METHOD			
LAT/LON SCALE		USGS HYDRO BASIN CODE	
LAT/LON DATUM		FLOW	0
RECEIVING WATERS		FEDERAL GRANT IND	
PRETREATMENT CODE		SLUDGE CLASS FAC IND	POTW
MAILING NAME		SLUDGE RELATED PERMIT NUM	
MAILING STREET (1)		ANNUAL DRY SLUDGE PROD	
MAILING STREET (2)			
MAILING CITY			
MAILING STATE			
MAILING ZIP CODE			
COGNIZANT OFFICIAL		COGNIZANT OFFICIAL TEL	

Figure 2. Source: EPA

Activity

FACILITY NAME (1)	NEUSE RIVER RESOURCE RECOVERY FACILITY	NPDES	NCG110001
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ACTIVITY NAME	ACTIVITY TYPE DESCRIPTION	ACTIVITY STATUS DESCRIPTION	ACTIVITY STATUS DATE	ACTUAL BEGIN DATE	ACTUAL END DATE
NPDES Permit (CWA)	Permit				
NPDES Permit (CWA)	Permit				
NPDES Permit (CWA)	Permit	Active	08-JUL-2013		
NPDES Permit (CWA)	Permit	Active	08-JUL-2013		
NCG110001-CEI-2012-12-19	Inspection/Evaluation	Active	25-FEB-2013	19-DEC-2012	19-DEC-2012
NCG110001-CEI-2012-12-19	Inspection/Evaluation	Active	25-FEB-2013	19-DEC-2012	19-DEC-2012
NEUSE RIVER WWTP (Permit NCG110001) Compliance Eval (Non-Sampling)	Inspection/Evaluation		24-NOV-2010		24-NOV-2010
NEUSE RIVER WWTP (Permit NCG110001) Compliance Eval (Non-Sampling)	Inspection/Evaluation		24-NOV-2010		24-NOV-2010
NEUSE RIVER WWTP (Permit NCG110001) Compliance Eval (Non-Sampling)	Inspection/Evaluation		31-OCT-2008		31-OCT-2008
NEUSE RIVER WWTP (Permit NCG110001) Compliance Eval (Non-Sampling)	Inspection/Evaluation		31-OCT-2008		31-OCT-2008
NEUSE RIVER WWTP (Permit NCG110001) Compliance Eval (Non-Sampling)	Inspection/Evaluation		25-APR-2006		25-APR-2006
NEUSE RIVER WWTP (Permit NCG110001) Compliance Eval (Non-Sampling)	Inspection/Evaluation		25-APR-2006		25-APR-2006
NEUSE RIVER WWTP (Permit NCG110001) Compliance Eval (Non-Sampling)	Inspection/Evaluation		28-APR-2005		28-APR-2005
NEUSE RIVER WWTP (Permit NCG110001) Compliance Eval (Non-Sampling)	Inspection/Evaluation		28-APR-2005		28-APR-2005
NEUSE RIVER WWTP (Permit NCG110001) Compliance Eval (Non-Sampling)	Inspection/Evaluation		24-JUN-2004		24-JUN-2004
NEUSE RIVER WWTP (Permit NCG110001) Compliance Eval (Non-Sampling)	Inspection/Evaluation		24-JUN-2004		24-JUN-2004

Figure 3. Source: EPA

Permit Tracking

FACILITY NAME (1)	NEUSE RIVER RESOURCE RECOVERY FACILITY	NPDES	NCG110001
PERMIT ISSUED BY		ORIGINAL DATE OF ISSUE	01-JUN-2008
PERMIT ISSUED DATE	01-JUN-2013	PERMIT EXPIRED DATE	31-MAY-2018
EFFECTIVE DATE	01-JUN-2013	RETIREMENT DATE	

FACILITY NAME (1)	NEUSE RIVER RESOURCE RECOVERY FACILITY	NPDES	NCG110001
PERMIT ISSUED BY		ORIGINAL DATE OF ISSUE	01-JUN-2008
PERMIT ISSUED DATE	01-JUN-2008	PERMIT EXPIRED DATE	31-MAY-2013
EFFECTIVE DATE	01-JUN-2008	RETIREMENT DATE	31-MAY-2013

EVENT DESCRIPTION	EVENT DATE
Permit Expiration	31-MAY-2018
Permit Issued	01-JUN-2013
Permit Effective	01-JUN-2013
Permit Reissued	01-JUN-2013
Permit Continued	01-JUN-2013
Permit Expiration	31-MAY-2013
Permit Retired	31-MAY-2013
Permit Effective	01-JUN-2008
Permit Issued	01-JUN-2008

Figure 4. Source: EPA

The Enforcement and Compliance History Online (ECHO⁸) system allows users to initiate a query of compliance-related data reported to EPA. A search for North Carolina facilities with water permits yields 6,338 entries. ECHO also contains reports from the Toxic Release Inventory (TRI) and the Discharge Monitoring Reports (DMR), under the water category. The TRI versus DMR comparison dashboard lists a total of 1,278 release reporting facilities for 2016, the most recent reporting year in the system 126 TRI and 1,152 DMR.

Accounting for the specifics behind the discrepancy between the number of facilities for North Carolina in PCS-ICIS and in ECHO is beyond the scope of this report. The underlying databases are providing access to related, but slightly different information. In addition, the EPA notes that there are ongoing transitions from older systems to newer systems, e.g. PCS to ICIS and that some states have encountered difficulties with data uploads, including North Carolina.

Other Data Access Methods

The EPA offers a number of machine-to-machine mechanisms for querying and retrieving data from EPA databases, e.g. through APIs and REST-ful services. These kinds of services enable automated report generation and other types of services that can return the content as part of a web page generated on the fly.

Future Electronic Permit Reporting Requirements

In 2015, the EPA announced it would be requiring electronic submission of permit applications, documentation and monitoring reports, setting the year 2020 for full electronic submission. In the interim, the EPA required states to submit an implementation plan for compliance with the electronic submission requirements by December 2016. North Carolina's electronic reporting rule compliance plan for all NPDES permits has been submitted. North Carolina's submission outlines DEQ's plan to evaluate various options to implement electronic application and reporting in order to reach full compliance by 2020.⁹

EPA has implemented an online system to submit state-related permit information, NetDMR (See Figure 5). EPA also provides an online data exchange platform, the EPA Central Data Exchange (CDX). The CDX can be customized to create a data submission service for each state.¹⁰

⁸ <https://echo.epa.gov/>

⁹ https://www.epa.gov/sites/production/files/2017-12/documents/nc_deq_r4_ip_21december2016.pdf

¹⁰ https://netdmr.zendesk.com/hc/en-us/article_attachments/115004193532/NetDMR_UserGuide_.pdf

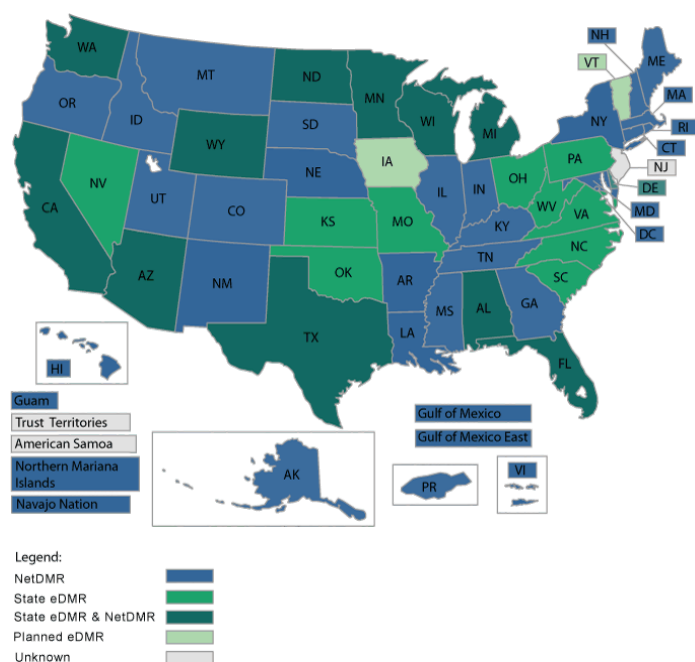


Figure 5. Source: EPA NetDMR Support Portal¹¹

North Carolina NPDES Permitting

North Carolina Department of Environmental Quality (NC DEQ) oversees water-related permitting, as well as other types of environmental permits per state policy and per the authority delegated to the state by the EPA. NC DEQ maintains a set of online resources devoted to the permitting processes including links to instructions and forms and contact information to obtain additional help. NC DEQ, through its Division of Environmental Assistance and Customer Service (DEACS), provides comprehensive assistance to the public seeking help with environmental permitting through their Environmental Assistance Coordinators located within the seven regional offices around the state. Technical permitting questions for the NPDES program are referred to the Division of Water Resources or the Division of Energy, Mineral and Land Resources as appropriate.

Types of Permits, Permit Process, and Compliance

NC DEQ provides a comprehensive set of online permit and permit process information, from general¹² to specific. The DEQ permit directory takes a user to a comprehensive alphabetical list of environment-related permit information. This page contains a submenu with classes of permits, including water-related permits. NPDES permits are listed within the water-related list.¹³ This list provides links to instructions (pdf files) that contain detailed information that guide an

¹¹ <https://netdmr.zendesk.com/hc/en-us/articles/209616426-For-New-Users-Who-Can-Report->

¹² <https://deq.nc.gov/node/1819>

¹³ See <https://deq.nc.gov/permits-regulations/permit-directory/water>

end-user through the permitting process. The instruction sheets contain links to the required forms and other sources of relevant information. An example instruction sheet is provided in Appendix B. In most cases, the NPDES permit application forms are provided by the EPA. In many instances, permit applicants are able to submit the required fees electronically via an online system. The NPDES stormwater program is overseen by DEQ, Energy, Mineral and Land Resources and the NPDES wastewater program and animal waste falls under DEQ Division of Water Resources. Additional permit process resources are available via an online handbook and 'tool box'.¹⁴

When an entity such as a municipal waste treatment facility or a new manufacturing facility engages with DEACS, an Environmental Assistance Coordinator works with the facility representative to evaluate the potential need for all relevant types of environmental permits such as those related to air quality, water quality, and ground/soil conditions. Once the requirements are established, the facility representatives can use the various online resources to progress through the permitting process. In addition to using the services provided by DEACS, many permit applicants engage consultants to help navigate the permitting process.

At the core of the NPDES permitting/compliance process is self-reporting whereby permittees are required to provide discharge monitoring reports (DMRs) on a regular basis. These are provided in paper or digital form depending on the type of permit. DEQ staff review the reports for potential permit violations or other problems.¹⁵ To facilitate submissions, DEQ provides an electronic submission capability known as eDMR. However, this system only accepts DMRs for NPDES individual wastewater permits.¹⁶

Access to North Carolina Permit Information

This section provides an overview of online and other digital resources for accessing the spectrum of water permit related information. These range from geographic information system (GIS) mapping interfaces to repositories of scanned documents. These online resources exist in addition to the EPA online resources outlined above.

Environmental Application Tracker

The Environmental Application Tracker can be accessed from DEQ home page, displays the range of environmental permits, e.g. air or water, geographically by permit type, and allows the user drill down to a given facility and retrieve selected attributes. The interface also allows the display of county boundaries or watershed delineations. See

<https://deq.nc.gov/permits-regulations/permit-guidance/environmental-application-tracker>.

¹⁴ <https://deq.nc.gov/permits-regulations/permit-guidance/permit-handbook>,
<https://deq.nc.gov/permits-regulations/permit-guidance/permit-handbook/permit-toolbox>

¹⁵ <https://deq.nc.gov/node/12590>

¹⁶ <https://deq.nc.gov/about/divisions/water-resources/edmr>

List of Active/Expired Individual and General Permits

Downloadable excel spreadsheets with lists of permits and associated attributes are available via links on the DEQ Permit Process page. See <https://deq.nc.gov/node/1819>.

NPDES Wastewater Permit Mapping Site

This interface allows the user to see the geolocation of permitted facilities and view the results by watershed (Figure 6). The user can select an individual site for more detailed information, or access subsets of permit documents. Appendix C contains several images from this interface.

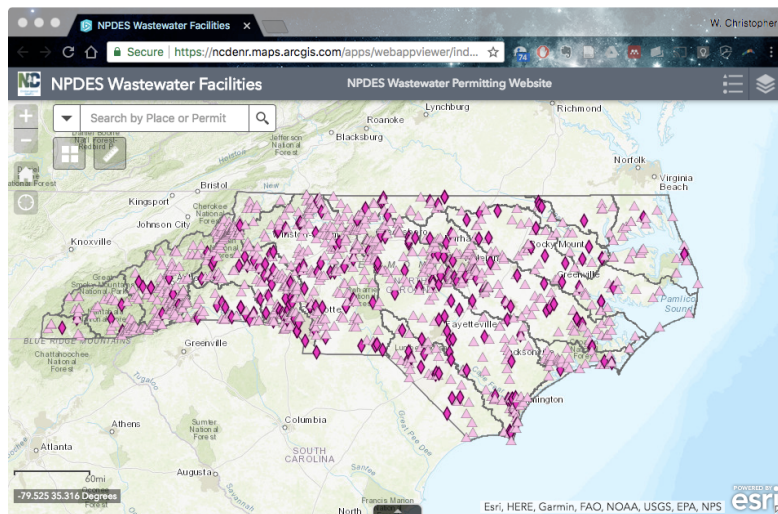


Figure 6. Source: NC DEQ¹⁷

Stormwater NPDES Permits

Stormwater permits can be accessed through a similar web-based GIS search interface (Figure 7). This interface provides geolocation mapping and individual site selection to view attributes about the facility. However, this interface does not provide access to specific permit documents.

¹⁷ <https://ncdenr.maps.arcgis.com/apps/webappviewer/index.html?id=4ca77e79b68e466cbcae9713a28dde7d>

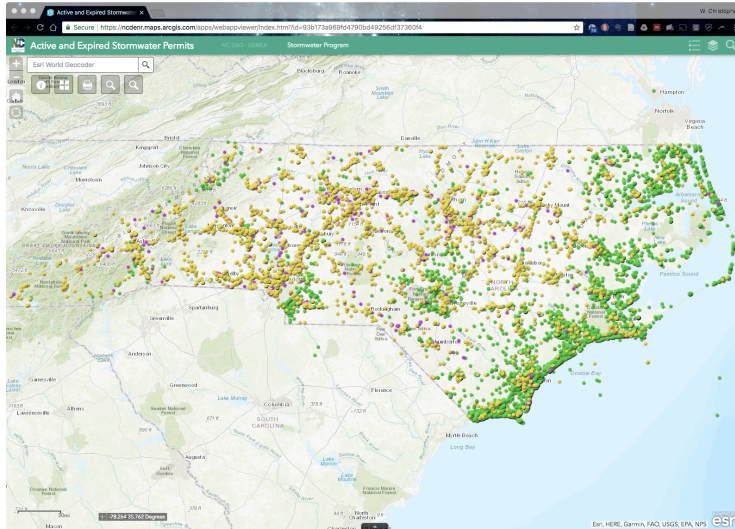


Figure 7. Source: NC DEQ¹⁸

Animal Waste Permit Mapping¹⁹

Similar to the other GIS interfaces above, this interface (Figure 8) provides geolocation and facility attribute access for permits related to animal waste. However, it does not provide access to specific permit documents.

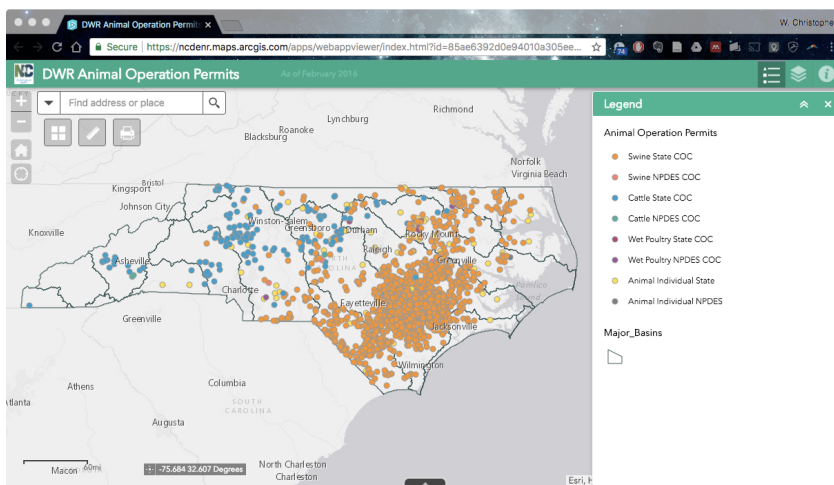


Figure 8. Source: NC DEQ²⁰

¹⁸ <https://ncdenr.maps.arcgis.com/apps/webappviewer/index.html?id=93b173a969fd4790bd49256df37360f4>

¹⁹ There is an additional mapping interface for energy-mineral-land-resources. However, this may be an outdated resource as there is a notice that the last update was in 2012. The purpose of the interface is to show jurisdictions subject to permit programs.
<https://deq.nc.gov/about/divisions/energy-mineral-land-resources/energy-mineral-land-data/stormwater-maps-gis-resources/Stormwater-Permitting-Interactive-Map>

²⁰ <http://ncdenr.maps.arcgis.com/apps/webappviewer/index.html?id=85ae6392d0e94010a305eedf06e3f288>

NC NPDES Electronic Reporting

Per the requirements of EPA to provide fully electronic reporting, NC DEQ has been transitioning to electronic submission of Discharge Monitoring Reports. There are currently approximately 1,000 facilities participating in the electronic reporting submission process. Until fully implemented, facilities will continue to submit paper copies of their executed reports to DEQ. See

<https://deq.nc.gov/about/divisions/water-resources/edmr/npdes-electronic-reporting/faq>.

Other Sources of Permit Information

NC DEQ maintains an electronic resource called the Basinwide Information Management System (BIMS). There is no publicly accessible interface to this system. However, individuals may request information subsets from the system.

DEQ also leverages an electronic document image management system for scanned copies of permit documents called Laserfiche.

NC Permits by the Numbers

Permit Counts as of 15 September 2017: (NPDES and State Stormwater) in BIMS (Basinwide Information Management System)

Type	Count
Wastewater	6,671
Stormwater	8,116
Animal	2,392
"Deemed" Animal	1,685
Ground Water	4,510
"Deemed" Groundwater	1,444
Non-Discharge	32,175
.....	
<i>NPDES Total</i>	<i>56,993</i>
State Stormwater	14,876
Total permits	71,869
Laserfiche NPDES-related documents	9,487 ²¹

²¹ Permit counts provided by NC DEQ staff.

Permit Transformation Project

DEACS has been tasked with developing recommendations for improving the permitting process. DEACS has solicited stakeholder needs and interests to inform potential improvements, and project goals include developing a database of permitting information and implementing an online applications tool. The full vision is to create an online permitting portal. The report will be made available to the DEQ administrator in the March-April 2018 time-frame.

NC Environmental Data

In addition to the various online water permitting resources described above, the North Carolina state government maintains many different online resources for a large array of environmental data. These data include meteorological and hydrologic data and models, geologic information, maps, aerial photographs, water quality data, and others. These data are made available in a variety of forms, ranging from tabular data to geospatial data formats and others. The interfaces to these data are varied as well from web GIS, basic hyperlinks to files or other web pages with information, to interactive database query applications. These starting points to deeper data access are available in many different places throughout the DEQ website. A simple query of the word “data” through their web search interface produces 2,175 results. While the search results probably overstate data availability, since this is a simple text-based search, it does reasonably illustrate the breadth of available resources. Additionally, NC environmental data is organized by topical lists of geospatial and other data types. Selecting a link takes the user to the particular page or interface for that resource. It is notable that these data resources are listed under the master heading of “Research”.²²

Legacy Records

Digitization

One of this project’s main objectives is to assess the feasibility of digitization of legacy data and information. While clearly desirable, the benefits of this conversion from analog paper records to searchable digital formats should be reconciled with the costs. This conversion is time-consuming, costly, and subject to issues of usability and quality control. The digitization process is generally broken into a number of steps, such as document preparation, scanning, conversion, optical character recognition (OCR) processing, and quality control. Technologies

²² See <https://deq.nc.gov/science-data>.

and services exist to facilitate digitization, but the production of quality results is usually a very labor intensive process.

Each of the digitization steps may have a unit cost depending on the vendor. Furthermore, to render the information contained in the paper records usable, the documents should be scanned at a higher resolution and processed via OCR. These latter steps require more effort and the concomitant costs are higher. There may also be costs associated with handling the physical documents, e.g. transporting the physical documents offsite to be processed. Even if the scanning is done onsite, the documents still have to be physically handled, and decisions made regarding the disposition of the originals after scanning. Typical considerations include whether (or not) the documents can be destroyed, and any record retention and archiving policies and laws. Costs can range from several cents per page to several dollars depending on the level of service.

It should be noted that there are numerous businesses that provide these types of services both within North Carolina and nationally. Document conversion services are also available via GSA contracting services that facilitate procurement by government entities.

Developing a Robust Online Permitting and Environmental Data System

The potential for digital content and systems to improve governmental efficiency, provide beneficial economic returns, inform policy-making, promote public safety, and address stakeholder needs is an exciting prospect. The development of a comprehensive online permit and environmental information system is a task defined in part by the end goals, but challenged by the complexity of the content, the range of stakeholders, the intricate policy and regulatory context, and the varied potential scenarios related to accessing and using the content. In this section, potential questions or user scenarios are outlined as a mechanism to understand aspects of the existing system that inhibit or promote access to and use of digital information. Describing these elements also sets the context for recommendations for potential actions going forward.

Representative Questions

The types of questions that can be raised in the context of access to permit data and information will depend largely on the stakeholder interests and their needs for delving into the environmental permit data and information domain, reporting requirements, and anticipated uses. However, it is reasonable to assert that these questions can be distilled and categorized to help organize a larger set of questions and issues. The following set of questions is thus meant to be illustrative.

Policy and Process

- How is pollution defined?
- What is an NPDES permit and how is it different from a state permit?
- When is a permit needed?
- How do I submit a permit?
- How much is it going to cost and how do I pay?
- How many permits are there and what is their status (e.g. active, expired, under review)?

Context, Analysis, Regulatory

- What types of pollution are being discharged from a given point source?
- What types of pollution are being discharged into a given waterway or water system?
- How much pollution is being discharged?
- Is the pollution being released toxic to humans, animals, or plants in general and at the levels reported?
- What facilities are discharging pollution, what kinds, and how much?
- Is my facility in compliance with applicable laws and regulations?

As the current available resources were investigated, these common user scenarios provided the means to evaluate the availability, accessibility, content, and organization of the various resources. We effectively took the role of a potential user and worked to determine how and where to find answers to the types of questions addressed above. Rather than address the feasibility of answering each question as part of the following analysis, the observations can be synthesized. The analysis does not address aspects like web design, aesthetics, or the technology used to render web pages and content.

Assessment

Positives

- There is a vast array of data and information available on permitting and environmental information.
- It is clear that a great deal of effort goes into collecting, archiving, and making available the current resources.
- The information is organized in a logical way both by topic and by organization and organizational subdivision.
- The access tools in many instances are using up-to-date operational technology.
- The search interfaces quickly return relevant results.
- There is a functionality for users to provide feedback on web pages.
- DEQ staff are available to provide help and answer questions as needed.

Challenges

- While the volume and variety of information available related to water permitting and the environment is a positive aspect, the amount of available information can be overwhelming. This can make the task of finding relevant material challenging. It may also undermine the user's perception of the information or site as an authoritative resource. For example, if the user finds similar, but not exactly the same, information in two different interfaces, how does the user know if they have found the authoritative information source.
- The existence of many different potential attributes tied to permits (e.g. multiple jurisdictions, geographies, permitted entities, permitted activities, types of pollution (toxic, regulated, unregulated), reporting, and testing) complicates the types of information, i.e. metadata, needed as part of the digital material in the permitting and environmental information systems. Is the unit of analysis the permit, the facility, the type of permit, the location (address, lat/long, watershed, municipality, county), the type of effluent, chemicals in the effluent, or something else? Slicing through a large amount of loosely organized content can only be done by adding structure and additional metadata to the underlying data. This is generally a time-consuming process.
- Similarly, the complexity of the regulatory environment and the array of potential policy questions that can be applied to the online resources increase the difficulties of determining what relevant content is needed, how to collect the ancillary information, how to organize and represent that content, and how to operationalize capturing and making available the relevant information. An agency may be responding to a regulatory reporting mandate that may not directly support other types of relevant policy-related use cases.
- The subject matter of much of water pollution-related information is very complex and opaque to a typical user. For example, chemical nomenclature is arcane; limitations on pollutant concentrations and testing results are complex and confusing; testing procedures are technically and scientifically complex; toxicity or other environmental risk is challenging to communicate and understand. This topical complexity increases the need for accurate and descriptive labeling, help and information pages, or other types of explanatory information to support usability of the system and facilitate understanding of the content.
- The existing organization of permit and environmental information appears to be largely from a top-down perspective, based on either an administrative or a topical hierarchy. This type of organization of data and information is logical, but can limit more general exploration and uses. Other approaches can be more cross-cutting and may more easily support multiple use cases, e.g. a GIS data clearinghouse, process or query-based organization, or online catalogs of available resources.
- Different departmental "walled gardens", which arise organically as technology and other requirements diffuse at different rates across organizations, can lead to a potential replication of information, make sharing harder, and present a confusing landscape for

the general user. This is usually an unintended consequence of the way in which technology evolves and is adopted. However, a countervailing strategy is needed to break down the walls where needed.

- The promise of technology, the view that the right technology is the answer to information management and retrieval, is attractive but potentially misdirects resources from activities that will provide better value-add for facilitating information management and retrieval.
- Evolving technology can lead to new tools and new analytical approaches that can create new data types and change the perception of what constitutes “data” (e.g. social media). The new approaches may also change the perceived need for information synthesized from a variety of sources. For example, new tools like drones or high resolution sensors may generate new data that is more complex and of greater volume than prior versions, potentially requiring system redesign and re-engineering. Extracting digital content from fields on a form and organizing it into a database potentially increases the utility of the content. The ability to do this is now much easier than starting from a scanned electronic version of a sheet of paper. However, existing systems were put in place using best available technology which may not be able to support new use cases.
- The pace of technology change also often outpaces an institution’s ability to adapt to change. The evolving hardware, software, middleware, standards, and protocols increase the potential to do new things with existing content. However, tracking and leveraging these types of changes can be challenging for governmental institutions particularly in resource constrained environments.

Addressing the Charge

At the beginning of this report, the charge was listed as contained in the relevant legislative language. These items are restated here along with a high-level assessment addressing each element.

1. Identification and acquisition of digital data relevant to environmental monitoring and natural resource management, including, but not limited to, the digitization of analog records.
 - The state of North Carolina has an array of all types of digital data relevant to environmental monitoring and natural resource management. These data are available in many forms and through a variety of interfaces.
 - The potential for digitization of analog records is difficult to evaluate without clearly identified and compelling needs.
2. The creation of online public access to National Pollutant Discharge Elimination System (NPDES) and other water quality permits, permit applications, and relevant supporting documents.
 - NC DEQ already provides access to various elements related to environmental permitting. These online resources cover a significant array of the permitting landscape.

- In addition, much of the permitting data and information is also available through EPA online interfaces as the EPA is increasingly moving to requiring digital submission as part of its regulatory oversight.
 - Permit information is provided via electronic forms. These forms are for the most part submitted as digital objects which facilitates their availability for retrieval via online systems.
 - Records of permits and permit attributes are maintained in the Basinwide Information Management System (BIMS) system.
 - DEQ is actively working to increase the availability of online digital permit information, permitting application and compliance tools, and to integrate these into a comprehensive system.
3. Creation of a system for electronic filing of applications for such permits and relevant supporting documents.
 - DEQ is also actively working to improve the permitting process through its permit transformation project.
 - The permit process is currently largely form-based. The focus on forms as the core object to be managed can limit the ability to extract information from the forms. However, these forms do not appear to be driving the population of a database on the backend. Developing a form interface that is database driven is a technically complex undertaking.
 4. The Collaboratory shall assess the feasibility of transferring these data to a central, searchable, and publicly accessible digital database as well as how and where the database could be managed.
 - Transferring these data, permit and environmental, to a central database would be a substantial undertaking. The number of relevant types of objects, object attributes, data formats, and file types, would make the effort extremely complex; particularly since the various elements are currently in different systems.
 - Centralizing content runs counter to current information technology trends which are moving in the direction of distributed (decentralized) storage and processing.
 - The idea of centralization, in the sense of a 'one-stop shop', is better supported by investing in capabilities to do value-added work on existing resources to promote curation and interoperability of data and data systems.
 - The idea of centralizing and homogenizing hardware and software platforms in the sense of developing a centralized cloud resource is a separate project with its own set of cost-benefit analyses.

The overarching challenge for implementing a concept of permitting and environmental data system in North Carolina is neither a lack of relevant content, nor technical infrastructure knowledge and expertise. The challenge is how to rethink the approach to how content is curated and how interoperability is supported so that the content can support multiple integrated search, access and use scenarios.

Rethinking Access to Water Permit and Environmental Data and Information

Provision of Publicly-Funded Data - General Concepts

Data Explosion

As is well known, we live in the age of data. Technology has enabled the efficient collection of all sorts of data from personal to environmental sensors, to vast amounts of social media, to satellite and other remotely sensed data. These trends show no signs of slowing down. In fact, the pace, volume, and complexity continues to grow. Data in this context are both a benefit and a curse. The benefits arise from the unprecedented ability to gather observations and the resulting opportunities to create and share new knowledge and new information. These benefits can arise through new economic opportunities, business efficiencies, benefits to corporate or fundamental research activities, or improved health and well-being. The curse comes in the form of tremendous challenges in effectively managing the data and information, as well as in providing effective access.

Value of Open and Accessible Data

In the past few years, there has been a large-scale effort to significantly expand the availability of data produced through public funds, whether directly from government activities or indirectly through government-funded activities. The primary driver behind this is the recognition of the potential of these public assets to contribute to economic growth for the country and contribute to security and well-being of citizens. At the national level, it is estimated that US government investments in open data provide an almost seven-fold return with an estimated \$200 billion value.²³ Data are central to national security and economic prosperity.

Deconstructing Data and Information Systems

Elements of Online Systems

Assuming that requirements are understood well enough to begin development and that the design principles (for example data interoperability) are well understood, developing the system still involves a range of required infrastructure and knowledge to realize the vision. Developing online information systems and decision support tools includes system architecture, *data*

²³ <https://www.data.gov/meta/roundtable-open-data-economic-growth/>, <https://esa.gov/sites/default/files/revisedfosteringinnovationcreatingjobsdrivingbetterdecisions-thevalueofgovernmentdata.pdf>

management, knowledge management, database expertise, content development, web design, user experience design, and user support, in addition to hardware, software, networking, and backup infrastructure. It is easy to overlook all of the factors necessary to provide even basic access to digital resources.

Tension Between General and Specific

An online system that supports regulatory, policy, or business processes ideally should be designed and developed with a vision that addresses as many potential use cases as possible. However, there is an ongoing tension in the development of online information systems between systems that adequately support specific use cases and systems that support a myriad of uses. In many cases, the system that is designed to support a multiplicity of use cases ends up not working well for anyone. The challenge is to find the right balance between the two extremes and to create approaches to development of data and information systems that are flexible and allow for changes and adaptations.

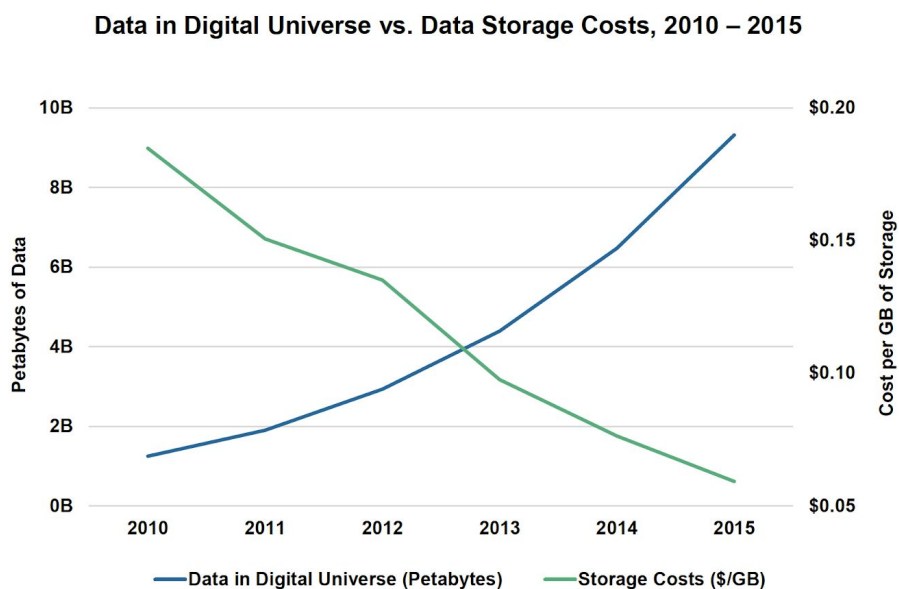
Curation and Knowledge Management

The most important element to providing flexible systems is to invest in the capability to do the value-added work of curation and knowledge management on the data and information. This requires ensuring that, to the extent possible, sufficient planning and execution go into determining the essential elements that need to be managed, and what metadata needs to be captured in order to make those elements accessible or interoperable for a variety of use cases. For example, if a form-based pdf file is made available, the same information could be served from a form-driven database where the content is submitted and validated and is then available to support *multiple* use cases. The effort to provide adequate metadata and to ascertain appropriate data formats and standards is essential to providing flexibility to serve different needs from the same underlying content. Another example would be distributed catalogs of information. The catalogs do not have to use a centralized infrastructure or even a common software framework as long as 1) the metadata is made available in a consistent way, and 2) the distributed resources are interoperable.

True Cost Drivers

It is also easy, when thinking about developing or evolving online information systems, to take for granted the human, value-added aspects of data management and knowledge management, particularly when assuming that infrastructure, hardware, networking, IT administration, and software, are the main cost drivers. To be sure, the hardware and software costs are a significant part of information system infrastructure. However, hardware IT infrastructure costs have generally declined per unit of capability over time. At the same time, as is well known, the rate, volume, and complexity of new data and information continues to exponentially increase. It is less well understood, however, that IT infrastructure is probably not the main driver of costs in the context of online data and information systems (Figure 9). Investments in personnel to

operationalize effective knowledge management are significant investments that are often overlooked.



@KPCB

Source: IDC, May 2016

KPCB INTERNET TRENDS 2016 | PAGE 195

Figure 9. Source: KPCB Internet Trends Report, 2016²⁴

Decision Points and Options

Scenarios for Developing Online Permitting and Environmental Data Systems

For purposes of thinking about pathways forward, we outline four basic approaches in Table 2. As presented, these pathways intentionally oversimplify the problem. However, they are helpful in the context of moving towards recommendations. The table below presents an overview of some of the potential trade-offs for each. The point here is not to advocate for one particular scenario over another. The goal is to help illustrate some of the necessary trade-offs. Many organizations use a variety of strategies to address their data system needs based on their priorities, available knowledge and technology, and available resources.

Scenario	Description	Pros	Cons
Purchase an off-the-shelf solution	Find a vendor who has already developed a similar system	• Might be faster in the short-term • Vendor should understand the problem	• Vendor lock-in • Will still likely have to customize • Support costs

²⁴ <http://www.kpcb.com/file/2016-internet-trends-report>

		- and desired outcome - Procurement might be easier	
Custom, in-house development	Use in-house expertise to develop the system	- You know your customers the best - Keep expertise in-house	- How to align goals across relevant groups - Could be costly - Sharing knowledge about how to operate, change, and use the system
Outsource	Hire developers to build a custom system	Can get to a system that functions well for a given set of scenarios.	- Potentially costly - Potentially long time horizons - Support may be costly
Collaborate	Create a consortium to pool resources	- Leverage resources, more bang for the buck - Gain value through common understanding of use cases and requirements	- Coordination potentially more challenging - Spin-up might take longer

Table 2: Comparison of Potential Development Pathways

Other trade-offs also occur in the context of development. There are many different models for developing information systems, tools, and applications. At the extremes are the ‘waterfall’ approach and the ‘agile’ approach, with several variations in between. Waterfall development generally means generating a fully documented set of requirements before starting any actual development. Agile development is an iterative, incremental approach designed to release working versions of capabilities in a rapid fashion with continuous improvement as the project reaches maturity. Each approach has its own strengths and weaknesses, with agile approaches more prevalent in the contemporary environment. However, there is a tension between government procurement processes that often require specific requirements as the basis for contracts, and agile approaches that initially define a more overall vision, then iterate toward specific milestones and deliverables.

State of Data in North Carolina

How does North Carolina compare to its peers across the United States (See Appendix D)? North Carolina has a wealth of data resources that are made available by a range of state agencies. These data resources make the state of North Carolina well-positioned to prosper from its data-related assets across a variety of sectors. North Carolina is a recognized leader in some data domains, for example the North Carolina investment in obtaining high quality, high resolution topographic data for applications in disaster planning, mitigation, and response. At the same time though North Carolina may not figure as prominently. A comparative report generated by the non-partisan, Center for Data Innovation, ranked 17th of the fifty states in a comparison of open data portals. In the same evaluation, North Carolina was ranked high in

access to legislative data, but lower in access to other data categories and when considering the overall data landscape compared to the other fifty states.²⁵

Data feature prominently in North Carolina public safety work, for example Hurricane Matthew (2016) response and efforts to increase resiliency after the hurricane. Availability of relevant data is key to managing and improving a valuable state resource such as the oyster industry in North Carolina. Similarly, access to rich sources of applicable data are valuable assets for many research endeavours in the state. Access to data from the state can be used to enable research relevant to decision-makers in many areas from resource management, economic and demographic research, to agriculture and economics.

The foundation to maximize the return on the investment of the state in its data assets rests on a few central principles :

1. Clear recognition of the value of open data and a commitment to provide, to the extent possible, open access to state data resources through consistent and authoritative interfaces.
2. Commitment to actively manage state data assets with a coordinated curation and knowledge management strategy to increase the availability and usability of those assets both in the short- and long-term.
3. Recognition of the need to provide resources to effectively curate state data resources throughout their lifecycle.

Recommendations

The core, fundamental challenge in developing and implementing potential solutions to the data challenge described above is a ***knowledge management problem, not a technological problem***. At present, no amount of hardware, software, vendor solutions, or the like, will provide a quick or long-term solution to meet the types of goals described above or overcome the challenges highlighted.

Near-term Recommendations

1. Where possible, accelerate existing efforts to move toward digital reporting.
2. Investigate rationalizing the organization of existing permitting resources into a workflow decision-tree; i.e. rethink approaches to curation and knowledge management of data and information objects to move from treating each as a distinct entity, to cataloging and interoperability.
3. Ensure consistency of terminology and representation of updates and quality of the data and information presented.
4. Look to increase online user support resources, e.g. online glossaries or through implementing an online knowledgebase FAQ system (N.B.: As noted above, the key cost

²⁵ <http://www2.datainnovation.org/2017-best-states-data.pdf>

driver for an activity such as this is not the capability, it's the committed human resources to populate and oversee the system.)

5. Enrich the metadata and structured information related to the various data and information resources to allow for increased findability and accessibility.
6. Investigate creation of a searchable data, tools, and services catalog or set of catalogs.

Longer-term

7. Recommend forming a group or task force similar to the Center for Geographic Information and Analysis (CGIA) but focused on NC government-funded data and information.²⁶ The group would benefit from a composition that engages the cross-section of data creators, data curators, and data users. A suggested charge for the group might include activities to investigate and make recommendations regarding:
 - a. Developing a knowledge management strategy across agencies.
 - b. Developing an NC data commons and a North Carolina environmental information commons. For example, create and populate a 'data.nc.gov' portal and a 'data.deq.nc.gov' portal.
 - c. Potential regional engagement, i.e. southeast states, to pool resources for joint development of catalogs and tools.
 - d. Ways to leverage the variety of potential partnerships within North Carolina to bring unique and innovative approaches and solutions to address the other elements and with a goal to maximize the return on the North Carolina's investment in its data and knowledge resources.

Digitization of Analog Material

To fully assess the value of conversion of analog material to digital assets the following questions should be addressed first:

1. Is there a compelling policy or scientific need to make the relevant material available in a digital format.
2. What would be an acceptable level of digitization, e.g. basic image or OCR-ready format.
3. What types of ancillary information will need to be added to the documents, i.e. metadata, to render them searchable, retrievable, and usable.
4. What level of resources would be available to pay for the conversion. The answer to this question will depend in part on the answers to the above questions.

At this time, we do not recommend extensive investments beyond what is already in process for digitization of analog records unless there is a clearly defined, compelling reason to do so. Resources allocated to digitization might be better directed to improving the existing and future systems. However, it would be useful to ensure that a publicly accessible catalog of analog information exists so that knowledge about the information can be accessed. This may lead to

²⁶ <https://files.nc.gov/ncdit/documents/files/GICC-Data-Sharing-Report-11-07.pdf>

the development of a clear reason to convert the documents at which point the methods and costs can be assessed more fully.

More might be learned from exploring the example of activities such as the North Carolina Digital Heritage Center, DigitalNC project (<http://www.digitalnc.org/>). This partnership, consisting of the NC Department of Natural and Cultural Resources, the North Carolina Digital Heritage Center, and the UNC Libraries, has a mission to explore the types of analog cultural material that should be digitized, how to do it, and how to fund it. Digitization of legacy analog governmental documents as a historical archive related to public records might be the seed for a future effort.

Centralizing the Data

One of the tasks of this report was to investigate the feasibility of transferring the environmental data to a central, searchable, and publicly accessible digital database. The notion of a one-stop shop is appealing as it suggests savings and stretching resources through economies of scale. In certain respects this is true. For example, the ongoing popularity of moving content to the cloud is indicative of this notion. However, the cloud, or any other centralized infrastructure, is simply the hardware and basic software to provide storage, connectivity, data ingress and egress, and perhaps access to computational resources. Centralization does not obviate the need for policies, procedures, and personnel to do the value-added work to develop and maintain the information systems running on the centralized resources, nor does it obviate the need for knowledge management.

That said, some of the recommendations above do suggest some centralization of services, such as data catalogs or data commons. The resources do not have to be centralized as long as the participating entities agree on approaches to knowledge management and interoperability.

Finally, this project also hints at fostering the confluence of assets found in North Carolina to create a ground-breaking online environment that could leverage many sources of institutional expertise and potentially fulfill a wide range of beneficial goals. The groups might include, in addition to relevant state agencies, entities such as data science programs across the university system, the UNC School of Information and Library Science (SILS), the Renaissance Computing Institute (RENCI), NC State College of Design, state museums, the state library system, as well as the private sector. Library and information science masters students could develop projects as master's theses that address specific knowledge management and curation needs and challenges at the state level. Design students could be recruited to develop state of the art prototype interfaces and applications as class projects. Data science activities such as those at several NC system universities, could engage to demonstrate ways to extract additional knowledge from online resources. State museums and the State library system could provide additional curation knowledge, content, user scenarios, and access mechanisms. Partnerships could be developed with the private sector to leverage public sector data.

Resources and Citations

Center for Data Innovation (Non-profit, non-partisan research institute)

<http://www2.datainnovation.org/2017-best-states-data.pdf>

<https://www.datainnovation.org/2014/08/state-open-data-policies-and-portals/>

Department of Information Technology, Strategic Plan and Information Technology Plan 2017 – 2019 Biennium

<https://files.nc.gov/ncdit/documents/files/DIT-Strategic-and-IT-Plan-2017-19.pdf>

John Loomis, Steve Koontz, Holly Miller, Leslie Richardson (2015). "Valuing Geospatial Information: Using the Contingent Valuation Method to Estimate the Economic Benefits of Landsat Satellite Imagery.", Photogrammetric Engineering & Remote Sensing, pp. 647-656 DOI: dx.doi.org/10.14358/PERS.81.8.647

<https://landsat.gsfc.nasa.gov/landsat-benefits-u-s-economy-by-1-8-billion-per-year/>

NC in the Next Tech Tsunami: Navigating the Data Economy

<http://www.nccommerce.com/Portals/6/Documents/Resources/NC%20Big%20Data%20Report.pdf>

The Executive Office of the President Office of Management and Budget (OMB) Roundtable on Open Data as a driver for economic growth, July 25, 2017

<http://reports.opendataenterprise.org/2017OpenDataRT1-EconomicGrowth.pdf>

U.S. Department of Commerce (2014) Fostering Innovation, Creating Jobs, Driving Better Decisions: The Value of Government Data

<http://www.esa.doc.gov/economic-briefings/value-government-weather-and-climate-data>

<http://www.esa.doc.gov/Reports/fostering-innovation-creating-jobs-driving-better-decisions-value-government-data>

Appendices

Appendix A: NPDES Programmatic Areas²⁷

Animal Feeding Operations (AFOs)

Aquaculture

Biosolids

Forest Roads

Industrial Wastewater

Municipal Wastewater

- Combined Sewer Overflows (CSOs)
- Integrated Planning
- Peak Flows
- Sanitary Sewer Overflows (SSOs)

National Pretreatment Program

Pesticide Permitting

Stormwater

- Stormwater Discharges from Construction Activities
- Stormwater Discharges from Industrial Activities
- Stormwater Discharges from Municipal Sources
- Stormwater Discharges from Transportation Sources
- Oil and Gas Stormwater Permitting
- EPA's Residual Designation Authority
- Stormwater Rules and Notices
- Stormwater Maintenance

Vessels Incidental Discharge Permitting

Water Quality Trading

Whole Effluent Toxicity (WET)

²⁷ For more information on these areas see <https://www.epa.gov/npdes/all-npdes-program-areas>.

Appendix B: Example NC DEQ Instruction Sheet

Water

NPDES (National Pollutant Discharge Elimination System) Wastewater Treatment/Disposal Permit

What Activities Require This Permit? Direct discharges of wastewater to surface waters of the state.

What Is The Purpose of This Permit? To protect waters of the state through compliance with state and federal water quality laws regarding direct discharges of wastewater. The U. S. Environmental Protection Agency (EPA) has delegated authority to North Carolina to administer the NPDES program. The N.C. Division of Water Resources issues NPDES permits for discharges of treated wastewater to surface waters. Types of facilities permitted to discharge include domestic wastewater treatment plants, industrial treatment plants, and water treatment plants. Certificates of Coverage under NPDES general permits may be acquired for certain activities that meet thresholds conditions including single-family residence discharges.

Who Issues This Permit? N.C. Division of Water Resources, NPDES Permitting.

How Much Will This Permit Cost?

New/Annual fee for Major Individual NPDES Permits: \$3,440; major modification fee \$1,030
New/Annual fee for Minor Individual NPDES Permits: \$860; major modifications fee \$260
New/Annual fee for Certificates of Coverage under General Permits: \$100; \$60 for single family residences

What Are My Payment Options for Permit Application Fees? Check

If Paying by Check, Who do I Make the Check Payable to and Where Do I Send the Check? Make the check payable to: North Carolina Department of Environmental Quality (NCDEQ). Send the check along with the application to the address listed under "Where Do I Submit My Application."

Where Can I Get The Application For This Permit? [general permit applications](#) and [individual applications](#)

How Long Will It Take To Review My Application? Approximately six months from the receipt of a complete application package; for certificates of coverage under general permits, approximately 60 days.

Where Do I Submit My Application? N.C. Division of Water Resources, NPDES Permitting, 1617 Mail Service Center, Raleigh NC 27699-1617

How Long Is My Permit or License or Certificate Valid? Up to five years.

Notes/Comments: 30-day public notice period required for all permits and renewals; Prior to accepting applications, an engineering alternative analysis and an environmental assessment may be required for new or expanded discharges. Coverage under general wastewater permits may be obtained for a given statewide activity below certain thresholds. These activities include discharges from non-contact cooling water, groundwater remediation of petroleum-based contaminants, sand dredging, seafood packing and fish farms, and domestic waste from single-family residences.

Legal Authority/Statute Reference:

Section 402 of the Clean Water Act; 40 CFR Parts 122-125; Parts 130-131; and Part 133; 15A NCAC 2H .0100

Link: <http://deq.nc.gov/about/divisions/water-resources/water-resources-permits/wastewater-branch/npdes-wastewater/permitting-contacts>

Statewide Contact Information:

NC Division of Water Resources
NPDES Permitting
1617 Mail Service Center
Raleigh, NC 27699-1617
Telephone: (919) 807-6300
Fax: (919) 807-6489

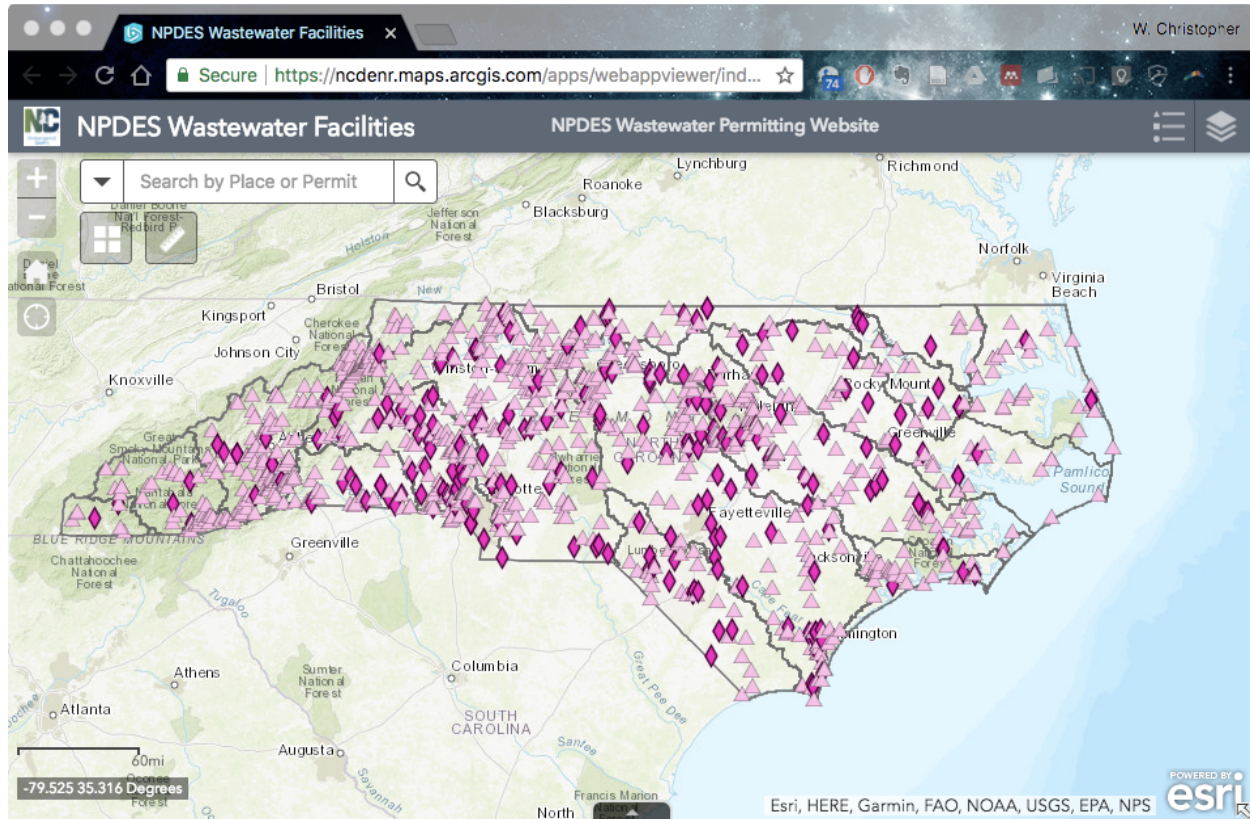
NC DEQ Permit Directory

Source: NC DEQ,

https://files.nc.gov/ncdeq/Environmental%20Assistance%20and%20Customer%20Service/Permit%20Handbook%20Documents/2016_Revisions/Water%20NPDES%20Wastewater%20Permit.pdf

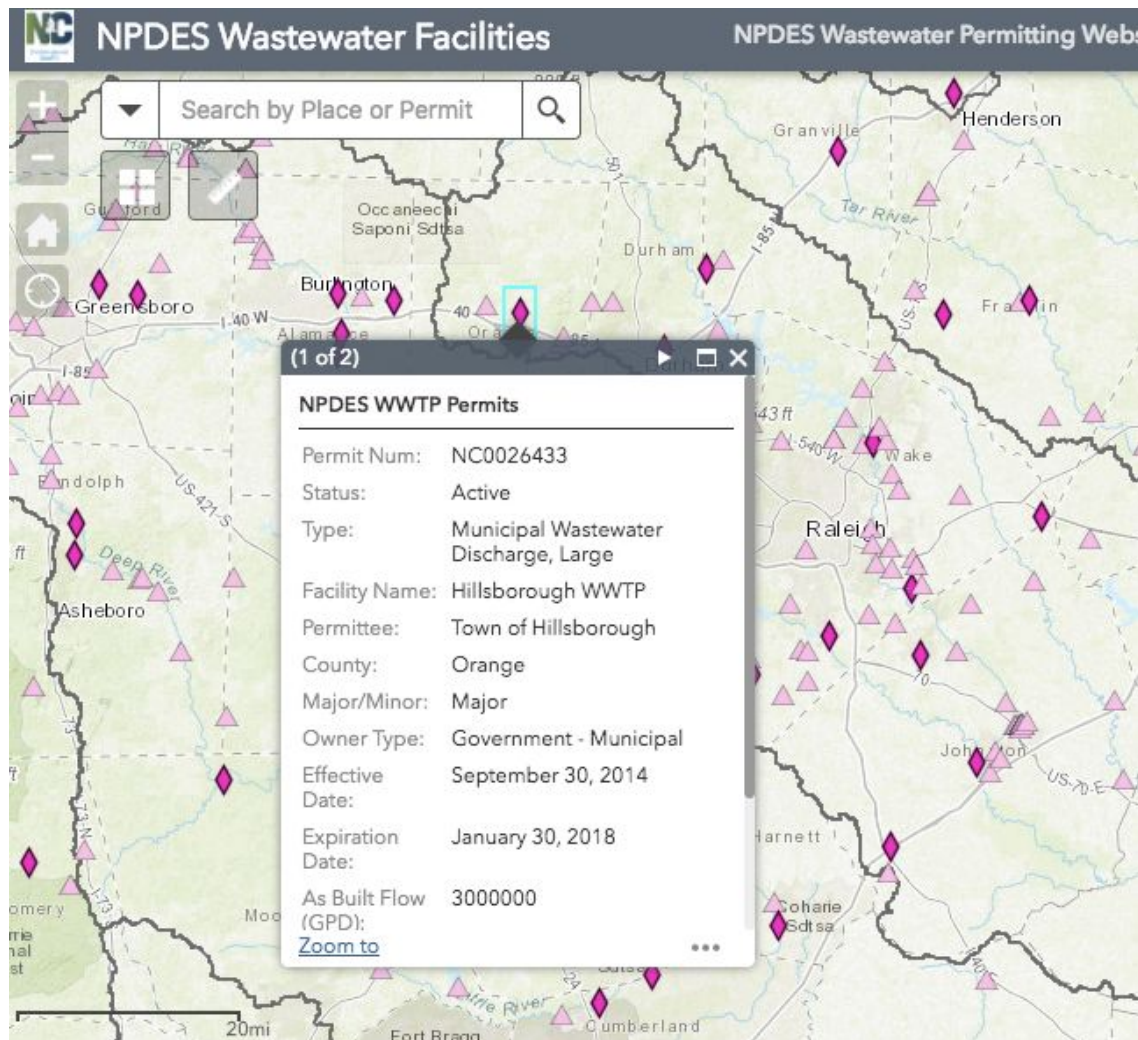
Appendix C: Screen Captures from the Online Wastewater Permit GIS Interface

Top Level View of Interface



The pink triangles are locations of minor facilities and the fuschia colored diamonds are major facilities.

View of Individual Facility Attributes



Example List of Permit Documents - Link from Attributes Window

NPDES Wastewater Facilities | Search - Laserfiche WebLink | W. Christopher

Secure | https://edocs.deq.nc.gov/WaterResources/Search.aspx?dbid=0&searchcommand=%7B%5B%5D%...

NC Environmental Quality

Home Browse Search

Customize Search
Records Management Search
General Search x

Search terms

Name	Hits	Current Status	ID #	Version	Facility/Project Name	County	Document Date
Signature Authority	0		NC0026433		Hillsborough WWTP	Orange	1/27/2015
Renewal Application	0		NC0026433		Hillsborough WWTP	Orange	7/7/2017
NC0026433 - Electronic Reporting Requirements	0		NC0026433		Hillsborough WWTP	Orange	7/25/2016
A to C	0		NC0026433		Hillsborough WWTP	Orange	7/22/2016

Page 1 of 1

View of Sample Permit Page

NPDES Wastewater Facilities | Renewal Application - Laserfiche WebLink | W. Christopher

Secure | https://edocs.deq.nc.gov/WaterResources/0/doc/550823/Page1.aspx?searchid=346ba1...

NC Environmental Quality

Home Browse Search

Renewal Application

Metadata Thumbnails Annotations

Entry Properties

Last modified: 3/12/2018 12:28:15 PM
Creation date: 7/11/2017 9:28:44 AM

Metadata

Fields

Template: WQ Permitting

Tags

Duplicates Removed Using...
Description: Removes duplicate field data has been run

Document management portal powered by Laserfiche WebLink 9 © 1998-2015 Laserfiche. All rights reserved.

4 / 56 Go PDF View plain text 8.54 in x 10.98 in

FACILITY NAME AND PERMIT NUMBER	PERMIT ACTION REQUESTED	RIVER BASIN
Town of Hillsborough WWTP, NC0026433	NPDES Permit Renewal	Neuse River

BASIC APPLICATION INFORMATION

PART A. BASIC APPLICATION INFORMATION FOR ALL APPLICANTS:
All treatment works must complete questions A 1 through A 6 of this Basic Application Information Packet

A 1 Facility Information

Facility Name: Town of Hillsborough WWTP
Mailing Address: PO Box 429
Hillsborough, NC 27278
Contact Person: Jeff Mahagan
Title: Plant Superintendent
Telephone Number: (919) 732-2681
Facility Address: 355 Elizabeth Brady Rd
(not P O Box) Hillsborough, NC 27278

A 2 Applicant Information If the applicant is different from the above, provide the following

Applicant Name: Town of Hillsborough
Mailing Address: PO Box 429
Hillsborough, NC 27278
Contact Person: Kenneth Keel, PE
Title: Town Engineer/Utilities Director
Telephone Number: (919) 732-1270 ext.631
Is the applicant the owner or operator (or both) of the treatment works?
☒ owner ☐ operator
Indicate whether correspondence regarding this permit should be directed to the facility or the applicant
☒ facility ☐ applicant

A 3 Existing Environmental Permits Provide the permit number of any existing environmental permits that have been issued to the treatment works (include state-issued permits)

NPDES	PSD
NC0026433	

UIC	Other

RCRA	Other

Appendix D: State Permit and Environmental Data Resources

State	General Data	Nat Resources / Env Agency	Environmental Data Portal	Water Permitting	GIS
Alabama	Not found	http://adem.alabama.gov/default.cnt		http://adem.alabama.gov/PermitWizard/default.aspx	http://adem.alabama.gov/emaps.cnt
Alaska	Not found	http://dec.alaska.gov/	Not found	http://dec.alaska.gov/water/wastewater/	http://www.asgdc.state.ak.us/
Arizona	Not found	http://www.azdeq.gov/	http://azdeq.gov/databases	http://azdeq.gov/permits	https://land.az.gov/arizona-gis-portal
Arkansas	Not found	https://www.adeq.state.ar.us/	https://www.adeq.state.ar.us/home/databases.aspx	https://www.adeq.state.ar.us/water/permits/npdes/	https://gis.arkansas.gov/data/
California	https://data.ca.gov/	https://calepa.ca.gov/	Not found	https://www.waterboards.ca.gov/water_issues/programs/npdes/	http://portal.gis.ca.gov/geoportal/catalog/main/home.page
Colorado	https://data.colorado.gov/	https://cdnr.us/	http://water.state.co.us/DataMaps/DataSearch/Pages/DataSearch.aspx	https://www.colorado.gov/pacific/cdphe/news/water-quality-permits	Not found
			https://www.colorado.gov/pacific/cdphe/data-topic		
Connecticut	https://data.ct.gov/	http://www.ct.gov/deep/	Not found	http://www.ct.gov/deep/cwp/view.asp?a=2709&q=324212&deepNav_GID=1643%20	Not found
Delaware	https://data.delaware.gov/	https://dnrec.alpha.delaware.gov/	https://dnrec.alpha.delaware.gov/dnrec-open-data/	http://dnrec.delaware.gov/wrl/information/SWDInfo/Pages/SWDSNPDES.aspx	http://opendata.delaware.gov/firstmap
Florida	Not found	https://floridadep.gov/	https://floridadep.gov/fgs/data-maps	https://floridadep.gov/Water/Stormwater	http://myfloridadisaster.opendata.arcgis.com/
				https://floridadep.gov/water/domestic-wastewater/content/wastewater-permitting	
Georgia	http://data-georgiagio.opendata.arcgis.com/	https://epd.georgia.gov/	Not found	https://epd.georgia.gov/npdes-and-las-general-permits	http://data-georgiagio.opendata.arcgis.com/
Hawaii	https://data.hawaii.gov/	http://dlnr.hawaii.gov/	Not found	https://eha-cloud.doh.hawaii.gov/epermit/	http://geoportal.hawaii.gov/
		http://health.hawaii.gov/cwrb/			
Idaho	http://data.gis.idaho.gov/	http://www.deq.idaho.gov/	Not found	http://www.deq.idaho.gov/permitting/water-quality-permitting/npdes/	http://inside.uidaho.edu/
Illinois	https://data.illinois.gov/	http://www.epa.illinois.gov/index	Not found	http://www.epa.illinois.gov/topics/forms/water-permits/index	
Kansas	http://ipsr.ku.edu/BIDC/region.php	http://www.kdheks.gov/environment/index.html	https://maps.kdhe.state.ks.us/keif/	http://agriculture.ks.gov/divisions-programs/dwr/water-appropriation/new-applications-and-permits	http://www.kansasgis.org

Kentucky	http://www.ksdc.louisville.edu	http://dep.ky.gov/Pages/default.aspx			http://kygisserver.ky.gov/geoportal/catalog/search/search.page
Louisiana		http://dep.louisiana.gov	http://dep.louisiana.gov/page/leadms-resource-page	http://dep.louisiana.gov/page/lpdes	see other
Maine	https://data.maine.gov	http://www.maine.gov/dep/	https://data.maine.gov/tracking/portal-content	see other	https://geolibary-maine.opendata.arcgis.com/datasets#data
Maryland	https://data.maryland.gov	http://mde.maryland.gov/Pages/index.aspx	Not found	http://mde.maryland.gov/programs/Water/StormwaterManagementProgram/Pages/storm_gen_permit.aspx	http://imap.maryland.gov/Pages/default.aspx
Massachusetts	http://www.mass.gov/opendata/#/	https://www.mass.gov/orgs/massachusetts-department-of-environmental-protection	https://matracking.ehs.state.ma.us/Environmental-Data/index.html	https://www.mass.gov/service-details/surface-water-discharge-permitting-npdes	https://www.mass.gov/orgs/massgis-bureau-of-geographic-information
Michigan		https://data.michigan.gov	Not found	http://www.michigan.gov/dep/0,4561,7-135-3313_71618_3682_3713---,00.html	http://gis-michigan.opendata.arcgis.com
Minnesota	http://www.state.mn.us/opendata/	https://www.pca.state.mn.us	https://www.pca.state.mn.us/environmental-data	https://www.pca.state.mn.us/quick-links/npdes-and-sds-permits	https://gisdata.mn.gov
Mississippi	call their GIS portal opendata	https://www.mdeq.ms.gov	see other	https://www.mdeq.ms.gov/permits/environmental-permits-division/types-on-general-permits/	http://opendata.gis.ms.gov
Missouri	https://data.mo.gov	https://dnr.mo.gov	https://dnr.mo.gov/edata.htm	https://dnr.mo.gov/env/wpp/permits/	https://dnr.mo.gov/gis/
Montana	http://data.mt.gov	http://dep.mt.gov	http://svc.mt.gov/dep/dst/#/home	http://dep.mt.gov/Public/services/permits	http://geoinfo.msl.mt.gov
Nebraska	http://www.nebraska.gov/government/open-data/	http://www.deq.state.ne.us	http://www.deq.state.ne.us/NDEQProg.nsf/%24%24OpenDominoDocument.xsp?documentId=A848A9F1141E207886257CC1005A5904&action=openDocument	http://www.deq.state.ne.us/NDEQProg.nsf/%24%24OpenDominoDocument.xsp?documentId=A2845D8487A5EE2B86257CB70067B600&action=openDocument	https://www.nebraskamap.gov
Nevada	not found	https://ndep.nv.gov	not found	https://ndep.nv.gov/water/water-pollution-control/permitting/individual-permits-npdes-state-permits	http://www.nbmng.unr.edu/Maps&Data/VirtualClearinghouse.html
New Hampshire	https://www.nh.gov/doit/open-source/index.htm	https://www.des.nh.gov	https://www.nh.gov/epht/data-portal/index.htm	https://www.des.nh.gov/organization/divisions/water/web/permit_npdes_sw_disch.htm	http://www.granit.unh.edu
New Jersey	https://data.nj.gov	http://www.nj.gov/dep/	https://www13.state.nj.us/DataMiner/Search/SearchByCategory?isExternal=y&getCategory=y&catName=Site+Remediation	https://www13.state.nj.us/DataMiner/Search/SearchByCategory?isExternal=y&getCategory=y&catName=Site+Remediation	http://www.nj.gov/dep/gis/

North Carolina		https://deq.nc.gov/	https://deq.nc.gov/science-data		http://data-ncdenr.opendata.arcgis.com/
West Virginia	Not found	https://dep.wv.gov/Pages/default.aspx	http://tagis.dep.wv.gov/	https://dep.wv.gov/WWW/permit/Pages/default.aspx	http://wv.gis.wvu.edu/data/data.php
Wisconsin	Not found	http://dnr.wi.gov/	https://data-wi-dnr.opendata.arcgis.com/	https://dnr.wi.gov/topic/wastewater/permits.html	http://data-ltsb.opendata.arcgis.com/
Wyoming	Not found	http://deq.wyoming.gov/	Not found	http://deq.wyoming.gov/wqd/wypdes/	http://geospatialhub.org/