GEORGIA DOT RESEARCH PROJECT 24-02

Final Report

DATA-SUPPORTED QUANTIFICATION OF BRIDGE DECK DEGRADATION USING GDOT'S ROAD MAINTENANCE DATA AND OTHER DATA AVAILABLE THROUGH OTD

Office of Performance-based Management and Research
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16. Abstract:

The study synthesized multiple GDOT data resources—including maintenance work orders, bridge inventory data, traffic data, and bridge condition information—in collaboration with GDOT district maintenance teams, the Office of Bridge Design and Maintenance (OBDM), and the Office of Transportation Data (OTD). A key focus was identifying bridge maintenance activities lacking Bridge IDs by linking maintenance records with bridge spatial data. The project developed the District Bridge Maintenance & Expenditure GIS Dashboard online to provide an interactive visualization of maintenance activities, expenditures, and related bridge information across GDOT districts. In addition, a Daily Work Report (DWR) Pocket Guide for Bridge Activities was developed to promote consistent documentation practices, improve Bridge ID entry, and enhance data quality. Pilot implementation demonstrated the value of standardized reporting practices and improved access to bridge maintenance information. The project outcomes provide GDOT with enhanced tools and guidance to support data-driven bridge maintenance decision making, cost evaluation, and statewide bridge asset management.

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Final Report

DATA-SUPPORTED QUANTIFICATION OF BRIDGE DECK DEGRADATION USING GDOT'S ROAD MAINTENANCE DATA AND OTHER DATA AVAILABLE

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
	NOTE: volumes greater than 1000 L shall be shown in m^3			
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

* SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)

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EXECUTIVE SUMMARY

This study improved the understanding and documentation of bridge maintenance activities performed by the Georgia Department of Transportation (GDOT) by integrating multiple data sources and collaborating with GDOT district maintenance teams, the Office of Bridge Design and Maintenance (OBDM), and the Office of Transportation Data (OTD). The study identified challenges related to inconsistent asset classification, incomplete Bridge ID documentation, and variability in Daily Work Report (DWR) data entry practices.

Two key online deliverables were developed: (1) the District Bridge Maintenance & Expenditure GIS Dashboard and (2) the Daily Work Report (DWR) Pocket Guide for Bridge Activities. The dashboard provides an interactive platform for reviewing bridge maintenance activities, expenditures, and related data across GDOT districts. The pocket guide establishes consistent definitions for bridge-related maintenance activities, clarifies bridge spatial extent, and promotes recording bridge activities under the Bridges asset type with corresponding Bridge IDs.

The study recommends continued implementation of standardized DWR documentation practices, including consistent entry of Bridge IDs for bridge-related activities, recurring training for field and administrative personnel, and expanded use of digital tools and emerging technologies to support automated Bridge ID identification. These efforts will improve data quality, transparency, and the ability to evaluate bridge maintenance activities and costs statewide.

CHAPTER 1. INTRODUCTION

OVERVIEW

There is a growing need to systematically review and monitor bridge maintenance activities performed by the Georgia Department of Transportation (GDOT) districts by geospatially linking maintenance records, bridge locations, and associated expenses. Integrating additional data resources available within the department, including the Bridge Linear referencing data, the Highway Performance Monitoring System (HPMS) data, and traffic counts from the Office of Transportation Data (OTD), can further enhance the understanding of bridge performance, maintenance needs, and long-term asset management strategies.

In conjunction with bridge condition data from the National Bridge Inventory (NBI) and maintenance records generated by the Bridge Maintenance Unit (BMU), GDOT districts routinely document bridge-related maintenance activities through Daily Work Reports (DWRs), which are stored in a database and managed through the 411 Application environment. The synthesis of the database with available resources enables more comprehensive analyses of bridge maintenance activities and bridge performance over time.

SCOPE AND OBJECTIVES

The scope of this project includes the collection and review of available GDOT data resources; coordination with GDOT district maintenance teams, the Office of Bridge

Design and Maintenance (OBDM), and OTD; and the integration, visualization, and analysis of bridge maintenance activities and associated costs within a unified GIS dashboard. The study also focuses on synthesizing traffic and bridge deck condition data and evaluating their relationships with maintenance activities. These focus areas and dashboard features, including the visualization of bridge deck conditions and associated maintenance activities, were identified through extensive discussions with GDOT stakeholders and subsequently refined based on data availability, available project resources, and stakeholder feedback. The initial project focus, which emphasized evaluating changes in bridge deck conditions, was expanded to incorporate broader bridge maintenance activities and associated trends to better support GDOT's needs for reviewing and analyzing district-level bridge maintenance activities.

The main objective of this project is to develop a data-supported framework, including a GIS dashboard, to evaluate bridge degradation patterns and their relationships with maintenance activities by integrating GDOT's available data resources, including traffic, bridge condition, and maintenance data.

Overall, this project leverages GDOT's existing data resources to better quantify bridge maintenance activities and support improved maintenance decision making with the goal of enhancing bridge safety, serviceability, and mobility across the transportation network.

RESEARCH METHODOLOGY

This section outlines the approach undertaken to achieve the objectives of the project.

Data Collection and Exploration

The research team compiled available data and conducted interviews with GDOT district maintenance teams to gather insights into the current state of maintenance activity data collection related to bridges. These interviews provided valuable information on existing practices, challenges, and needs related to bridge maintenance. Additionally, the team collaborated with GDOT districts to improve Bridge ID identification. Although documentation practices for maintenance activities varied slightly across districts, this collaboration identified the need for additional training and guidance on best practices for documentation.

Data Analysis and Identification of Bridge IDs

The key task of this study is to identify Bridge IDs that are not recorded by district maintenance teams. Bridge IDs are identified by mapping maintenance activity locations against the Bridge Linear and HPMS datasets. These datasets provide bridge start and end locations and roadway surface condition survey data collected at approximately 0.1-mile intervals, enabling the identification of previously unrecorded Bridge IDs associated with maintenance activities.

GIS Dashboard Development

Building on insights gained through interactions with GDOT district maintenance managers throughout the project, the study team developed a GIS-based online dashboard. This dashboard consolidates essential bridge-related maintenance activities and

expenditures to facilitate efficient review. CHAPTER 2 presents the dashboard design and development process in detail. CHAPTER 3 presents the dashboard results and key findings.

Maintenance Data Analysis and Pocket Guide Development

CHAPTER 4 provides additional analyses to enhance understanding of bridge maintenance data recorded by GDOT districts and presents the resulting pocket guide for recording bridge maintenance activities. The pocket guide was developed to support consistent data entry practices across GDOT district maintenance offices and to address observed variability in work order reporting. The guide was informed by the analysis results, particularly issues related to inconsistent Bridge ID entry, incomplete inventory naming conventions, and missing or inconsistent milepost information. It provides concise, field-oriented instructions for entering Bridge IDs when applicable and is available on the dashboard.

Pilot Implementation

CHAPTER 5 describes the pilot implementation of the study findings and recommendations and summarizes the resulting outcomes.

CHAPTER 2. DASHBOARD DESIGN AND DEVELOPMENT

DASHBOARD DESIGN GOALS

The primary objective of this project is to develop an analytical framework that quantifies district-level bridge maintenance expenditures by activity classification and geographic district, thereby enhancing GDOT's ability to monitor maintenance activities, evaluate expenditure patterns, and support strategic resource allocation. By integrating maintenance work orders recorded by district offices in DWRs with bridge condition ratings and traffic data into a unified geospatial platform, the project establishes a structured framework for evaluating how maintenance funds are allocated and how those expenditures align with asset condition needs.

The dashboard aggregates bridge-related maintenance costs by district and activity type, enabling evaluation of fiscal year spending distributions and identification of dominant maintenance activities across regions. To provide context for these expenditures, the dashboard also reports the number of bridges associated with each activity, allowing expenditures to be interpreted relative to the number of bridges receiving maintenance. Maintenance records are further integrated with annual component condition ratings from the Federal Highway Administration's National Bridge Inventory (FHWA 2026). This integration enables evaluation of whether maintenance expenditures correspond to bridges in good, fair, or poor condition categories. Traffic exposure metrics are also incorporated to provide additional context for maintenance demand.

The analytical framework is implemented within a Geographic Information System (GIS)-based web environment, enabling spatial integration; interactive filtering; and visualization of maintenance expenditures, bridge conditions, and traffic characteristics. GIS-based infrastructure management systems have been shown to improve the integration of multiple data sources and strengthen analytical decision support within transportation agencies (Mohammed et al. 2025; Wei et al. 2021). Previous studies further demonstrate that GIS dashboards enhance transparency and performance monitoring within state departments of transportation (Chorzepa et al. 2025).

Collectively, these capabilities provide a spatially integrated framework for evaluating bridge maintenance expenditure patterns, activity distributions, bridge conditions, and traffic exposure across GDOT districts. The resulting dashboard supports informed budgeting decisions, evaluation of maintenance activities, and strategic maintenance planning.

DASHBOARD DEVELOPMENT

To support data-driven decision making and visualization of district-level bridge maintenance activities, a structured data processing workflow, illustrated in Figure 1, was developed to create a unified geospatial dataset for dashboard deployment. The workflow integrates maintenance work order records, bridge linear referencing data, HPMS dataset, InspectX bridge inspection data, and National Bridge Inventory (NBI) condition data into a single analysis-ready database. This integrated dataset serves as the primary data source

for the ArcGIS Online environment, a cloud-based GIS platform, and supports the development of interactive dashboards using ArcGIS Experience Builder.

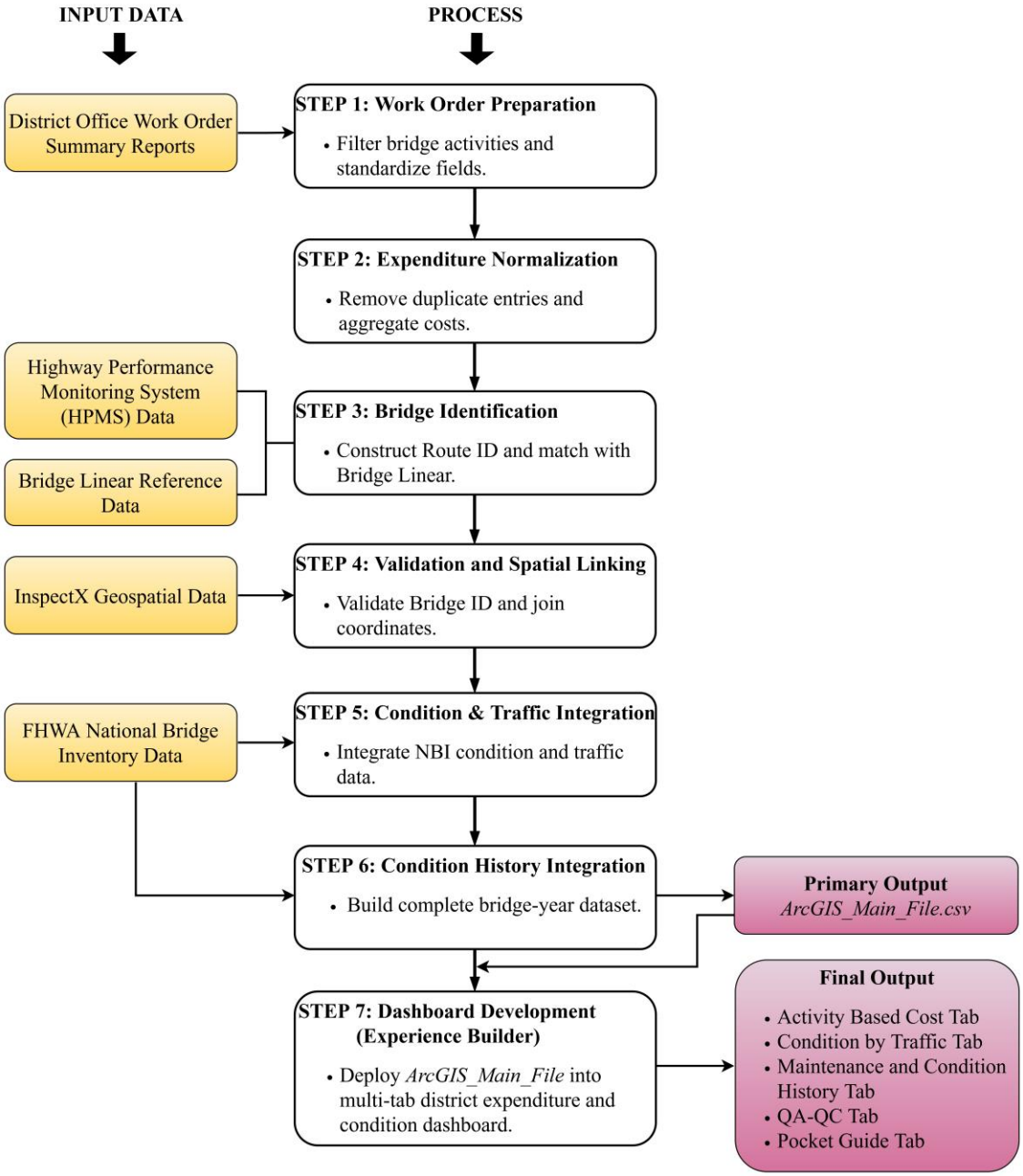


Figure 1. Process. Workflow for dashboard development.

Source Data Integration

The workflow integrates multiple datasets to provide a comprehensive representation of bridge maintenance activities and conditions. Primary inputs include the GDOT Work Order Summary reports available in the 411-application database, spanning multiple fiscal years and documenting bridge maintenance activities performed by district offices. The Bridge Linear dataset, provided by the Office of Transportation Data (OTD), includes Route ID and linear referencing information, including the specific start and end milepoints for bridge locations along each route. Additionally, HPMS data, also supplied by OTD, include milepost locations at approximately 0.1-mile increments. These datasets are used to assign Bridge IDs by matching a developed Route ID to the RCLink field, while InspectX data provide district verification and geographic coordinates for bridges. Finally, annual NBI datasets published by the FHWA provide bridge condition ratings and traffic information. Each dataset contributes a specific role within the workflow: work orders document maintenance activities; OTD's datasets enable bridge identification and spatial linkage; InspectX data support verification of bridge locations and provide geographic coordinates; and NBI files provide standardized condition ratings and traffic information, including Average Daily Traffic (ADT) and percent trucks, which are reported by GDOT to the FHWA.

Work Order Processing and Standardization

Work order records in the 411 application were first consolidated and standardized to ensure consistency across reporting periods. Records were filtered to retain activities classified under the Road Maintenance category, and fiscal years were computed using the

GDOT fiscal calendar, which runs from July 1 through June 30. Data cleaning procedures included removal of incomplete records; standardization of route attributes including route type classification, route number formatting, and route suffix consistency; and elimination of duplicate entries. To eliminate repeated activity entries, accomplishment quantities and total costs were aggregated by Work Order ID (see Figure 2). Cost values were retained only for the first occurrence of each work order record, ensuring accurate representation of maintenance costs. Figure 2 shows a screenshot of the work order summary database available in the 411 application.

Start Date	End Date	Work Order ID	Project ID	Owner Name	District	County	Route Type	Route	Route Suffix	Activity Name	Work Description	Status Name	Labor Cost
Aug-05-2026	Aug-05-2026	9607380	A270701-ADM	4841510911 - D5A1RM Appling	District Five-Jesup	Appling	State Route (SR)	0027	00	845 - OTHER BRIDGE MAINT	REPAIRING SLOPE PAVING	Completed	$473.26
Aug-24-2026	Nov-20-2026	9564337	A260701-ADM	4841210900 - D2A1RM Supv	District Two-Tennille	Baldwin	State Route (SR)	0540	00	845 - OTHER BRIDGE MAINT	BUILDING/REPAIR APPROACH SLABS	Active	$0.00
Aug-04-2026	Aug-04-2026	9605871	A270701-ADM	4841209402 - D2MTBrdg/Conc Crew#2	District Two-Tennille	Baldwin	State Route (SR)	0022	00	845 - OTHER BRIDGE MAINT	OTHER	Completed	$1,426.26
Aug-05-2026	Aug-05-2026	9607660	A270701-ADM	4841209402 - D2MTBrdg/Conc Crew#2	District Two-Tennille	Baldwin	State Route (SR)	0022	00	845 - OTHER BRIDGE MAINT	OTHER	Active	$1,551.56
Aug-06-2026	Aug-06-2026	9610079	A270701-ADM	4841209402 - D2MTBrdg/Conc Crew#2	District Two-Tennille	Baldwin	State Route (SR)	0022	00	800 - BRIDGE JOINT SEALING	PERFORMING ACTIVITY	Active	$1,426.26
Aug-10-2026	Aug-10-2026	9610091	A270701-ADM	4841209402 - D2MTBrdg/Conc Crew#2	District Two-Tennille	Baldwin	State Route (SR)	0022	00	800 - BRIDGE JOINT SEALING	PERFORMING ACTIVITY	Active	$1,426.26
Aug-11-2026	Aug-11-2026	9610963	A270701-ADM	4841209402 - D2MTBrdg/Conc Crew#2	District Two-Tennille	Baldwin	State Route (SR)	0022	00	800 - BRIDGE JOINT SEALING	PERFORMING ACTIVITY	Active	$1,216.62
Aug-12-2026	Aug-12-2026	9612800	A270701-ADM	4841209402 - D2MTBrdg/Conc Crew#2	District Two-Tennille	Baldwin	State Route (SR)	0022	00	800 - BRIDGE JOINT SEALING	PERFORMING ACTIVITY	Active	$1,426.26
Aug-18-2026	Aug-18-2026	9616884	A270701-ADM	4841209402 - D2MTBrdg/Conc Crew#2	District Two-Tennille	Baldwin	State Route (SR)	0022	00	800 - BRIDGE JOINT SEALING	PERFORMING ACTIVITY	Active	$1,253.01

(a) Columns 1 through 14

Labor Hours	Material Cost	Equipment Cost	Equipment Hours	Other Cost	Total Cost	Comment	Begin MP	End MP	Direction	Position	Total Accomplishment	Accomplishment Unit of Measure	Asset Type	Inventory Item Name
20.	$0.00	$240.77	10.		$714.03		14.60	14.60	Both	All	20.	PERSON HOURS	Section	001-SR-0027-00-INC - 0 to 24.781
0.	$0.00	$0.00	0.		$0.00	BRIDGE-3561-BALDWIN	0.00	13.12	Both	All			Bridges	009-0024-0
70.	$0.00	$902.12	24.		$2,328.38	pumped under bridge	1.93	1.93	Decreasing	All	70.	PERSON HOURS	Bridges	009-0001-0
76.	$80.33	$420.30	20.		$2,052.19	Did spall and joint seal	9.00	9.00	Increasing	All	76.	PERSON HOURS	Bridges	009-0004-0
70.	$0.00	$397.98	18.		$1,824.24	joint seal	9.00	9.00	Decreasing	All	144.	LINEAR FEET	Bridges	009-0004-0
70.	$0.00	$397.98	18.		$1,824.24	joint seal	12.24	12.24	Increasing	All	170.	LINEAR FEET	Bridges	009-0007-0
60.	$0.00	$397.98	18.		$1,614.60	joint seal	12.24	12.24	Increasing	All	154.	LINEAR FEET	Bridges	009-0007-0
70.	$0.00	$389.80	18.		$1,816.06	joint seal	12.24	12.24	Increasing	All	210.	LINEAR FEET	Bridges	009-0007-0
60.	$49,500.00	$389.80	18.		$51,142.81	joint seal	12.24	12.24	Decreasing	All	270.	LINEAR FEET	Bridges	009-0007-0

(b) Columns 15 through 29

Figure 2. Illustration. Work order summary database in 411 application.

Bridge Identification and Spatial Linking

Work orders were grouped by asset type to determine the appropriate bridge identification method. For records with Asset Type = Bridges, bridge identifiers are directly available in the work order data, as entered by district offices during work order creation. However, for records associated with roadway segments (e.g., Asset Type = Section or GDOT Assets), Bridge IDs are frequently not provided for bridge-related 800-series maintenance activities. Because these activities represent work performed on bridges, a systematic procedure was developed to identify the corresponding Bridge IDs.

Route ID Development for Section Work Orders

To assign Bridge IDs to work orders that were recorded as roadway segments (Asset Type = Section), a standardized fourteen (14) digit code Route ID key was developed (see Figure 3). This Route ID was designed to match the Route ID field used in the Bridge Linear/HPMS datasets (and therefore enable a consistent join to the Bridge Linear and/or HPMS datasets through the RCLink/Route ID field-based route reference). Route ID development was applied only to records where Asset Type = Section. For all other asset types, Route ID was left blank. Route ID development was performed using HPMS route definitions to ensure consistency with existing route records. The Bridge Linear dataset was subsequently used to associate validated Route IDs with bridge locations.

Function Type	County			System Code	Route Code						Route Suffix		Direction
					Reference Post			Route Number			Quadrant Letter	Route Suffix	
1	0	0	0	1	0	0	0	0	0	0	0	0	INC

Figure 3. Illustration. Standard Route ID structure and components (GDOT 2024).

Route ID development consisted of the following steps:

- Step 1. Assign a Function Type prefix. A one-character Function Type prefix was assigned based on the Route Type attribute to align with the route coding conventions used in the Bridge Linear and HPMS datasets (see Table 1). The Route Type attribute specifically refers to the source data field used to determine the corresponding Function Type code. If the Route Type did not match any of the Function Type categories listed in Table 1, a Route ID was not generated for that record.

Table 1. Function type codes for Route ID development (GDOT 2024).

Function Type	**Code**
State Route (SR)	1
Ramp (RP)	2
Collector Distributor (CD)	3
Ramp CD Connector	4
Frontage Road (FR)	5
Alley	6
Separate Managed Facility (MF)	7
Local	8
Private	9
Projected	P
Public Road (PR) Non-Accepted Road	Z

- Step 2. Parse the encoded route string from Inventory Item Name. For Asset Type = Section records, the portion of the Inventory Item Name (see Figure 2) preceding the mileage description was extracted by splitting the text at the delimiter "–" and retaining the first segment. For example, an Inventory Item Name such as "151-SR-0401-00-INC - 207.944 to 228.564" was processed to extract "151-SR-0401-00-INC" as the main route string. The extracted route string was then separated using the hyphen (-) delimiter to obtain the individual route components.
- Step 3. Construct Route ID using Function Type specific rules. Two cases (SR and other route types) are considered. For State Route (SR) records, Route ID values were constructed using Function Type specific formatting rules to ensure compatibility with the Bridge Linear/HPMS Route ID structure. A sample Inventory Item Name such as "151-SR-0401-00-INC" was first parsed into its components. From this parsing:
    - RouteCode corresponds to the third component (e.g., "0401").
    - Route Suffix value corresponds to the fourth component (e.g., "00").
    - Direction corresponds to the fifth component when present (INC or DEC).

The RouteCode was then converted to an integer and zero-padded to a three-digit format (0401 → 401 → "401"). The Route ID was constructed using the following format: Function Type prefix + "000" + "1" + "000" + RouteCode + Route Suffix + Direction. For example:

- Input: Route Type = State Route (prefix = 1)
- Route string = 151-SR-0401-00-INC
- Output: Route_ID = 1000100040100INC

For other function types (e.g., RP, CD, and FR), which are non-State-Route (SR) route types, Route ID values were constructed using a standardized route string format: prefix-abc-XX-de-ghi-jk-direction. A sample Inventory Item Name such as "121-RP-002-0407-B0-INC" was first parsed into its constituent components, where *abc* represents the first segment (e.g., "121"), *de* corresponds to the third segment (e.g., "002"), *ghi* corresponds to the fourth segment (e.g., "0407"), *jk* corresponds to the fifth segment representing the Route Suffix (e.g., "B0"), and direction corresponds to the sixth segment when present.

The *ghi* component was normalized using the same procedure as SR routes, converting values such as 0407 → 407 → "407" to ensure consistent formatting across datasets. The Route ID was then constructed using the following format: Function Type + first segment + third segment + normalized fourth segment + Route Suffix + Direction, where the Function Type is represented by its corresponding one-character code (e.g., RP = 2). For example:

- Input: Route Type = Ramp (Function Type = 2)
- Route string = 121-RP-002-0407-B0-INC
- Output: Route_ID = 2121002407B0INC

When the direction field was missing (e.g., “121-RP-002-0407-B0”), a Route ID was not assigned during the initial pass. In a subsequent fallback pass, missing direction values were assumed to be INC, resulting in a final Route_ID = 2121002407B0INC. This two-pass procedure ensures consistency in Route ID formatting whether directional information is originally present or absent.

Following construction, Route ID values were verified against the HPMS dataset to confirm that the generated identifiers matched existing route records. Only validated Route IDs were retained for subsequent linkage with the Bridge Linear dataset for bridge identification.

Bridge ID Assignment for Section and GDOT Assets

For maintenance work order records recorded under the Section and GDOT Assets asset types without an associated Bridge ID, the Route ID developed in the previous step was used to associate those work orders with bridge inventory records contained in the Bridge Linear dataset. The Route ID corresponds to the Route ID (RCLink) used in Bridge Linear, enabling identification of bridges located along the same roadway route. Because multiple bridges may exist along a single route, bridge identification was performed using a sequential filtering process designed to narrow candidate bridges and identify the most appropriate match. The following steps were used to identify Bridge IDs:

- Step 1. Match Route IDs. The developed Route ID was matched to the RCLink (Route ID) field in the Bridge Linear dataset. This step returned all

bridges located along the same route as the work order's roadway segment, and this bridge list served as the initial candidate set.

- Step 2. Confirm county agreement. The county associated with the work order was compared with the county code derived from the candidate bridge records. Candidate bridges were filtered to those located within the same county as the work order record. This step prevented bridges on multi-county routes from being assigned to an incorrect county.
- Step 3. Compare location limits. The start and end locations for each work order were compared with bridge milepoint limits to determine whether the work activity occurred within the bridge location. The begin and end milepoints from work order records were normalized to ensure proper ordering. Candidate bridges were retained when the work segment fell within the bridge milepoint range or overlapped the bridge location. This step was critical because multiple bridges may share the same route and county.
- Step 4. Select final bridge. If a single bridge satisfied all filtering criteria, the corresponding Bridge ID was assigned. If multiple bridges satisfied the criteria, the first matching record was selected, which represented the bridge whose milepoint limits most closely aligned with the work order segment.
- Step 5. Address unmatched work orders. If no candidate bridge satisfied the filtering criteria, the Bridge ID remained unassigned. These maintenance work order records were subsequently classified as "unknown" during further processing and reporting.

- Step 6. Validate district. Following Bridge ID assignment, InspectX data were used to validate district consistency. Bridge IDs from InspectX were linked to district information. For Section and GDOT Asset Type records, the district from InspectX was compared with the district recorded in the work order. When district values did not match, the assigned Bridge ID was cleared to prevent erroneous attribution and ensure data integrity.
- Step 7. Integrate spatial data. After district validation, geographic coordinates from InspectX were joined to the work order records. These coordinates provide the spatial reference required for mapping and enable the visualization of maintenance activities within the ArcGIS environment.

Condition and Traffic Data Enrichment

To provide information about bridge component conditions and traffic exposure, annual NBI datasets published by the FHWA and reported by GDOT were incorporated into the maintenance dataset. These data provide bridge condition ratings and traffic metrics used nationwide for bridge monitoring and reporting.

Bridge IDs were derived from the NBI database and formatted to match how Bridge IDs appear in the district work order maintenance dataset. Standardizing this identifier enabled the merging of condition and traffic attributes with maintenance records by Bridge ID and fiscal year.

Condition Rating Integration

NBI condition ratings were incorporated to provide bridge condition rating information associated with maintenance activities. Depending on structure type, the deck condition rating (for bridges) or culvert condition rating (for culvert structures) was used.

To support dashboard filtering and interpretation, numeric NBI condition ratings were grouped into qualitative condition categories, with ratings of 7–9 classified as good, 5–6 as fair, and 0–4 as poor.

Traffic Data Integration

Traffic exposure data were incorporated to support the prioritization and risk-based evaluation of maintenance activities. Average Daily Truck Traffic (ADTT) was computed using NBI traffic attributes as the product of ADT and the percentage of trucks divided by 100. ADT represents the total average daily traffic, while the percent trucks value represents the proportion of truck traffic within the traffic volume. Truck traffic was selected as a key indicator because heavy vehicle loads are expected to contribute significantly to structural deterioration and maintenance demand.

To support dashboard filtering, sorting, and prioritization, computed ADTT values were grouped into categorical traffic ranges of 0–500, 501–1,000, 1,001–2,000, 2,001–5,000, and greater than 5,000. A corresponding numeric category code was also assigned to enable sorting and symbology within the dashboard environment.

Synthesis

Ultimately, the synthesis of traffic exposure with condition ratings establishes a context for interpreting maintenance activities. Condition categories allow users to quickly assess the structural health of bridges, while traffic exposure helps identify bridges subjected to higher and/or more frequent loading demands. Together, these attributes support prioritization, visualization, and informed decision making within the ArcGIS dashboard.

Bridge Condition History Integration

Bridge condition history data were integrated to support performance analysis and enable time-series visualization within the ArcGIS dashboard. Annual NBI datasets for Georgia provide component condition ratings for deck, superstructure, substructure, and culvert systems. Because FHWA NBI condition ratings are reported on a calendar-year basis, maintenance records were linked to condition ratings by calendar year. Meanwhile, fiscal-year fields used for maintenance reporting were preserved.

To ensure continuity in a multi-year evaluation, the dataset was structured such that each bridge contains a record for each year in the study period, regardless of whether a maintenance activity occurred. This preserves annual condition ratings independent of maintenance frequency and prevents artificial gaps in time-series visualizations. The resulting integrated dataset enables bridge-level condition tracking and provides a context for interpreting maintenance activities within the broader framework of bridge performance over time.

Creation of the ArcGIS Input File

The final workflow stage produces a unified dataset combining maintenance history, Bridge IDs, geographic coordinates, traffic metrics, and condition ratings. The dataset is structured to support GIS integration with standardized attribute fields, consistent Bridge IDs, and spatial coordinates suitable for mapping and analysis. This file serves as the authoritative data source for dashboard visualization and enables consistent reporting across counties, districts, and analysis periods.

Use of the Unified Dataset in ArcGIS Dashboard Development

The unified dataset is published to ArcGIS Online and serves as the authoritative data layer for a single dashboard application developed using ArcGIS Experience Builder. The application is structured into multiple pages to organize key analytical components, including maintenance history, condition ratings, and traffic exposure. These pages were configured using interactive maps, charts, tables, and summary indicators linked to the unified dataset, enabling dynamic filtering, querying, and visualization of bridge data across districts, time periods, activity classifications, and individual bridge records.

CHAPTER 3. OUTCOMES OF THE DASHBOARD

OVERVIEW OF THE DASHBOARD INTERFACE

The GDOT District Bridge Maintenance & Expenditure GIS Dashboard was developed as a web-based analytical platform to support the monitoring and evaluation of bridge maintenance activities across Georgia. The application is accessible online: https://experience.arcgis.com/experience/189588a9f9454b56b7545ac90915240e

This platform provides a structured environment for reviewing district-level bridge maintenance expenditures, activity distributions, bridge condition ratings, traffic exposure, and data quality indicators. Through coordinated filtering and interactive visualization, users can examine maintenance patterns across fiscal years, districts, activity classifications, and individual bridge records. Displayed results can be filtered by fiscal year, quarter, maintenance team, district, activity name, sub-activity, Bridge ID, and asset type. All visual components—including summary indicators, charts, tables, and maps—update simultaneously in response to user selections, ensuring consistent analysis across the dashboard.

The dashboard is organized into five analytical pages: Activity-Based Costs, Conditions by Traffic Levels, Maintenance and Condition History, QA/QC Statistics, and Pocket Guide. Each page presents a distinct analytical perspective while sharing the same underlying dataset and interactive filtering capabilities. Collectively, these pages support

transparent expenditure tracking, traffic-informed condition assessment, maintenance activity evaluation, and data quality review.

Activity-Based Costs Page

The Activity-Based Costs page provides a consolidated view of bridge maintenance workload and expenditures across districts. Summary performance indicators displayed at the top of the interface include the total number of completed bridge maintenance activities, the total number of bridges worked on, and the total amount spent on bridge maintenance for the selected criteria. Figure 4 illustrates the page with example filters applied for fiscal year 2026 (FY 2026), quarter 2 (Q2), specialized team, and activity 845 (other bridge maintenance). Under these selected conditions, the dashboard reports 308 completed bridge maintenance activities, 161 bridges worked on, and a total expenditure of $461,505. These summary values adjust automatically based on the selected filters.

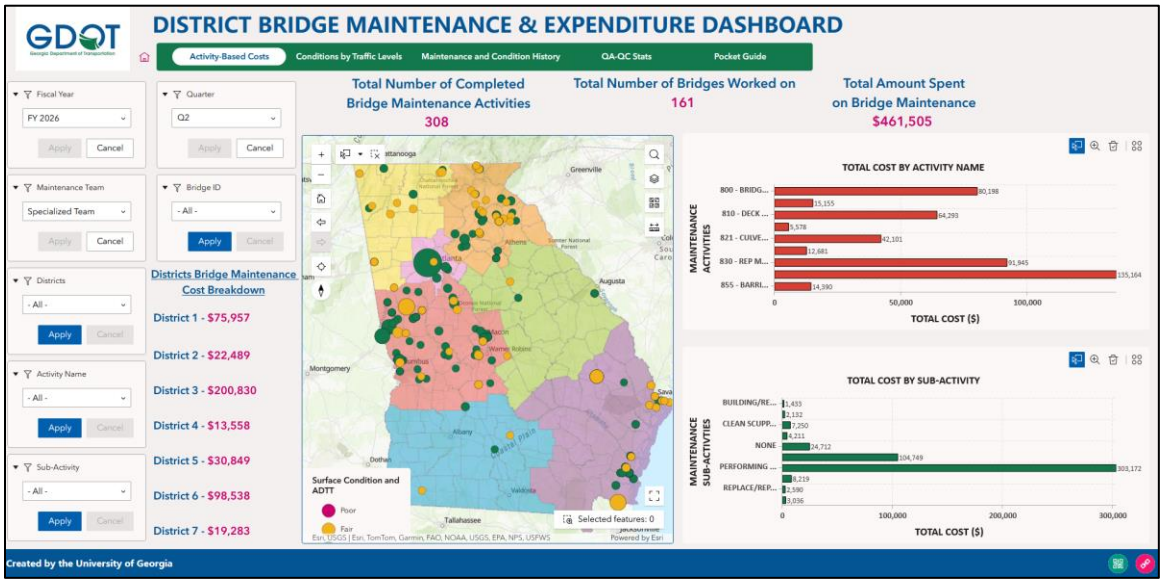


Figure 4. Illustration. Activity-Based Costs page of the dashboard.

Expenditures are further reported by activity name and sub-activity. The Total Cost by Activity Name chart identifies the relative contribution of each 800-series maintenance classification to overall spending. The Total Cost by Sub-Activity chart provides additional detail by separating work types, such as cleaning, repairing, replacing, or other field operations. Together, these charts identify dominant cost drivers within the selected period and work type classification. A district-level cost breakdown is displayed to the left of the map, reporting total bridge maintenance expenditures for each GDOT district under the active filters. This enables direct comparison of maintenance investment across GDOT districts within a consistent time frame and activity category.

The central map provides spatial context by displaying bridge locations associated with the filtered maintenance records. Bridge location markers are color coded according to surface condition classification, with green representing good, yellow representing fair, and red representing poor. The condition values are based on NBI condition ratings corresponding to the selected fiscal year, where the condition is taken from the preceding calendar year (i.e., NBI year = Fiscal Year − 1; for example, Fiscal Year 2026 uses 2025 NBI condition ratings). Marker size varies according to traffic intensity, with larger symbols indicating higher ADTT levels. This symbology enables visual assessment of the geographic distribution of bridge maintenance activities while simultaneously conveying condition status and relative traffic exposure.

Overall, this page showcases how bridge maintenance resources are allocated across districts, activity types, and time periods, and provides a summary of completed work and associated costs.

Conditions by Traffic Levels Page

The Conditions by Traffic Levels page examines traffic exposure, measured using ADTT categories, and its relationship to bridge surface condition. Figure 5 illustrates this page with example filters applied for fiscal year 2026, quarter 3, and specialized team. The upper chart in the figure presents the distribution of bridges by surface condition classification across five ADTT bins. Surface condition is grouped into good and fair categories in the displayed example. The chart allows comparison of the number of bridges within each traffic category and condition group, providing a visual summary of how condition status varies with truck traffic.

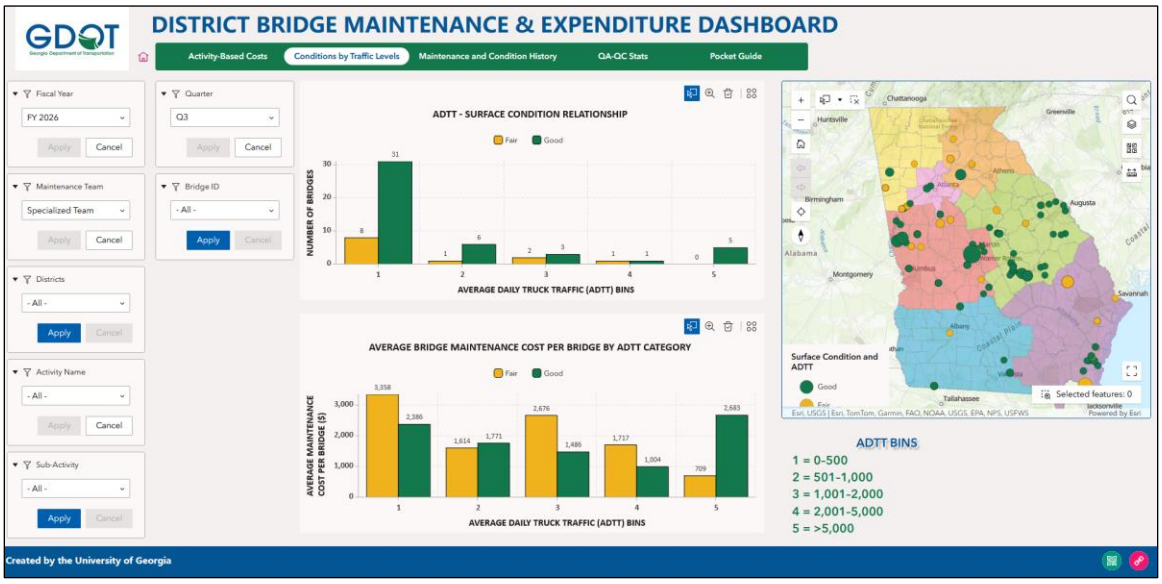


Figure 5. Illustration. Conditions by Traffic Levels page of the dashboard.

The lower chart displays the average bridge maintenance cost per bridge within each ADTT category, separated by surface condition. This visualization enables comparison of maintenance cost intensity across traffic levels and condition classes. Differences in average cost across ADTT bins provide insight into how traffic exposure may influence maintenance demand and expenditure levels. The map on the right provides spatial context for the filtered dataset. Together, these visualizations support evaluation of whether bridges subjected to higher truck volumes exhibit different condition distributions or maintenance cost patterns compared to those with lower traffic exposure.

Maintenance and Condition History Page

The Maintenance and Condition History page provides bridge specific tracking of completed maintenance activities together with annual structural condition ratings. Figure 6 illustrates this for Bridge ID 051-0006-0. The upper table lists the recorded maintenance history for the selected bridge. Fields include start date, end date, year, activity name, work description, comments, and total cost. In the example shown in the figure, maintenance activities in 2022 include debris removal and bridge curb or rail repair, along with associated costs and descriptive comments. This table enables review of the timing, type, and expenditure associated with each maintenance action.

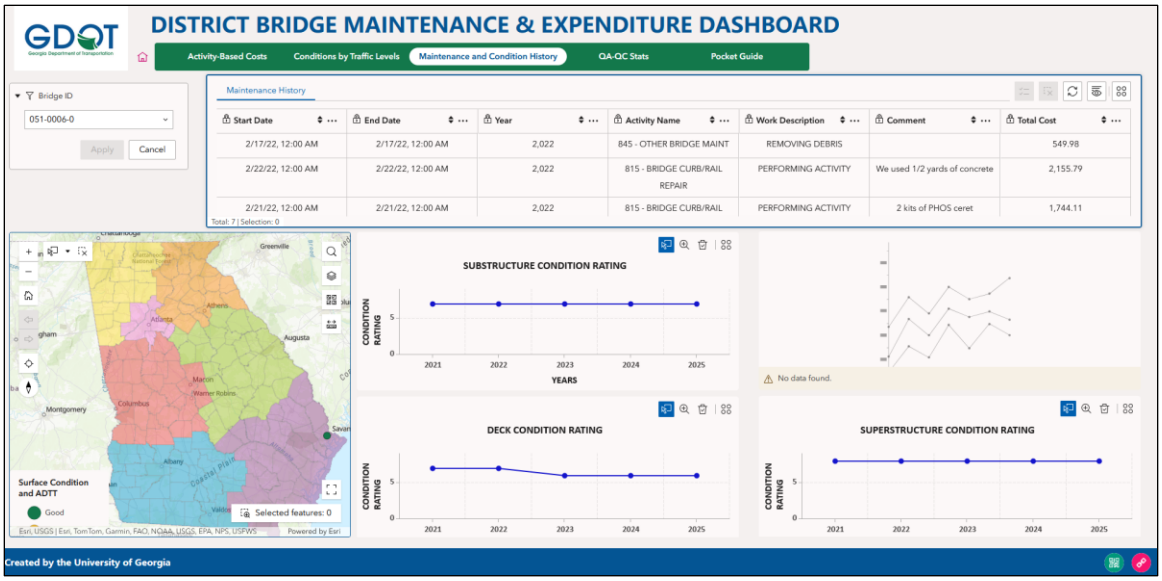


Figure 6. Illustration. Maintenance and Condition History page of the dashboard.

Below the Maintenance History table, annual condition ratings are presented in time series format for the deck, superstructure, and substructure components. Condition ratings are plotted by year, allowing visual assessment of performance trends over time. In the example shown in Figure 6, substructure and superstructure ratings remain relatively stable across the displayed years, while the deck rating shows a slight decline before stabilizing.

A culvert condition panel (upper-right quadrant) is also included in the layout even when, as indicated in the figure, no culvert data are available. This ensures that the page remains consistent across bridge types while clearly indicating when a component is not applicable.

The map displayed on the left provides the geographic context for the selected bridge, while the table and charts provide longitudinal performance information. Together, these elements support assessment of how recorded maintenance activities correspond to

observed condition ratings and enable bridge-level review of maintenance effectiveness and structural performance trends.

QA-QC Statistics Page

The QA-QC Statistics page provides a summary of Bridge ID entries by district and establishes data entry consistency within maintenance records. Figure 7 illustrates this page for fiscal year 2026. Four summary indicators are displayed at the top of the page: total number of bridges worked on, total number of Bridge IDs entered, total number of Bridge IDs identified using the Route ID matching process, and total number of Bridge IDs not identified using Route ID. In the example shown, 1158 bridges were worked on, 695 Bridge IDs were directly entered, 373 Bridge IDs were identified through the Route ID process, and 137 bridge records remained unidentified. These indicators provide a quantitative measure of Bridge ID coverage within maintenance documentation. The distinction between directly entered Bridge IDs and those identified through Route ID allows evaluation of reporting completeness and the effectiveness of the automated identification procedure.

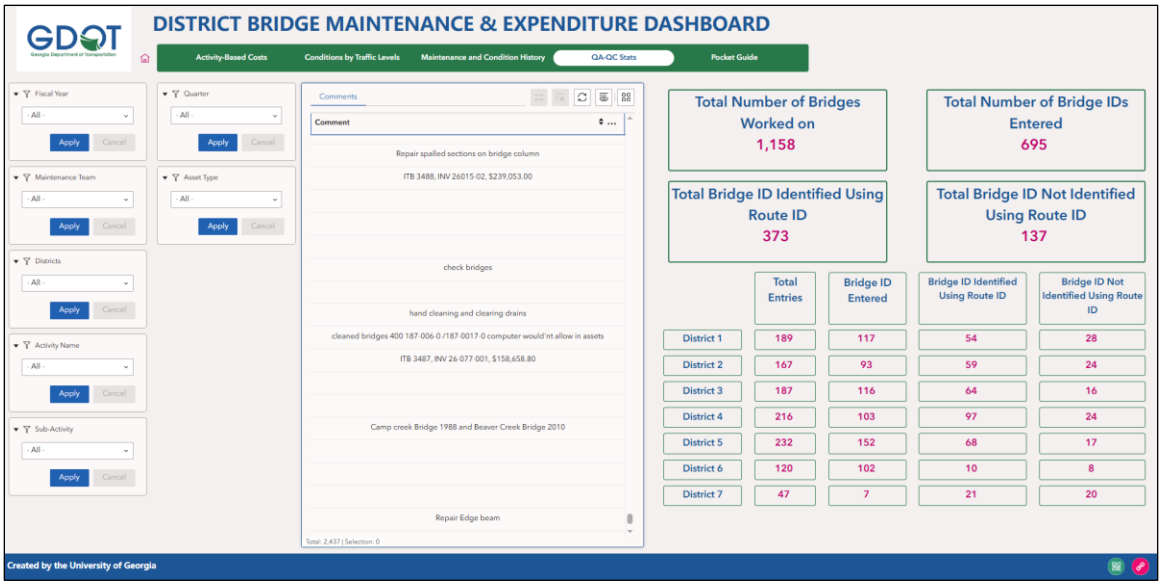


Figure 7. Illustration. QA-QC Statistics page of the dashboard.

A district-level breakdown is presented below the summary indicators. For each district, totals are reported for overall entries, Bridge IDs entered, Bridge IDs identified using Route ID, and Bridge IDs not identified. This structure enables comparison of identification performance across districts and highlights where additional data entry standardization may be needed. The comments panel displayed on the left provides context from maintenance work descriptions. Review of comment patterns may assist in understanding common reporting practices and identifying opportunities for improving consistency in bridge-level maintenance documentation.

Overall, this page supports the monitoring of data quality, identification accuracy, and reporting completeness within the bridge maintenance program. By quantifying identification success rates and highlighting unidentified records, it provides a structured mechanism for improving long-term data reliability.

Pocket Guide Page

The Pocket Guide page provides direct access to the DWR Pocket Guide for recording bridge maintenance activities. Figure 8 illustrates the embedded guide interface within the dashboard environment. The guide outlines standardized procedures for classifying bridge-related maintenance activities, including clarification on when to enter "Bridges" as the asset type and how to identify the correct Bridge ID.

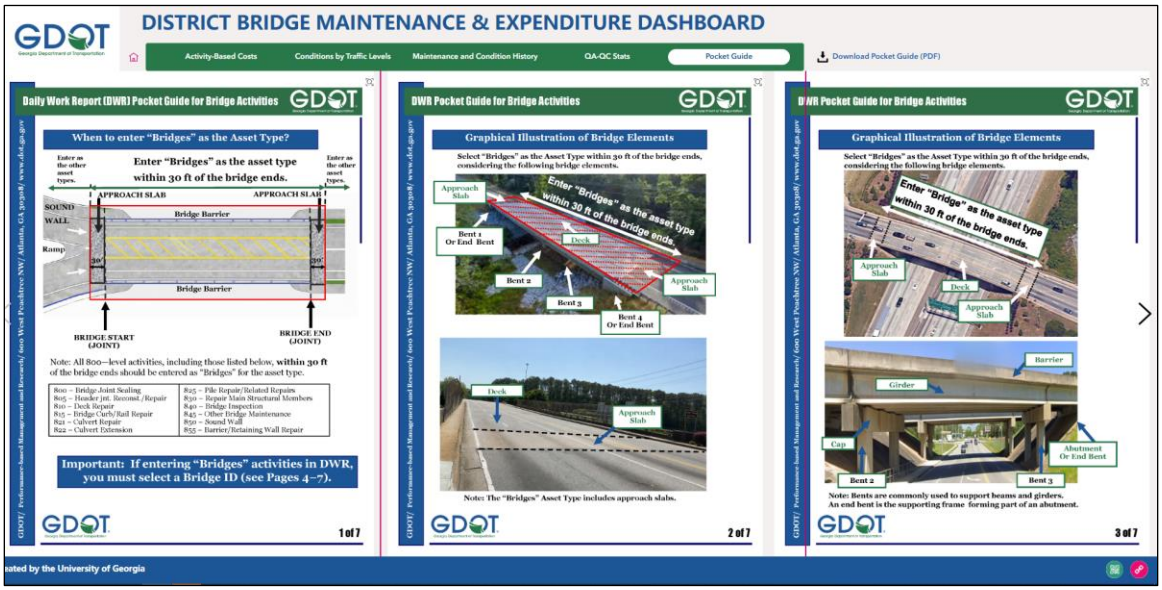


Figure 8. Illustration. Pocket Guide page of the dashboard.

Visual diagrams and step-by-step reference materials are included to support accurate field documentation and bridge identification. A downloadable PDF version of the guide is also available within the module, ensuring accessibility for field personnel and maintenance teams. By integrating reporting guidance directly into the dashboard platform, this module supports improved data entry consistency and reinforces standardized documentation

practices. The inclusion of the guide complements the QA-QC Statistics module by addressing common sources of incomplete or inconsistent bridge identification.

FUTURE ENHANCEMENTS

The data must be entered in DWRs using Bridge IDs. Once districts successfully enter data that consistently identifies Bridge IDs, it is recommended to develop the project dashboard using Power BI as the primary analytics and reporting platform rather than a standalone GIS dashboard. Power BI provides stronger capabilities for interactive data visualization, cross-filtering, performance metrics, and executive-level reporting, which are critical for monitoring trends, comparing scenarios, and supporting dynamically updated, data-driven decision making, particularly within the GDOT interface using the 411 database.

Further, GIS maps may be integrated within the Power BI dashboard to preserve essential spatial context, such as asset locations, network connectivity, and regional patterns. This hybrid approach allows users to interact with maps alongside charts, tables, and key performance indicators in a single, cohesive environment, eliminating the need to switch between separate GIS and reporting tools.

CHAPTER 4. DATA ANALYSIS, SYNTHESIS, AND POCKET GUIDE

This chapter presents a comprehensive analysis of the 411 database and the processed data used to develop the dashboard described in the previous chapters. The analysis followed a structured approach to examine maintenance activities, identify key trends, and generate meaningful summary charts that synthesize the findings.

The research team compiled work order data in coordination with the GDOT OBDM, the OTD, and the IT team. Through a series of meetings (2024–2026) with GDOT district maintenance managers, the team developed a clear understanding of data characteristics and district practices for data entry and recordkeeping, including asset types, Bridge IDs, Route IDs, and maintenance crew assignments involving specialized bridge crews and other maintenance crews.

Based on these discussions, the research team defined the required data format and obtained the necessary information from the IT team through the 411 database. As noted in the previous chapters, additional data processing was required to produce meaningful summaries of bridge maintenance activities. This effort focused on supporting the long-term goal of achieving consistent and standardized data entry (e.g., Bridge IDs), enabling the GDOT team to generate reliable summaries within internal applications without relying on multiple databases or assumptions to infer Bridge IDs.

ANALYSIS OF WORK ORDER DATA

Two analytical approaches were employed to analyze the work order data based on asset type classification. The first approach was applied to work orders associated with bridge assets; the second was applied to work orders associated with non-bridge assets.

For Bridges asset type records, the Bridge ID was obtained directly from the Inventory Item Name field. For non-bridge asset records, the Inventory Item Name field contained the Route ID rather than the Bridge ID. The Route ID was converted to the HPMS Route ID format, and the corresponding Bridge ID was then determined using the recorded milepost information.

Entries of All Activities with "Bridges" as Asset Type

For records classified under the Bridges asset type, the Bridge ID was directly extracted from the Inventory Item Name field. This allowed each work order record to be associated directly with a bridge asset without requiring additional route conversion or location-matching procedures. After the Bridge ID was identified, the data were organized by district, fiscal year, and activity code to evaluate the distribution of bridge-related maintenance activities recorded in the 411 database.

The analysis focused on bridge-related activity codes within the 800-series. These activities include bridge joint sealing, header joint reconstruction and repair, deck repair, curb and rail repair, culvert repair and extension, pile repair, repair of main structural members, bridge inspection, other bridge maintenance, and barrier or retaining wall repair. The

records were summarized using the number of unique work order IDs so that the analysis reflects the frequency of documented activities by category, district, and fiscal year (FY).

Figure 9 presents the distribution of maintenance activities recorded with Bridges as the asset type based on the number of unique work order records. A total of 3,827 bridge-asset work orders were identified over FY 2021 through FY 2026. The annual totals increased from 411 in FY 2021 to 838 in FY 2026, with intermediate totals of 620 in FY 2022, 711 in FY 2023, 602 in FY 2024, and 645 in FY 2025. Overall, the figure indicates an increasing level of bridge-related maintenance activity over the study period, although the year-to-year pattern is not uniform.

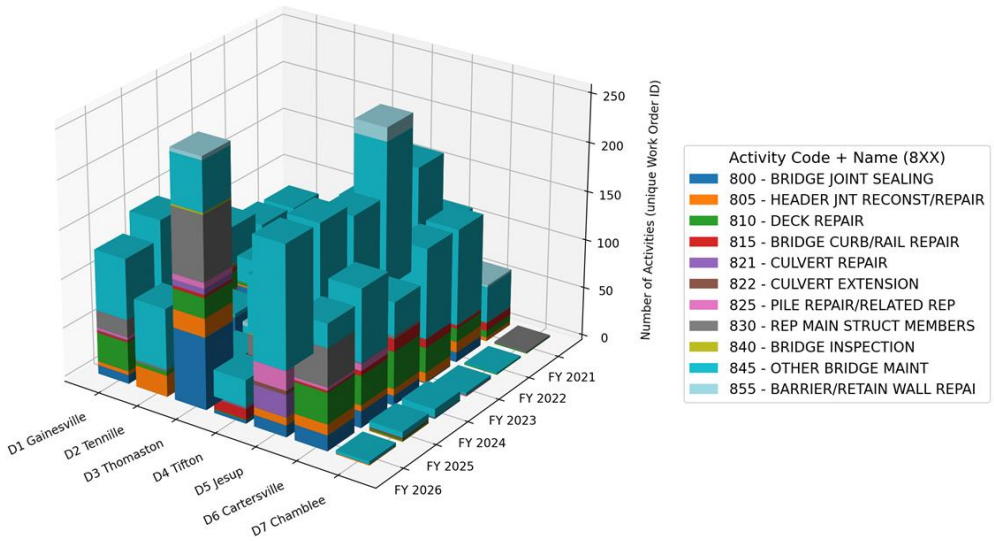


Figure 9. Chart. Activity counts for Bridges asset type by fiscal year and district.

A prominent feature of Figure 9 is the substantial contribution of activity 845 (other bridge maintenance) across all districts and fiscal years. This activity category accounted for 2,030

work orders, representing approximately 53 percent of the total bridge-asset records, and was the largest category throughout the analysis period. In addition to activity 845, the most frequently reported activities were 800 (bridge joint sealing) with 513 work orders, 810 (deck repair) with 445, 830 (repair of main structural members) with 261, and 805 (header joint reconstruction/repair) with 250. These results indicate that records entered under the Bridges asset type capture both routine maintenance activities and more focused repair actions.

The district-level distribution of work order counts further shows that bridge maintenance activities were concentrated in several districts. District 5 (Jesup) recorded the largest cumulative total with 1,110 work orders over the six-year period, followed by district 6 (Cartersville) with 706, district 1 (Gainesville) with 664, and district 3 (Thomaston) with 624. The highest district-year total occurred in district 3 (Thomaston) in FY 2026, with 253 work orders. Elevated activity levels were also observed in district 5 (Jesup) across multiple fiscal years, including 247 work orders in FY 2023 and 192 work orders in both FY 2025 and FY 2026. By comparison, district 7 (Chamblee) recorded relatively low activity levels throughout the analysis period.

Overall, Figure 9 shows that maintenance activities entered under the Bridges asset type increased over the study period and were dominated by other bridge maintenance (activity 845), with additional contributions from bridge joint sealing, deck repair, header joint repair, and repair of main structural members. The figure also shows that the distribution

of work was not uniform across districts, but instead was concentrated in a limited number of district-year combinations, particularly in districts 1, 3, 5, and 6.

Entries of Activity 845 Classified Under the Bridges Asset Type

Because activity 845 (other bridge maintenance) represents the highest-cost category among work orders recorded under the Bridges asset type, an additional level of analysis was conducted to better understand the types of work included under this activity code. Since activity 845 is a broad category, the Work Description field was reviewed to identify more specific sub-activities recorded under this code. These sub-activities were then grouped and summarized by district and fiscal year to provide a more detailed understanding of how activity 845 is applied in practice. It is noted that Figure 10 intentionally shows District 5 first for better visibility of the chart.

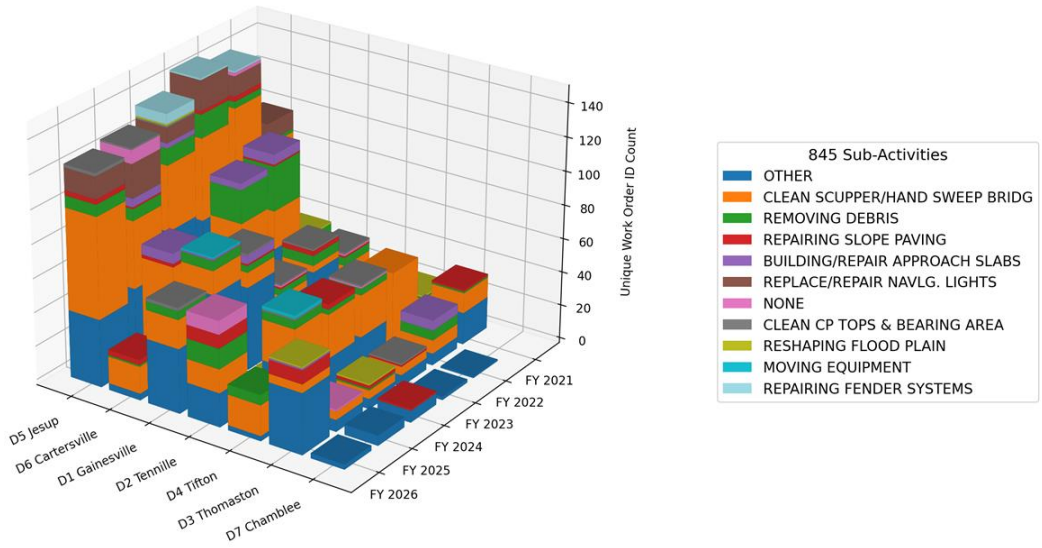


Figure 10. Chart. 845 Sub-activity counts for the Bridges asset type by fiscal year and district.

Figure 10 presents the distribution of sub-activities under activity 845 (other bridge maintenance) for records entered with Bridges as the asset type based on the number of unique work order records. From FY 2021 through FY 2026, a total of 2,030 activity 845 work orders were identified under the Bridges asset type. The annual totals were 233 in FY 2021, 385 in FY 2022, 373 in FY 2023, 321 in FY 2024, 364 in FY 2025, and 354 in FY 2026. These results show that activity 845 remained a consistently prominent bridge maintenance category throughout the study period, with the highest annual levels occurring in FY 2022 and FY 2023. Throughout this report, sub-activity descriptions are presented in CAPITAL LETTERS for clarity and to distinguish them from the main activities.

A key feature of Figure 10 is the dominance of the sub-activities OTHER and CLEAN SCUPPER/HAND SWEEP BRIDGE across nearly all districts and fiscal years within activity 845 (other bridge maintenance). The OTHER sub-activity category accounted for 915 work orders, representing approximately 45 percent of all activity 845 records, while CLEAN SCUPPER/HAND SWEEP BRIDGE accounted for 711 work orders, or approximately 35 percent. Together, these two sub-activities comprised about 80 percent of the total activity 845 records entered under the Bridges asset type. Other recurring sub-activities included REMOVING DEBRIS with 173 work orders, REPLACE/REPAIR NAVIGATION LIGHTS with 83, BUILDING/REPAIR APPROACH SLABS with 47, and REPAIRING SLOPE PAVING with 37. Less frequent entries were associated with NONE, MOVING EQUIPMENT, CLEAN CP TOPS & BEARING AREA, RESHAPING FLOOD PLAIN, and REPAIRING FENDER SYSTEMS.

The district-level distribution indicates that activity 845 work under the Bridges asset type was concentrated in a limited number of districts. District 5 (Jesup) recorded the highest cumulative total with 777 work orders over the six-year period, followed by district 6 (Cartersville) with 359, district 1 (Gainesville) with 331, and district 4 (Tifton) with 264. The highest district-year total occurred in district 5 (Jesup) in FY 2023, with 147 work orders. District 5 also recorded consistently high totals in FY 2022 (141), FY 2024 (137), FY 2025 (128), and FY 2026 (125), indicating sustained activity 845 usage in that district. By comparison, district 7 (Chamblee) recorded relatively few activity 845 work orders during the analysis period.

Overall, Figure 10 shows that activity 845, when entered under the Bridges asset type, was used primarily to document broad maintenance actions such as general bridge-related work and scupper or hand-sweeping activities. The concentration of records in the OTHER sub-activity category further indicates that a substantial portion of activity 845 work was reported using general descriptions rather than narrowly defined task labels. At the same time, the figure shows that more specific bridge maintenance functions—including debris removal, navigation light repair, approach slab work, and slope paving—were also captured within the activity 845 code. Accordingly, Figure 10 provides a more detailed view of how the largest bridge maintenance activity category was represented across districts and fiscal years.

Entries of All Activities with Asset Types Other Than "Bridges"

The non-bridge asset records were further grouped according to the asset type labels available in the 411 database, including Section, GDOT Assets, and Blank/NA. For each of these categories, the work orders were summarized by district, fiscal year, and activity code using the number of unique work order IDs. This approach provided a basis for evaluating how bridge-related maintenance activities were recorded when the original asset type classification was not explicitly identified as Bridges.

For records not classified under the Bridges asset type, the inventory item name did not directly provide the Bridge ID. Instead, these records generally contained a Route ID, which was converted to the HPMS Route ID format using the procedure described in the previous chapters. In turn, the corresponding Bridge ID was identified using the associated milepost information. This procedure allowed work orders recorded under non-bridge asset types to be linked to bridge locations for subsequent analysis.

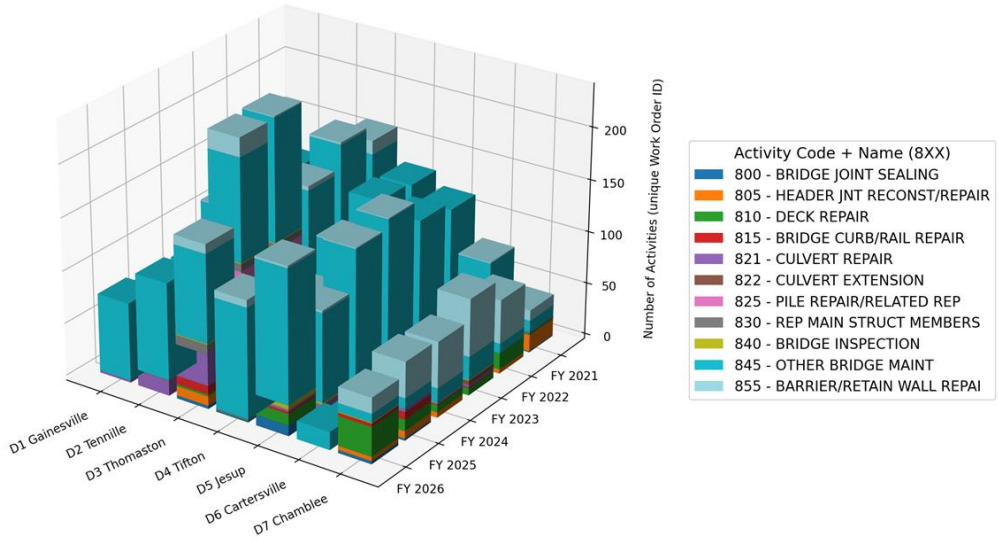


Figure 11. Chart. Activity counts for Section asset type by fiscal year and district.

Figure 11 presents the distribution of maintenance activities recorded with Section as the asset type based on the number of unique work order records. From FY 2021 through FY 2026, a total of 4,211 work orders were identified under the Section asset type. The annual totals were 750 in FY 2021, 752 in FY 2022, 685 in FY 2023, 647 in FY 2024, 687 in FY 2025, and 690 in FY 2026. These results indicate that Section-based records remained consistently high throughout the study period, with only moderate year-to-year variation.

A prominent feature of Figure 11 is the dominance of activity 845 (other bridge maintenance) across all fiscal years. This activity category accounted for 3,014 work orders, representing approximately 72 percent of all Section asset type records, and was the largest activity category in every fiscal year. Annual counts for activity 845 were 544 in FY 2021, 571 in FY 2022, 505 in FY 2023, 435 in FY 2024, 452 in FY 2025, and 507

in FY 2026. In addition to activity 845, the most frequently reported activities were 855 (barrier/retaining wall repair) with 281 work orders, 821 (culvert repair) with 249, 810 (deck repair) with 209, 800 (bridge joint sealing) with 143, and 805 (header joint reconstruction/repair) with 121. These results show that a substantial number of bridge-related maintenance activities were recorded under the Section asset type.

The district-level distribution of work orders further indicates that Section-based activity was concentrated in several districts. District 3 (Thomaston) recorded the highest cumulative total with 1,116 work orders over the six-year period, followed by district 5 (Jesup) with 776, district 4 (Tifton) with 662, district 2 (Tennille) with 561, and district 1 (Gainesville) with 534. The highest district-year total occurred in district 3 (Thomaston) in FY 2024, with 236 work orders, followed closely by district 3 in FY 2025, with 234 work orders. Elevated activity levels were also observed in district 5 (Jesup) and district 4 (Tifton) in multiple fiscal years, while district 6 (Cartersville) recorded comparatively low Section-based activity throughout the study period.

Overall, Figure 11 shows that bridge-related maintenance activities entered under the Section asset type constituted a substantial portion of the work order database and were dominated by activity 845 (other bridge maintenance). The figure also shows that these records were not uniformly distributed across districts; instead, they were concentrated in particular district-year combinations involving district 3 (Thomaston) and district 5 (Jesup). These findings further support the need to evaluate non-bridge asset type entries when reviewing bridge-related maintenance activity in the 411 database.

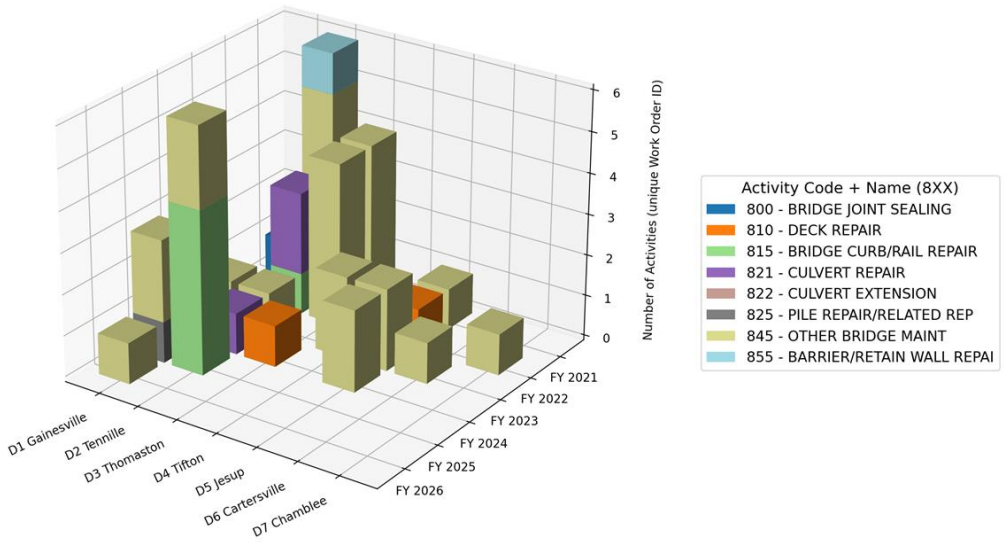


Figure 12. Chart. Activity counts for the Blank/NA asset type by fiscal year and district.

Figure 12 presents the distribution of maintenance activities recorded with Blank/NA as the asset type based on the number of unique work order records. From FY 2021 through FY 2026, a total of 43 work orders were identified under this asset type. The annual totals were 12 in FY 2021, 9 in FY 2022, 7 in FY 2023, 5 in FY 2024, 9 in FY 2025, and 1 in FY 2026. Compared with Bridge and Section asset type categories, the Blank/NA group represents only a small portion of the overall work order database.

A prominent feature of Figure 12 is the dominance of activity 845 (other bridge maintenance) within this asset type. This category accounted for 28 work orders, representing approximately 65 percent of all Blank/NA records. The remaining work orders were distributed across a small number of other activity categories, including 815

(bridge curb/rail repair) with 5 work orders, 821 (culvert repair) with 4, 810 (deck repair) with 2, and single records in 800 (bridge joint sealing), 822 (culvert extension), 825 (pile repair/related repair), and 855 (barrier/retaining wall repair). This distribution shows that, although limited in number, the Blank/NA category still includes several bridge-related maintenance activities.

The district-level distribution indicates that these records were concentrated primarily in a few districts. District 2 (Tennille) recorded the highest cumulative total with 17 work orders over the six-year period, followed by district 3 (Thomaston) with 9, district 1 (Gainesville) with 7, and district 5 (Jesup) with 6. The highest district-year totals occurred in district 2 (Tennille) in FY 2021 and FY 2025, with 6 work orders in each year. By contrast, several districts recorded only isolated entries, and FY 2026 contained only a single Blank/NA work order statewide.

Overall, work orders entered under the Blank/NA asset type constituted a very limited share of the database, but the activities represented within this category were still predominantly bridge-related, particularly under activity 845 (other bridge maintenance). Although small in number, these records were retained in the analysis to provide a more complete account of bridge-related maintenance activity recorded under non-specific asset type entries.

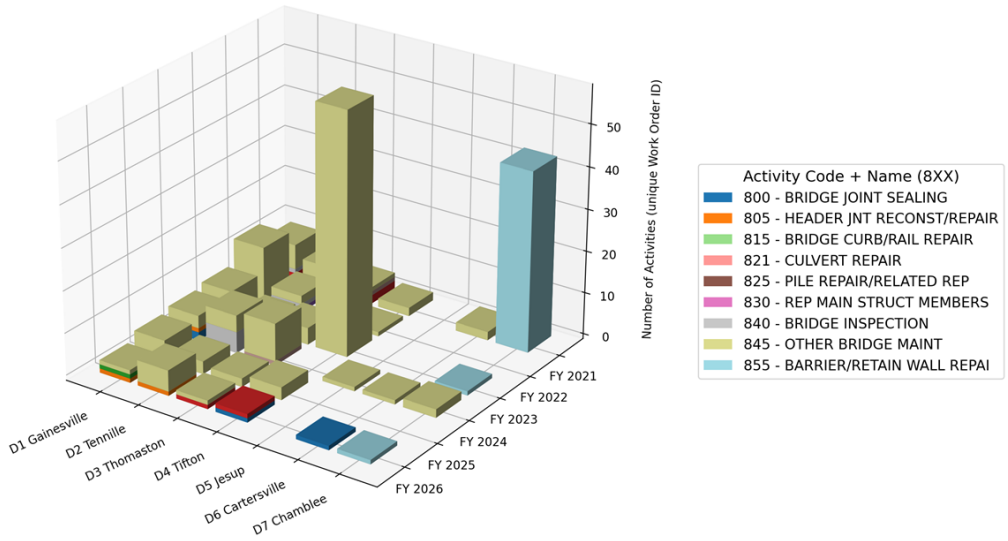


Figure 13. Chart. Activity counts for GDOT Assets by fiscal year and district.

Figure 13 presents the distribution of maintenance activities recorded with GDOT Assets as the asset type based on the number of unique work order records. From FY 2021 through FY 2026, a total of 214 work orders were identified under this asset type. The annual totals were 66 in FY 2021, 18 in FY 2022, 73 in FY 2023, 29 in FY 2024, 13 in FY 2025, and 15 in FY 2026. These results indicate that activities recorded under the GDOT Assets category were relatively limited in number and were distributed unevenly across the study period.

A dominant feature of Figure 13 is the prominence of activity 845 (other bridge maintenance), which accounted for 140 work orders, or approximately 65 percent of all GDOT Assets records. The second-largest activity category was 855 (barrier/retaining wall repair) with 45 work orders, followed by 840 (bridge inspection) with 10 work orders. All remaining activity categories were recorded only in very small numbers, including 805

(header joint reconstruction/repair) and 815 (bridge curb/rail repair) with 5 work orders each, 800 (bridge joint sealing) with 4, 825 (pile repair/related repair) with 2, and single records in 810 (deck repair), 821 (culvert repair), and 830 (repair of main structural members). This distribution shows that the GDOT Assets category was used primarily for general bridge maintenance and barrier or retaining wall work, with only limited representation of other activity types.

The district-level distribution indicates that the GDOT Assets records were concentrated in a small number of districts. District 4 (Tifton) recorded the highest cumulative total with 66 work orders over the six-year period, followed by district 7 (Chamblee) with 47, district 1 (Gainesville) with 43, district 2 (Tennille) with 31, and district 3 (Thomaston) with 22. By contrast, district 5 (Jesup) and district 6 (Cartersville) recorded very few GDOT Assets work orders. The highest district-year total occurred in district 4 (Tifton) in FY 2023, with 58 work orders, while another notable concentration occurred in district 7 (Chamblee) in FY 2021, with 43 work orders. These results indicate that activities entered under the GDOT Assets classification were not broadly distributed statewide; rather, they were concentrated in particular district-year combinations.

Overall, the GDOT Assets asset type represents a relatively small but distinct portion of the work order database and is dominated by activity 845 (other bridge maintenance) and activity 855 (barrier/retaining wall repair). The concentration of these records in particular districts and years further indicates that non-bridge asset classifications can still contain

bridge-related maintenance activities and therefore should be considered in a comprehensive review of the 411 database.

Taken together, most non-bridge asset work orders linked to bridge-related activities are associated with the Section category, while the GDOT Assets category contributes a smaller but still meaningful share, whereas Blank/NA accounts for only a minor portion of the overall dataset. These findings indicate that bridge-related maintenance work is not recorded exclusively under the Bridges asset type and that additional non-bridge asset categories must be considered to obtain a more complete representation of bridge-related maintenance activity within the 411 database.

The results also indicate that the quality and consistency of asset type classification directly affect the interpretation of work order data. Records classified under the Section and GDOT Assets categories can provide meaningful information when Route ID conversion and milepost-based linkage are used, allowing bridge-related activities to be identified despite their non-bridge asset type assignments. In contrast, the Blank/NA category reflects limitations associated with incomplete or missing asset classification, resulting in the reduced traceability of work orders. Accordingly, inclusion of these non-bridge asset types was necessary to improve the completeness of the analysis and to support a more comprehensive synthesis of bridge-related maintenance activities across the state. It is important to note that the absence of Bridge IDs for these asset types prevents dynamic updates (i.e., nearly in real time) of work order data within GDOT's internal applications.

Entries of Activity 845 for Asset Types Other Than "Bridges"

Because activity 845 (other bridge maintenance) represented a major activity category within the non-bridge asset records, an additional level of review was conducted to better understand the specific maintenance actions reported under this activity. As noted previously, activity 845 is a broad classification and does not, by itself, provide sufficient detail regarding the exact nature of the work performed. Therefore, the Work Description field was examined to identify sub-activities within activity 845 for the non-bridge asset type categories. These sub-activities were then summarized by district and fiscal year using the number of unique work order records.

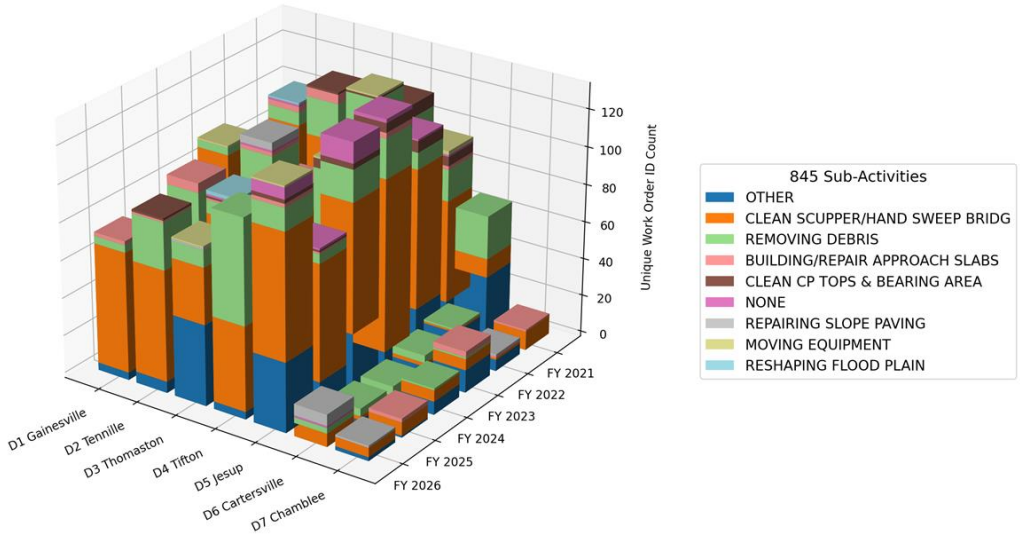


Figure 14. Chart. 845 Sub-activity counts for the Section asset type by fiscal year and district.

Figure 14 presents the distribution of activity 845 (other bridge maintenance) sub-activities for records entered with Section as the asset type based on the number of unique work

order records. From FY 2021 through FY 2026, a total of 3,014 activity 845 work orders were identified under the Section asset type. The annual totals were 544 in FY 2021, 571 in FY 2022, 505 in FY 2023, 435 in FY 2024, 452 in FY 2025, and 507 in FY 2026. These values indicate that activity 845 remained consistently prominent within the Section asset type throughout the study period, with the highest annual total occurring in FY 2022.

A dominant feature of Figure 14 is the concentration of records in the sub-activities CLEAN SCUPPER/HAND SWEEP BRIDGE and OTHER. CLEAN SCUPPER/HAND SWEEP BRIDGE accounted for 1,458 work orders, representing approximately 48 percent of all activity 845 records under the Section asset type, while OTHER accounted for 803 work orders, or approximately 27 percent. Together, these two sub-activities comprised about 75 percent of the total activity 845 records. Other recurring sub-activities included REMOVING DEBRIS with 600 work orders, BUILDING/REPAIR APPROACH SLABS with 52, CLEAN CP TOPS & BEARING AREA with 42, NONE with 31, REPAIRING SLOPE PAVING with 14, MOVING EQUIPMENT with 11, and RESHAPING FLOOD PLAIN with 3. This distribution indicates that activity 845, when recorded under the Section asset type, was used primarily for routine bridge-related maintenance tasks and general work.

The district-level distribution further shows that these records were concentrated in several districts. District 5 (Jesup) recorded the highest cumulative total with 678 work orders over the six-year period, followed by district 3 (Thomaston) with 599, district 4 (Tifton) with 596, district 2 (Tennille) with 522, and district 1 (Gainesville) with 417. By contrast,

district 6 (Cartersville) and district 7 (Chamblee) recorded substantially fewer activity 845 Section-based work orders. The highest district-year total occurred in district 5 (Jesup) in FY 2023, with 131 work orders, followed closely by district 5 (Jesup) in FY 2024 with 129 and district 4 (Tifton) in FY 2022 with 128. These results show that activity 845 work under the Section asset type was not evenly distributed across districts, but instead was concentrated in certain district-year combinations.

Overall, when categorized under the Section asset type, activity 845 records were dominated by broad maintenance functions such as scupper cleaning/hand sweeping and general bridge-related work, with debris removal also representing a substantial portion of the total activity. The results further indicate that a significant number of bridge-related maintenance activities were documented under the Section asset type rather than the Bridges asset type, highlighting the importance of including non-bridge asset type records in a comprehensive review of the 411 database.

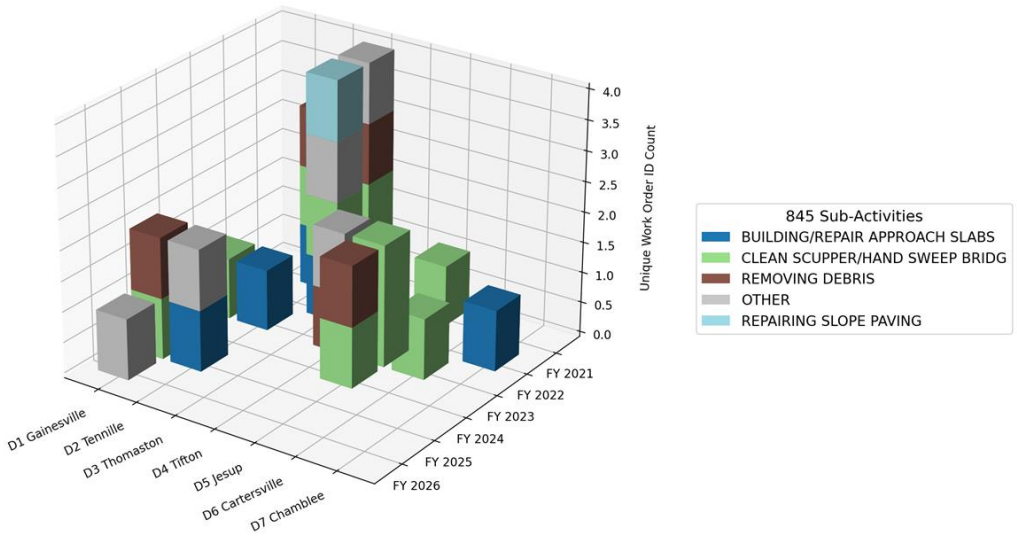


Figure 15. Chart. 845 Sub-activity counts for the Blank/NA asset type by fiscal year and district.

Figure 15 presents the distribution of activity 845 sub-activities for records entered with Blank/NA as the asset type based on the number of unique work order records. From FY 2021 through FY 2026, a total of 28 activity 845 work orders were identified under the Blank/NA asset type. The annual totals were 6 in FY 2021, 4 in FY 2022, 5 in FY 2023, 4 in FY 2024, 6 in FY 2025, and 3 in FY 2026. These results indicate that activity 845 entries under the Blank/NA asset type were limited in number and remained relatively low throughout the study period.

The sub-activity distribution shown in Figure 15 indicates that the recorded work was concentrated primarily in CLEAN SCUPPER/HAND SWEEP BRIDGE, OTHER, and REMOVING DEBRIS. CLEAN SCUPPER/HAND SWEEP BRIDGE accounted for 13

work orders, representing approximately 46 percent of all Blank/NA activity 845 records. OTHER accounted for 6 work orders, while REMOVING DEBRIS accounted for 4. The remaining records were distributed among BUILDING/REPAIR APPROACH SLABS with 3 work orders and REPAIRING SLOPE PAVING with 2 work orders. This distribution indicates that even within the limited Blank/NA category, the recorded activity 845 work remained largely associated with routine bridge-related maintenance tasks.

The district-level distribution further shows that these records were concentrated in a small number of districts. District 2 (Tennille) recorded the highest cumulative total with 8 work orders, followed by district 5 (Jesup) with 7, district 3 (Thomaston) with 6, and district 7 (Chamblee) with 4. The highest district-year total occurred in district 5 (Jesup) in FY 2021, with 4 work orders. Other district-year combinations generally contained only one or two records. These results confirm that the Blank/NA asset type contributed only a minor portion of the activity 845 records in the overall database.

In sum, activity 845 work entered under the Blank/NA asset type was limited in scale and was dominated by routine maintenance functions such as scupper cleaning or hand sweeping, general work descriptions, and debris removal. Although the number of such records was small, Figure 15 indicates that even undefined or missing asset type entries contained bridge-related maintenance activities and therefore contributed to the overall representation of activity 845 in the 411 database.

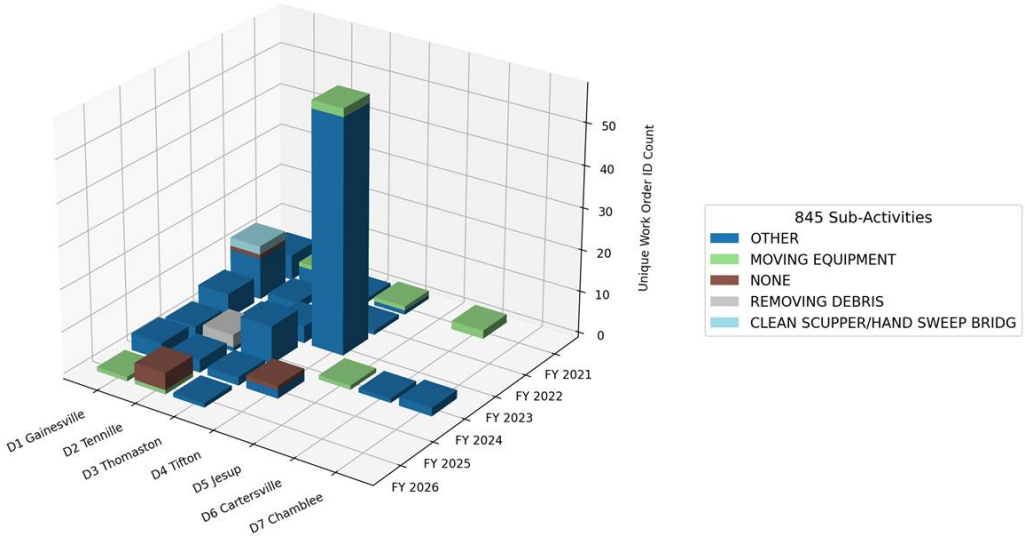


Figure 16. Chart. 845 Sub-activity counts for the GDOT Assets by fiscal year and district.

Figure 16 presents the distribution of activity 845 (other bridge maintenance) sub-activities for records entered with GDOT Assets as the asset type based on the number of unique work order records. From FY 2021 through FY 2026, a total of 140 activity 845 work orders were identified under the GDOT Assets asset type. The annual totals were 16 in FY 2021, 16 in FY 2022, 69 in FY 2023, 20 in FY 2024, 12 in FY 2025, and 7 in FY 2026. These results indicate that activity 845 work under the GDOT Assets classification was concentrated primarily in FY 2023, while the remaining years contained comparatively lower totals.

The sub-activity distribution shown in Figure 16 indicates that the recorded work was dominated by OTHER, which accounted for 120 work orders, representing approximately

86 percent of all activity 845 records under the GDOT Assets asset type. The remaining work orders were distributed among MOVING EQUIPMENT with 9 work orders, NONE with 6, REMOVING DEBRIS with 3, and CLEAN SCUPPER/HAND SWEEP BRIDGE with 2. This distribution shows that activity 845 work entered under the GDOT Assets asset type was recorded primarily using broad or general work descriptions rather than more specific maintenance task labels.

The district-level distribution further shows that these records were concentrated in a small number of districts. District 4 (Tifton) recorded the highest cumulative total with 64 work orders over the six-year period, followed by district 1 (Gainesville) with 33, district 2 (Tennille) with 20, and district 3 (Thomaston) with 17. The highest district-year total occurred in district 4 (Tifton) in FY 2023, with 58 work orders. By contrast, district 5 (Jesup), district 6 (Cartersville), and district 7 (Chamblee) recorded very few activity 845 work orders under the GDOT Assets asset type.

Overall, activity 845 work recorded under the GDOT Assets asset type represented a limited number of work orders but was highly concentrated in the OTHER sub-activity category and a small number of district-year combinations, particularly district 4 (Tifton) in FY 2023. Although the GDOT Assets asset type represents a relatively small portion of the overall work order database, it includes bridge-related maintenance activities that contribute to a more complete understanding of activity 845 representation within the 411 database.

SUMMARY OF ANALYSIS FINDINGS

The analysis results indicate that Section is the primary non-bridge asset type through which activity 845 work is recorded; meanwhile, GDOT Assets contributes a smaller but still meaningful share and Blank/NA accounts for only a minimal portion of the records. A substantial number of work orders fall within broad categories (i.e., other and none), indicating that the available work descriptions do not consistently provide sufficient detail regarding the maintenance activities performed. Although the Work Description field provides a useful basis for disaggregating activity 845 into more specific maintenance sub-activities, the frequent use of generalized terminology limits the precision, consistency, and interpretability of the resulting classification. Overall, a meaningful portion of bridge-related maintenance activities was found to be recorded under non-bridge asset type categories even though the underlying work was associated with bridge-related locations and functions.

POCKET GUIDE DEVELOPMENT

In response to this observation, the UGA research team, in collaboration with the GDOT Bridge Maintenance Office, developed a DWR Pocket Guide for Bridge Activities. The purpose of this guide is to support improved consistency and accuracy in work order entry practices by providing field personnel with a practical reference for identifying when (and how) bridge-related maintenance work should be entered under the Bridges asset type and when (and how) an appropriate Bridge ID should be selected. The guide includes a schematic representation of the bridge area or boundary, including the bridge start and end points and a 30-ft boundary beyond these points, to indicate the area within which bridge-

related 800-level maintenance activities should be associated with the Bridges asset. The pocket guide identifies nearby features such as approach slabs, barriers, sound walls, and adjacent roadway elements to help users distinguish bridge-related work areas from other asset locations.

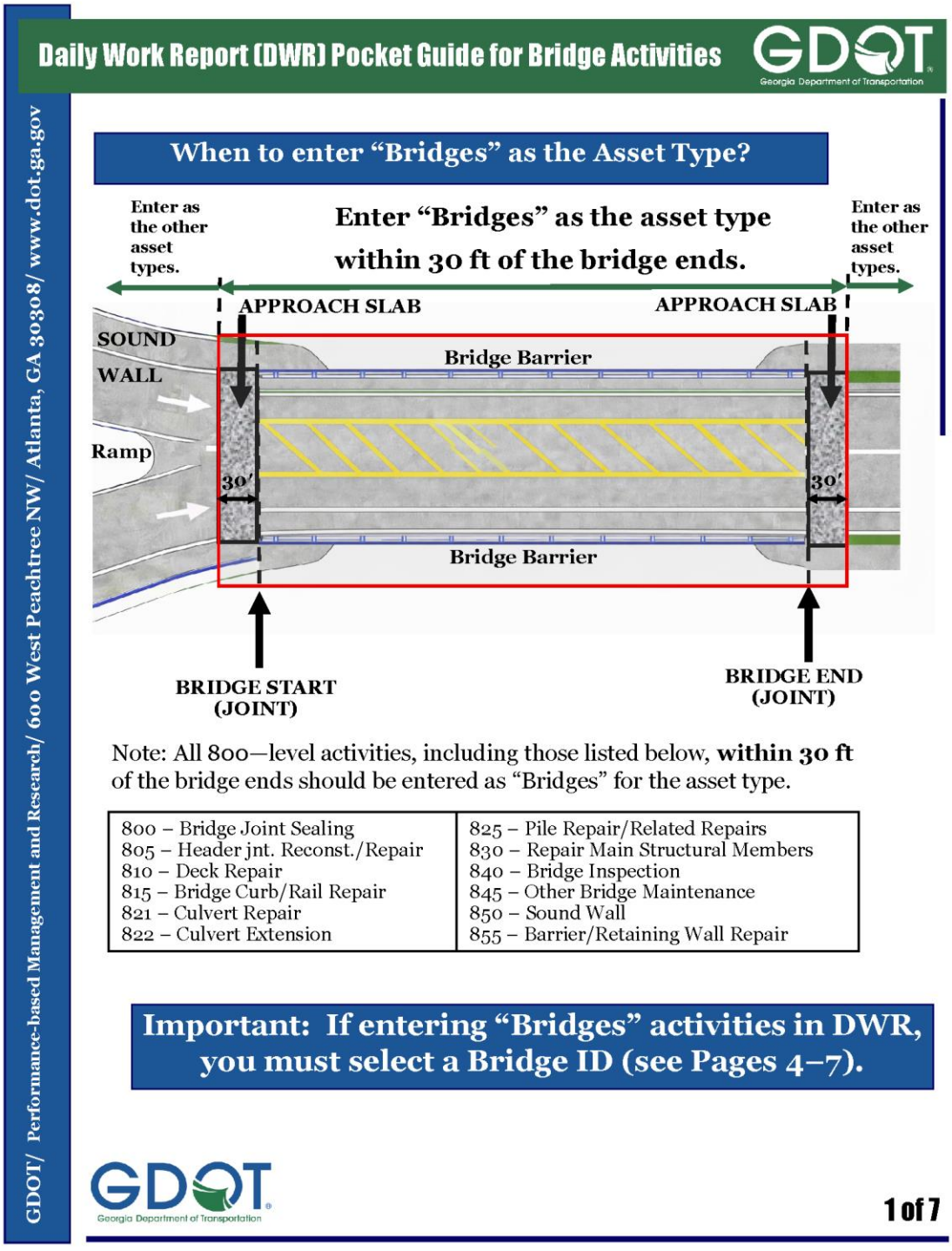


Figure 17. Illustration. First page of the pocket guide.

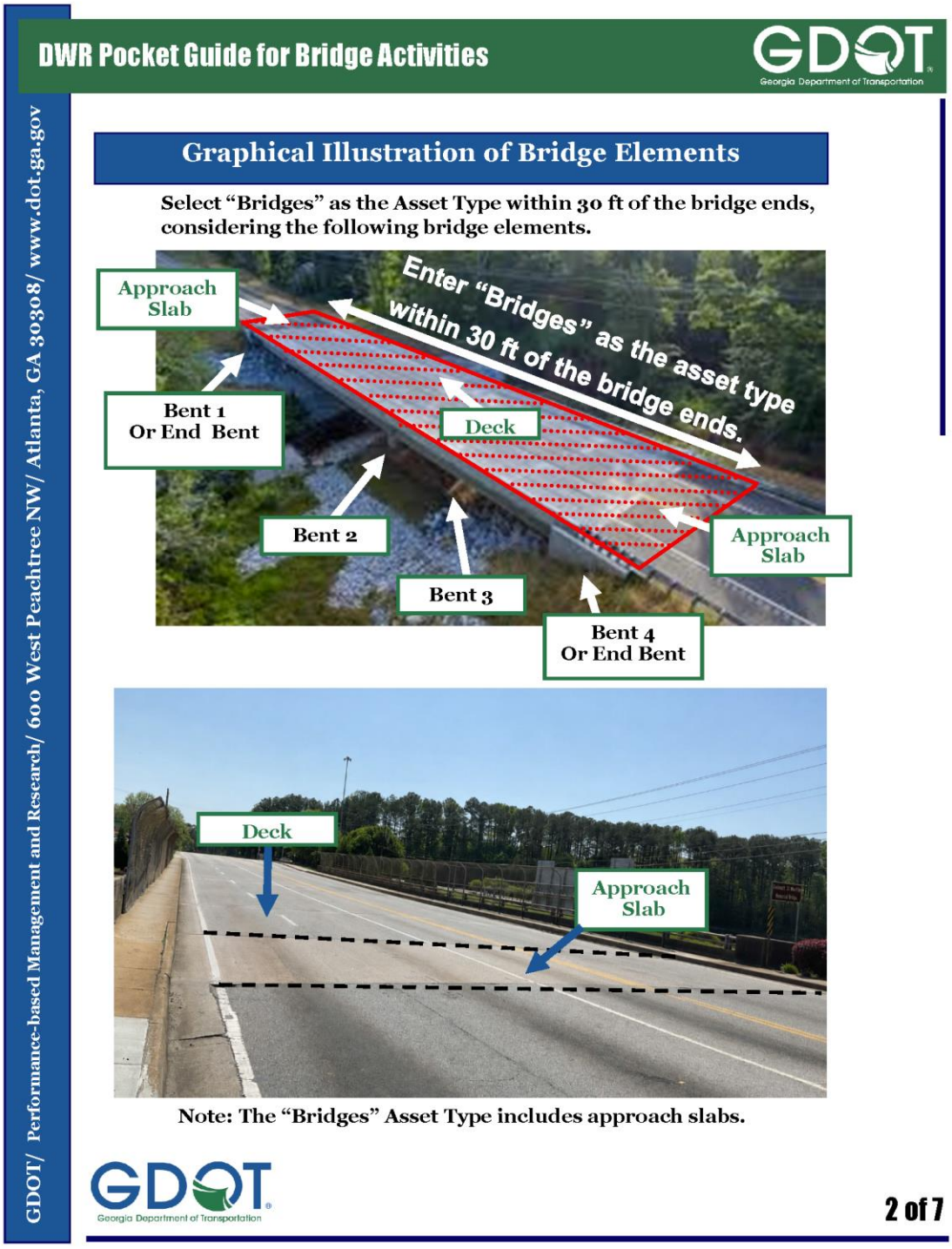


Figure 18. Illustration. Second page of the pocket guide.

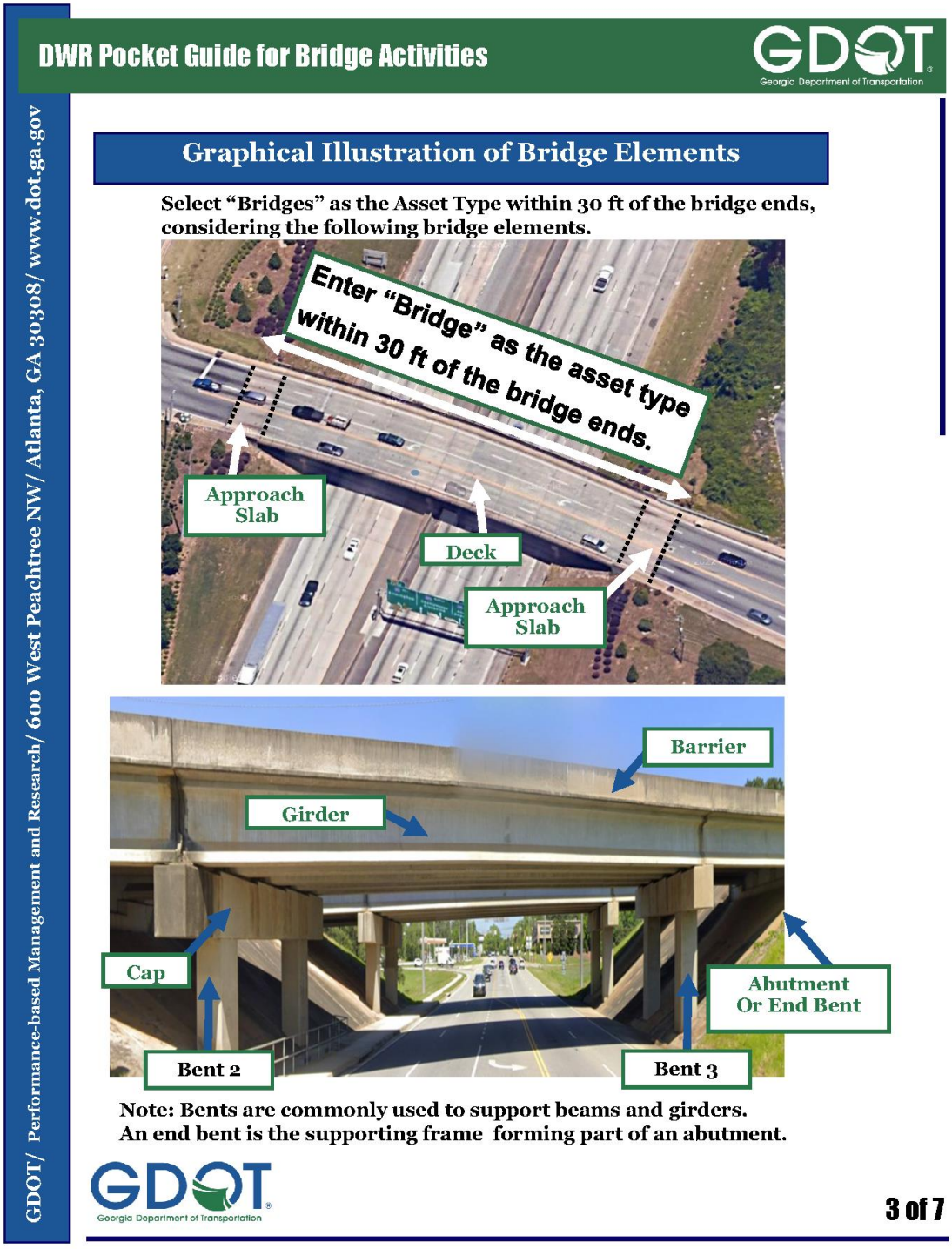


Figure 19. Illustration. Third page of the pocket guide.

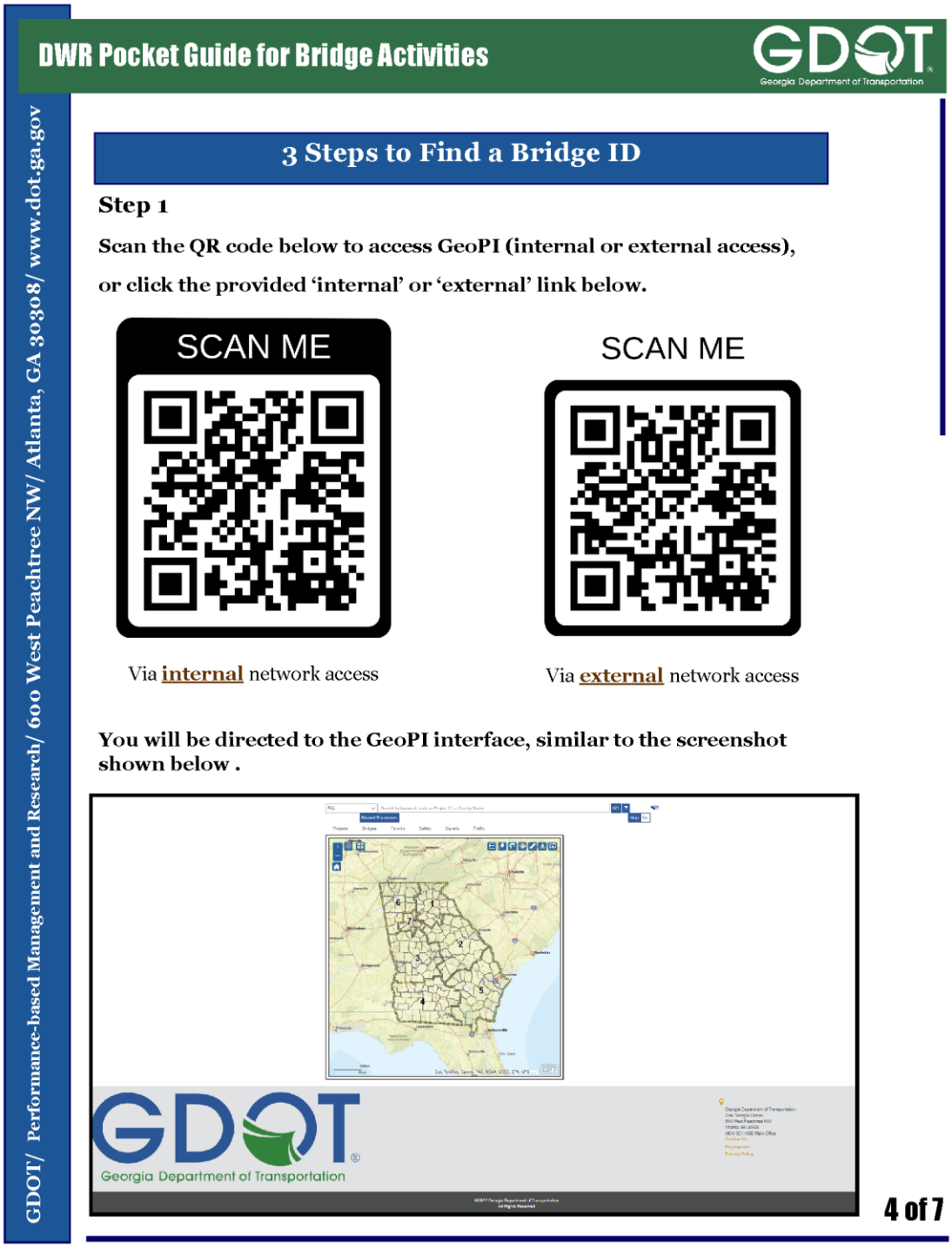


Figure 20. Illustration. Fourth page of the pocket guide.

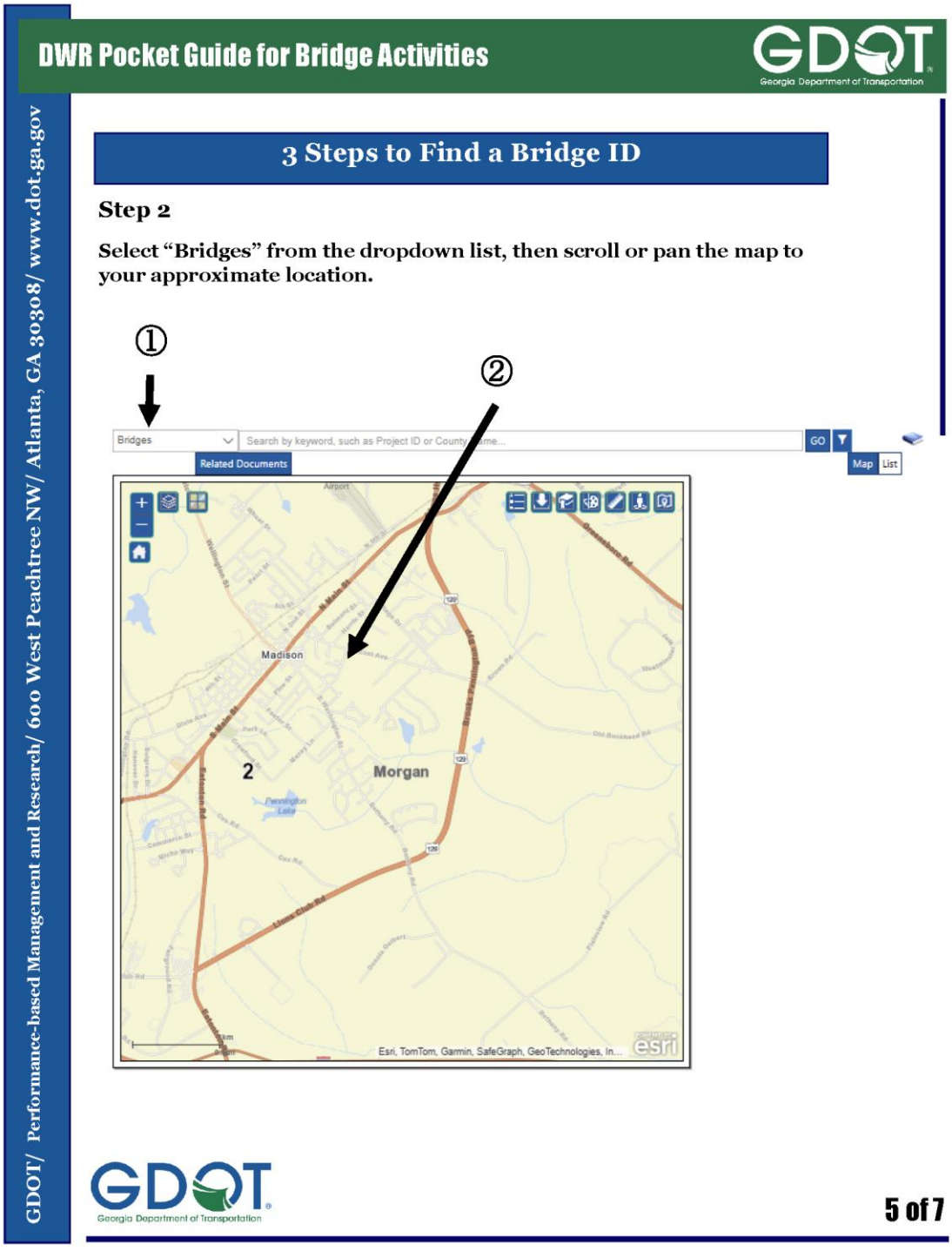


Figure 21. Illustration. Fifth page of the pocket guide.

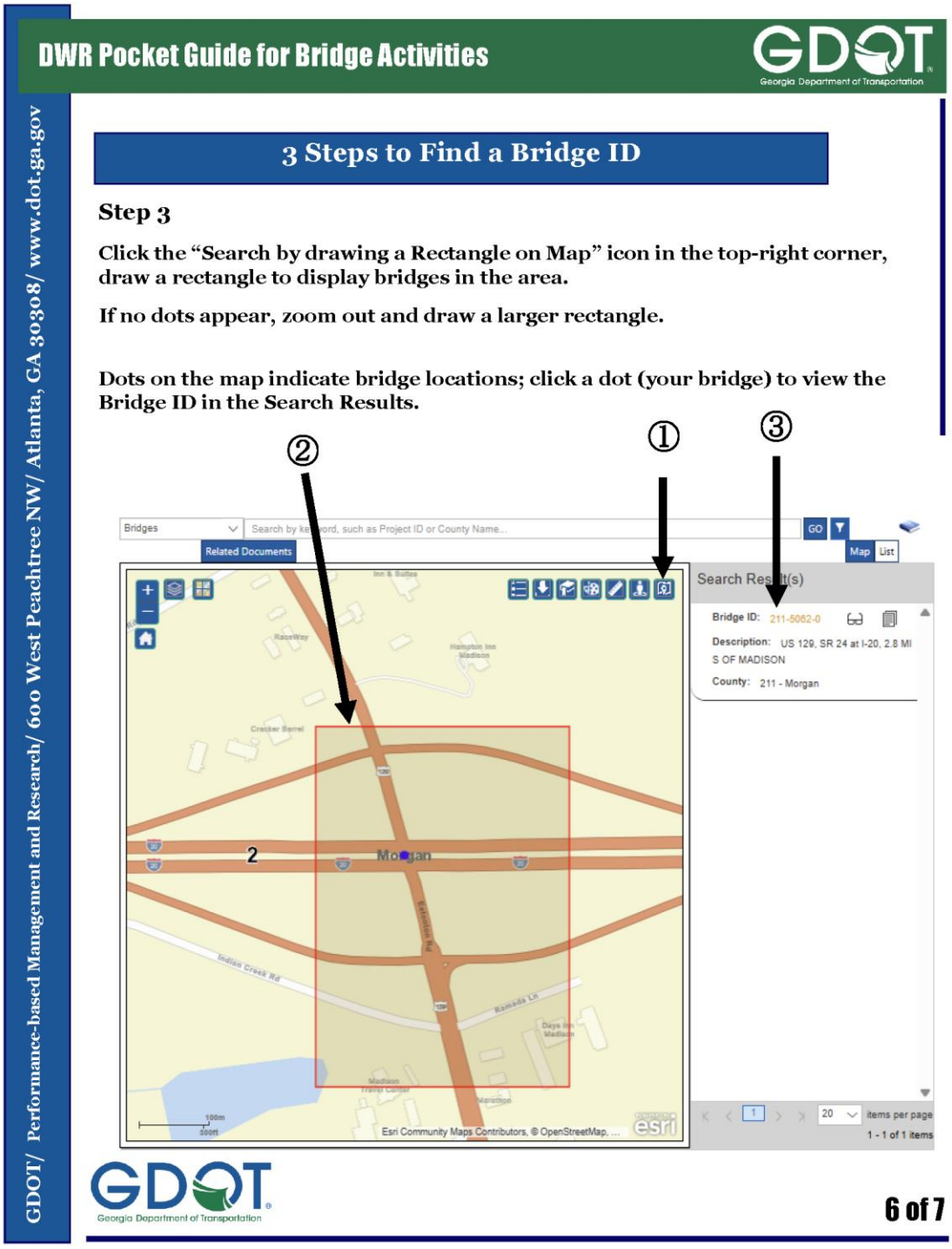


Figure 22. Illustration. Sixth page of the pocket guide.

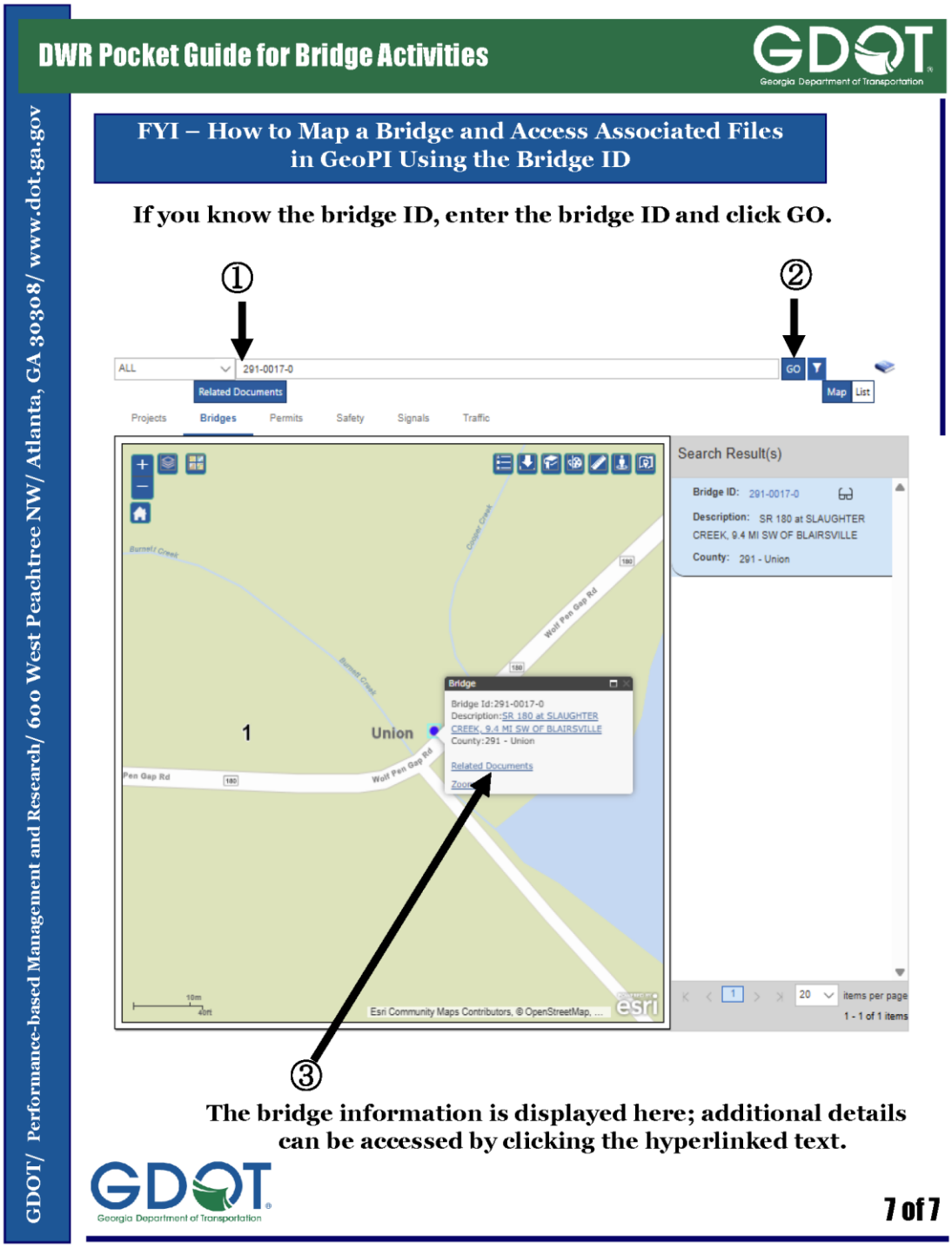


Figure 23. Illustration. Seventh page of the pocket guide.

CHAPTER 5. PILOT IMPLEMENTATION

The dashboard, analysis results, and pocket guide were presented to GDOT district managers and bridge-specialized maintenance teams within the GDOT District Maintenance Office during an online meeting on February 12, 2026. At that meeting, the research team and GDOT OBDM encouraged district maintenance teams to enter Bridge IDs for bridge-related maintenance activities when applicable and feasible. The meeting also clarified when the Bridges asset type should be selected and reinforced the consistent use of the appropriate Bridge ID and 800-series activity code when documenting bridge maintenance activities. In addition, district-level variability in data entry practices and the need for improved milepost completeness for the Section asset type were discussed.

The pocket guide, which provides clear definitions of bridge activity areas (defined as locations within 30 feet of the bridge start and end points), was presented and distributed to support consistent documentation practices. Maintenance data continued to be monitored through the fourth quarter of FY 2026 to evaluate implementation outcomes, with results compared against data from the fourth quarter of FY 2025.

The need for additional training for field staff was also discussed among Donn Digamon, Rabindra Koirala, and GDOT district maintenance managers during this February meeting. District maintenance managers were encouraged to work with field personnel to promote consistent documentation of bridge maintenance activities in accordance with the recommended practices.

ANALYSIS OF OUTCOMES

Figure 24 through Figure 26 compare, by district, the distribution of unique bridge-related 800-series work orders between Q4 of FY 2025 and Q4 of FY 2026 for records entered under three asset types: Bridges, Section, and GDOT Assets. The height of each stacked bar represents the total number of unique work orders recorded for the corresponding district and quarter, while the colors within each bar indicate the individual 800-series activity types. The district-level counts for each asset type, as well as the total counts across all asset types, including Blank/NA records, are summarized in Table 2.

Table 2. Work order counts by asset type and district for Q4 of FYs 2025 and 2026.

Quarter, Fiscal year	Asset type	D1	D2	D3	D4	D5	D6	D7	Total
Q4, 2025	Bridges	36	4	13	23	81	28	5	190
Q4, 2026	Bridges	37	35	86	6	60	27	2	253
Q4, 2025	Section	32	28	68	27	18	3	24	200
Q4, 2026	Section	29	10	16	32	38	3	14	142
Q4, 2025	GDOT Assets	1	1	2	1	0	0	0	5
Q4, 2026	GDOT Assets	1	0	0	0	0	0	0	1
Q4, 2025	Blank/NA	1	4	0	0	0	0	0	5
Q4, 2026	Blank/NA	0	0	0	0	0	0	0	0
Q4, 2025	All asset types	70	37	83	51	99	31	29	400
Q4, 2026	All asset types	67	45	102	38	98	30	16	396

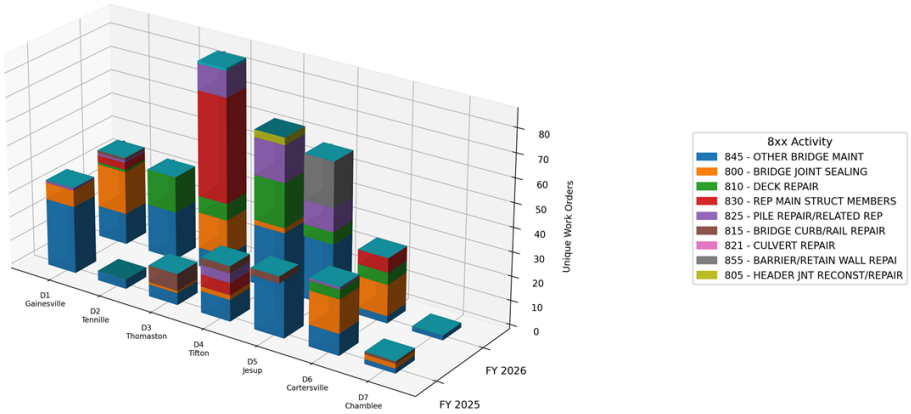
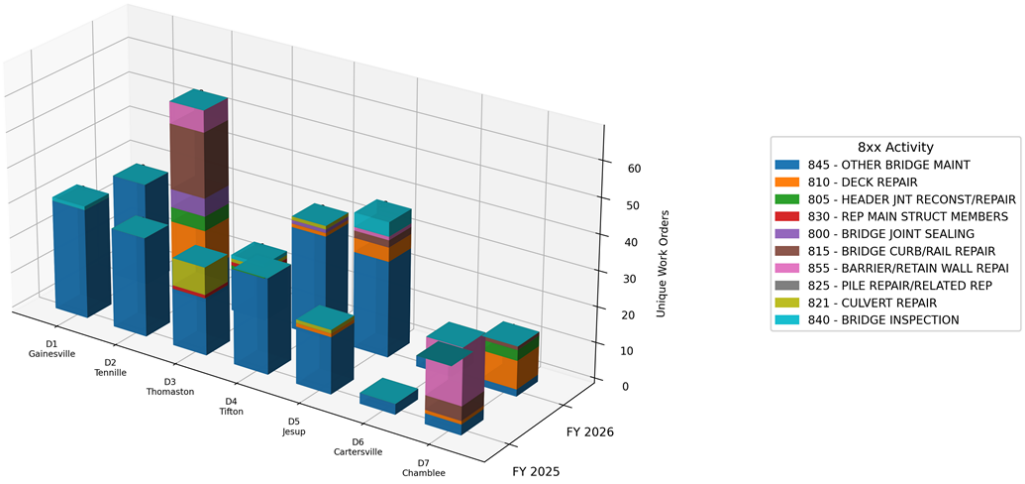
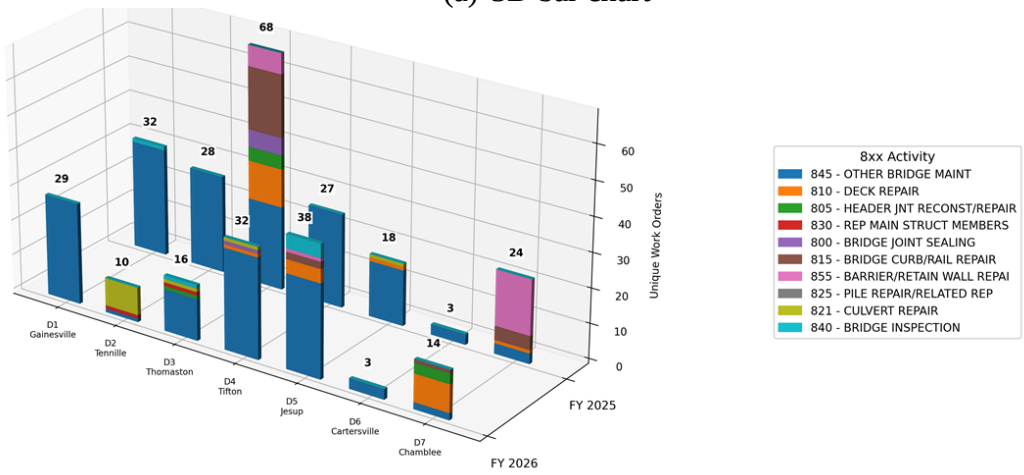


Figure 24. Chart. Work orders for Bridges asset type by district for Q4 of FYs 2025 and 2026.



(a) 3D bar chart



(b) Enhanced the bar chart for clarity

Figure 25. Chart. Work orders for Section asset type by district for Q4 of FYs 2025 and 2026.

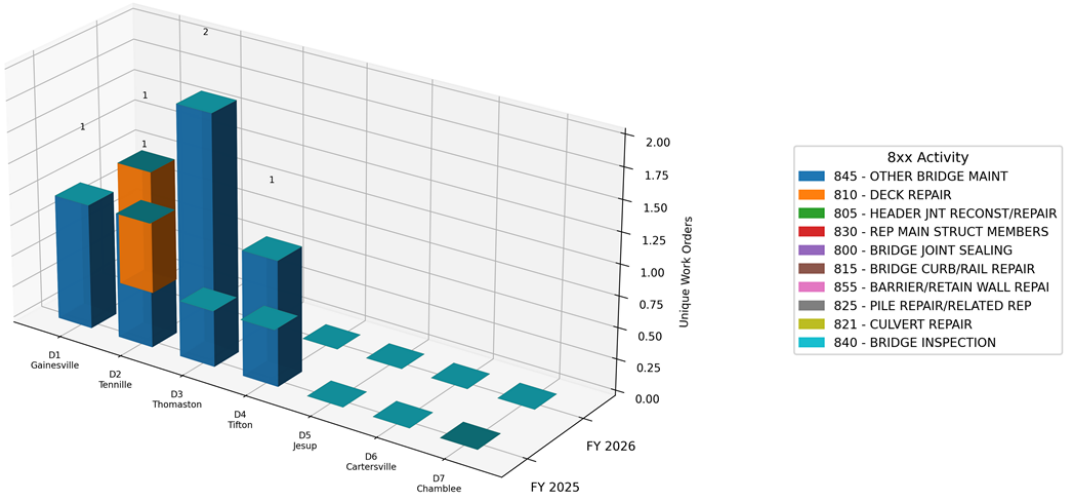


Figure 26. Chart. Work orders for GDOT Assets by district for Q4 of FYs 2025 and 2026.

The results indicate a substantial shift toward the use of the Bridges asset type. As shown in Figure 24 and Table 2, the number of bridge-related work orders recorded under the Bridges asset type increased from 190 in Q4 FY 2025 to 253 in Q4 FY 2026, representing an increase of approximately 33 percent. This change is significant because the total number of work orders across the evaluated asset type categories remained nearly unchanged, decreasing only from 400 to 396. Therefore, the increase in Bridges records likely reflects improved asset type selection and documentation practices rather than a general increase in the number of activities associated with the Bridges asset type.

At the same time, bridge-related work orders recorded under non-bridge asset types decreased. As shown in Figure 25, records entered under the Section asset type decreased from 200 in Q4 FY 2025 to 142 in Q4 FY 2026, representing a reduction of approximately 29 percent.

Figure 26 shows that records entered under GDOT Assets decreased from five to one. In addition, the Blank/NA category decreased from five records in Q4 FY 2025 to zero records in Q4 FY 2026. These reductions are positive indicators, suggesting that district offices increasingly selected the Bridges asset type when documenting maintenance activities associated with bridge assets.

District-level results further support this interpretation. District 3 increased its records entered under the Bridges asset type from 13 to 86, while records entered under the Section asset type decreased from 68 to 16. Similarly, District 2 increased its Bridges records from 4 to 35, while its Section records decreased from 28 to 10. These paired changes suggest that bridge-related activities that may have previously been recorded under the Section asset type were more frequently assigned to the Bridges asset type in Q4 FY 2026. Similar trends are observed in the overall statewide distribution.

The activity composition shown in Figure 24 through Figure 26 provides additional evidence of improved data entry practices. In Q4 FY 2025, many stacked bars were dominated by activity 845 (other bridge maintenance), indicating that a substantial portion of bridge-related work was recorded under this broad activity category. In Q4 FY 2026, the stacked bars show a more diverse distribution of 800-series activity codes, particularly for records entered under the Bridges asset type, as shown in Figure 24. This broader distribution reflects increased use of specific activity codes, including deck repair, header

joint reconstruction or repair, repair of main structural members, pile repair, and other defined bridge maintenance activities.

This change indicates improvement not only in the selection of the appropriate Bridges asset type but also in the level of detail used to document completed maintenance activities. Rather than assigning a large proportion of bridge maintenance work to the general activity 845 category, district offices more frequently selected activity codes corresponding to the specific maintenance tasks performed. Combined with the reduction in bridge-related records entered under the Section and GDOT Assets asset types and the elimination of Blank/NA entries in Q4 FY 2026, the more diverse activity distribution provides further evidence that district offices incorporated the study findings, applied the documentation guidance presented in the pocket guide, and implemented the recommendations provided by OBDM during the February 2026 meeting.

SUMMARY OF FINDINGS

The pilot implementation results for the fourth quarter of FY 2026 indicate that the development of the dashboard and pocket guide, along with discussions with district maintenance managers and specialized bridge crews, supported improvements in two key aspects of data entry: (1) selecting the appropriate asset type and (2) increasing the use of specific 800-series activity codes instead of the general activity code (845, other bridge maintenance). The increase in records entered under the Bridges asset type, the decrease in records entered under non-bridge asset types, and the broader distribution of records among

specific 800-series activities suggest more consistent and descriptive documentation of bridge maintenance activities during Q4 of FY 2026 compared to Q4 of FY 2025.

CHAPTER 6. CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

This study synthesized bridge maintenance activity data from GDOT by integrating multiple data sources and collaborating with district maintenance personnel to better capture and understand bridge maintenance activities across the state. Based on feedback from GDOT districts, the research team identified asset types and maintenance activities that require more consistent classification and improved documentation in DWRs. Throughout the project, OBDM, OTD, and district maintenance managers provided valuable guidance by advising the project team, evaluating current practices, identifying opportunities for improvement, and helping implement the study's recommendations. These collaborative efforts focused on improving the clarity and consistency of bridge maintenance activity definitions, reducing barriers to linking maintenance activities with specific bridge assets, and producing two key deliverables.

Producing Two Key Deliverables

The first deliverable is the District Bridge Maintenance & Expenditure GIS Dashboard, which provides an interactive visualization of bridge maintenance activities, expenditures, and related data across all GDOT districts. The dashboard can be accessed online: https://experience.arcgis.com/experience/189588a9f94

The second deliverable is the DWR Pocket Guide for Bridge Activities**.** District maintenance personnel are encouraged to review the seven-page pocket guide (see Figure 17 through Figure 23) before entering bridge maintenance activities into DWRs. The guide achieves the following objectives:

- Clearly defines bridge spatial extent for maintenance activities. The pocket guide illustrates the spatial extent associated with each bridge maintenance activity. Bridge-related maintenance activities and their corresponding spatial extent on a bridge are clearly defined.
- Promotes the practice of entering Bridge IDs. When activities are identified as bridge-related in accordance with the established spatial definition, they should be recorded under the Bridges asset type and assigned a corresponding Bridge ID.
- Facilitates the review of bridge-maintenance-related costs. By improving data transparency, the pocket guide enhances the dashboard's effectiveness, supporting the regular assessment of bridge maintenance activities and associated costs.

These deliverables establish the foundation for achieving the main objective of quantifying changes in bridge condition ratings and characterizing associated maintenance trends by integrating GDOT’s available data resources.

RECOMMENDATIONS

This study identifies three key areas for improving the documentation, synthesis, and understanding of bridge maintenance activities.

Record Bridge-Related Activities Under Bridges Asset Type in DWRs

The pocket guide was presented to GDOT district managers and specialized bridge crew members during an online meeting on February 12, 2026. During this meeting, the research team and the GDOT Bridge Office emphasized the importance of recording bridge-related maintenance activities under the Bridges asset type in DWRs and entering a Bridge ID whenever available. These practices are essential for improving data quality, traceability, and analytical consistency.

District-level variability in data entry practices and existing documentation gaps were also identified. To support consistent implementation, the pocket guide was distributed across districts. Continued monitoring of data entry quality and targeted field staff training were identified as key follow-up actions.

Assign Bridge IDs

The procedure for identifying and assigning Bridge IDs is outlined in the pocket guide. Future efforts should focus on expanding the use of digital tools and emerging technologies, including AI-based applications, to simplify and standardize Bridge ID identification. For example, a downloadable mobile application could allow field personnel to capture a bridge image and automatically retrieve or suggest the corresponding Bridge

ID, which would be particularly useful for remotely located structures or bridges with uncertain identification.

Implement Consistent Work Order Documentation and Training

Consistent and standardized documentation of DWRs is critical for improving the completeness and reliability of bridge maintenance data. This includes uniform recording of both in-house and contracted bridge-related maintenance activities across all districts. Improved consistency will enhance the ability to accurately capture total expenditures, activity scope, and maintenance history. To achieve this objective, targeted and recurring training for field and administrative staff is recommended, along with the continued reinforcement of standardized documentation practices and monitoring of data quality.

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The authors extend their appreciation to Teague Buchanan and the GDOT IT Applications team for their support in accessing the 411 application database, providing technical advice throughout the project, and guiding the development of the application design document to thoroughly document the procedures used for the GIS dashboard.

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Wei, J., Chen, G., Huang, J., Xu, L., Yang, Y., Wang, J., and Sadick, A.-M. (2021). “BIM and GIS Applications in Bridge Projects: A Critical Review.” *Applied Sciences, 11*(13), 6207.

APPENDIX A. DWR GUIDE DAILY WORK REPORT (DWR) POCKET GUIDE FOR BRIDGE ACTIVITIES

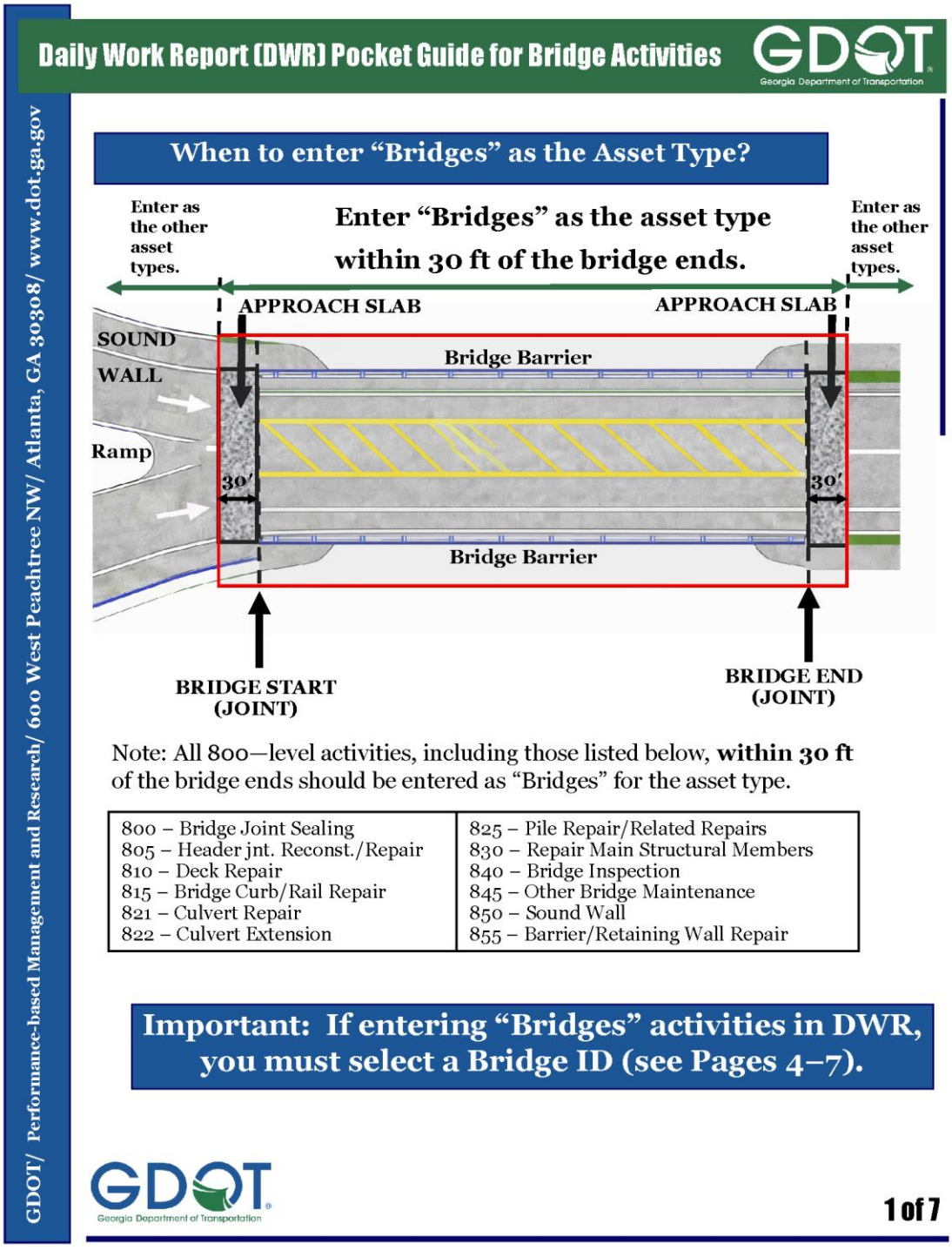

Figure 27. Photo. First page of the pocket guide.

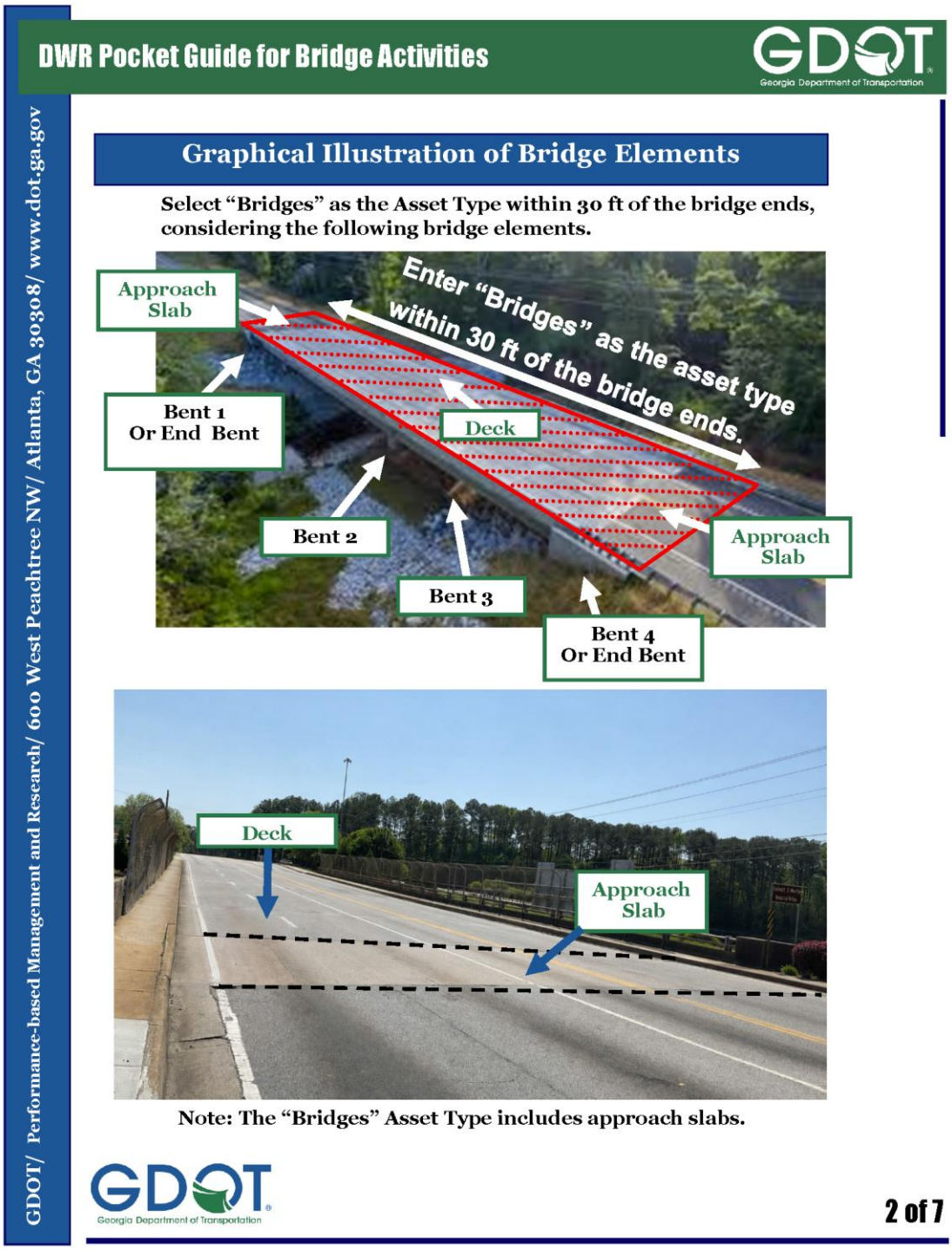

Figure 28. Photo. Second page of the pocket guide.

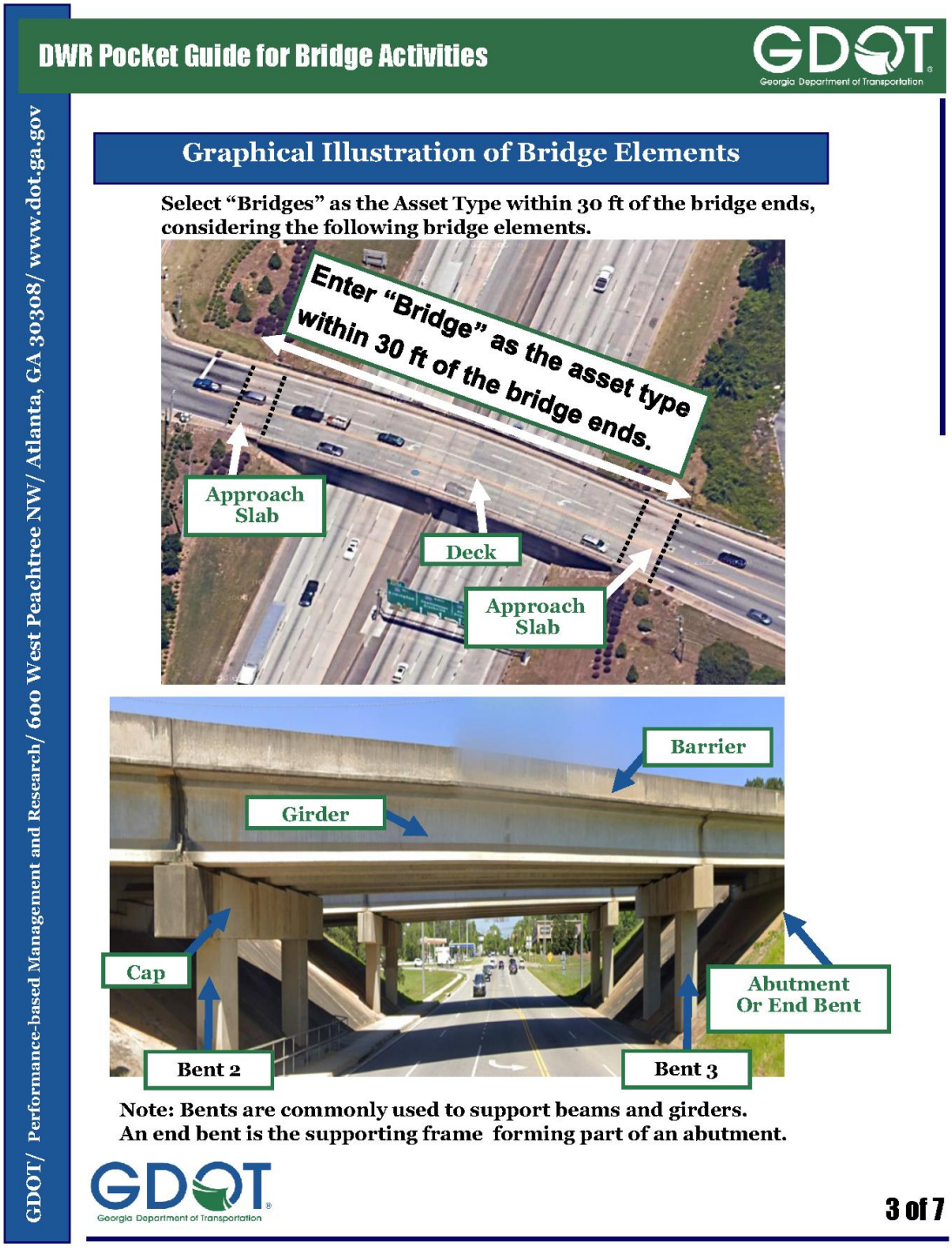

Figure 29. Photo. Third page of the pocket guide.

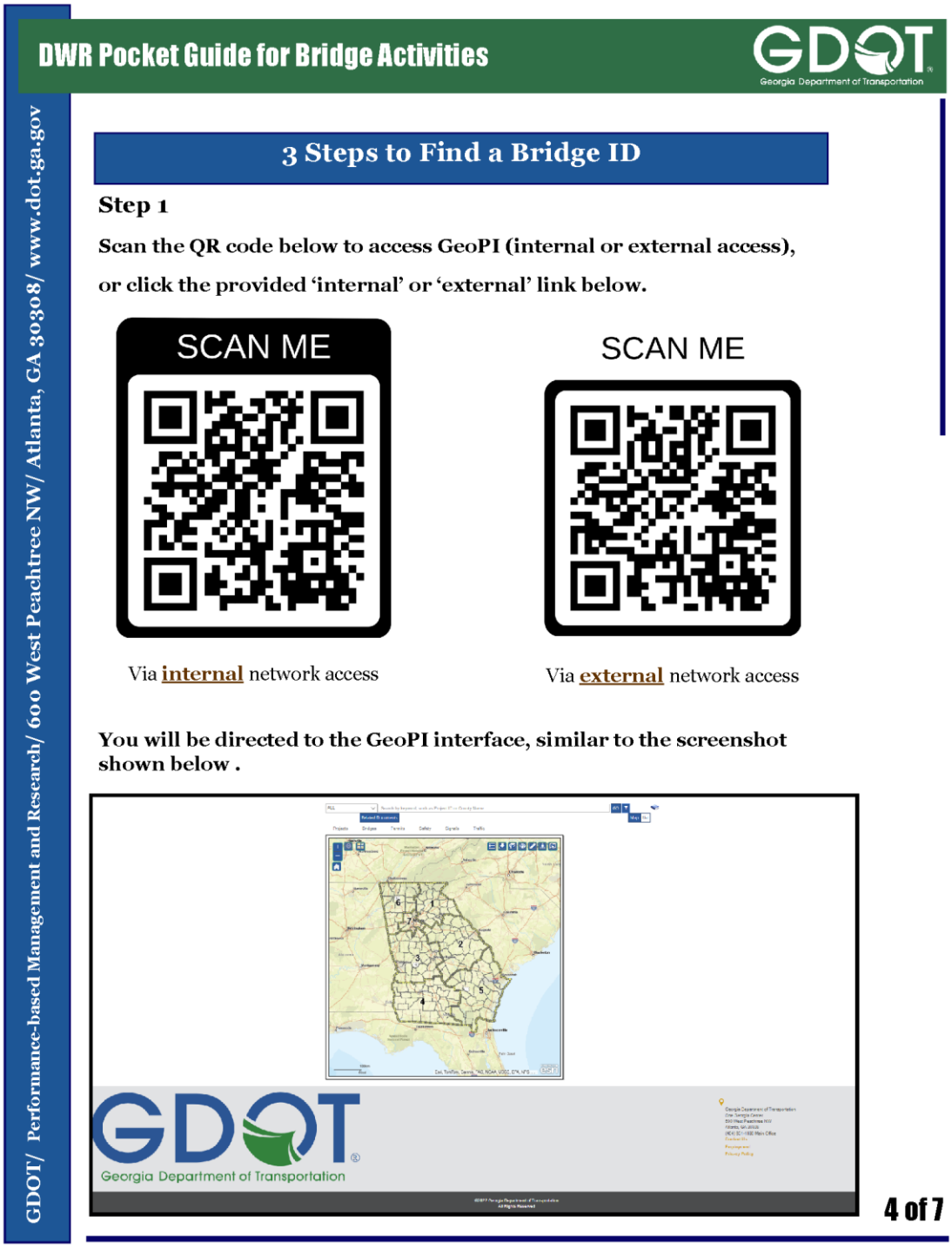

Figure 30. Photo. Fourth page of the pocket guide.

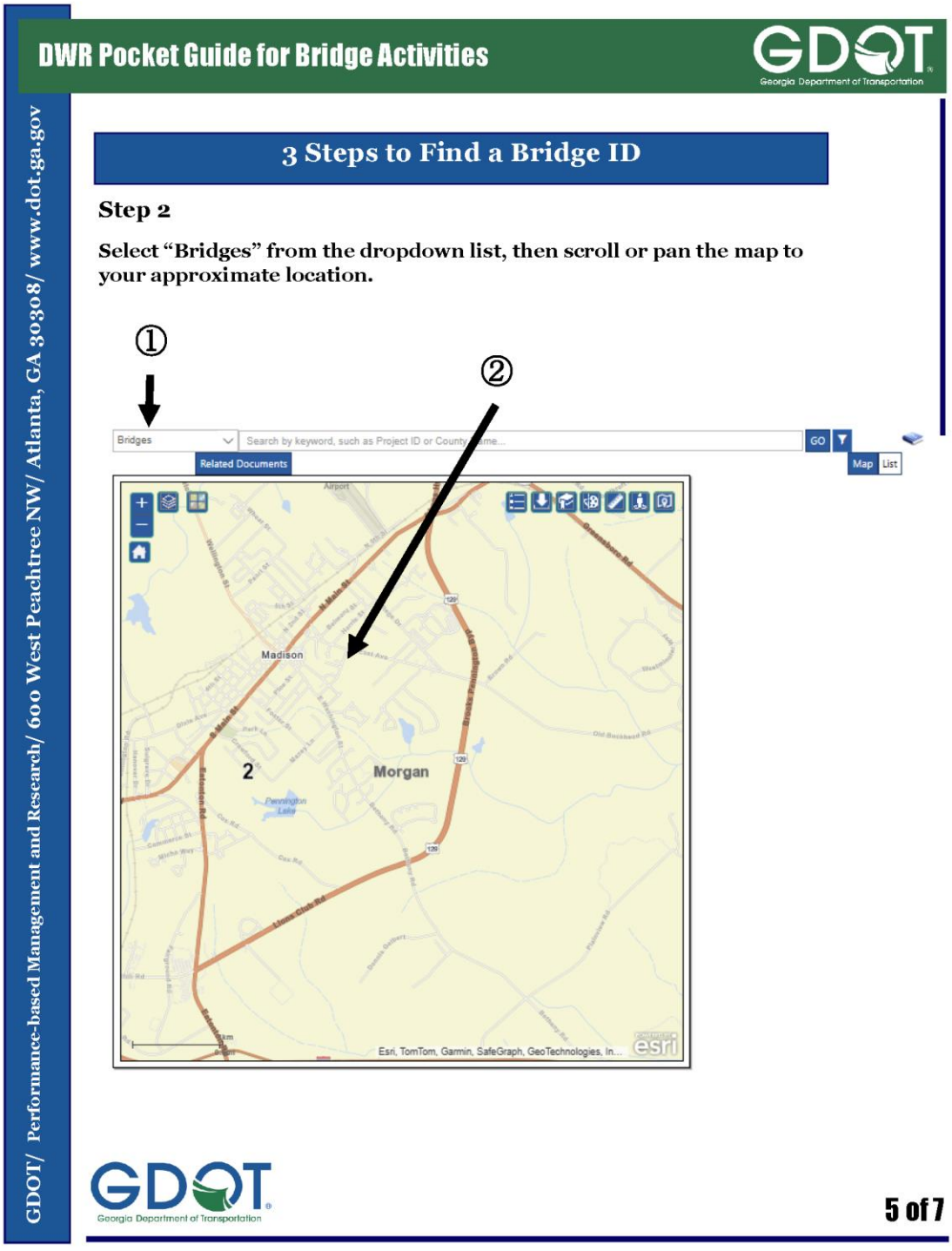

Figure 31. Photo. Fifth page of the pocket guide.

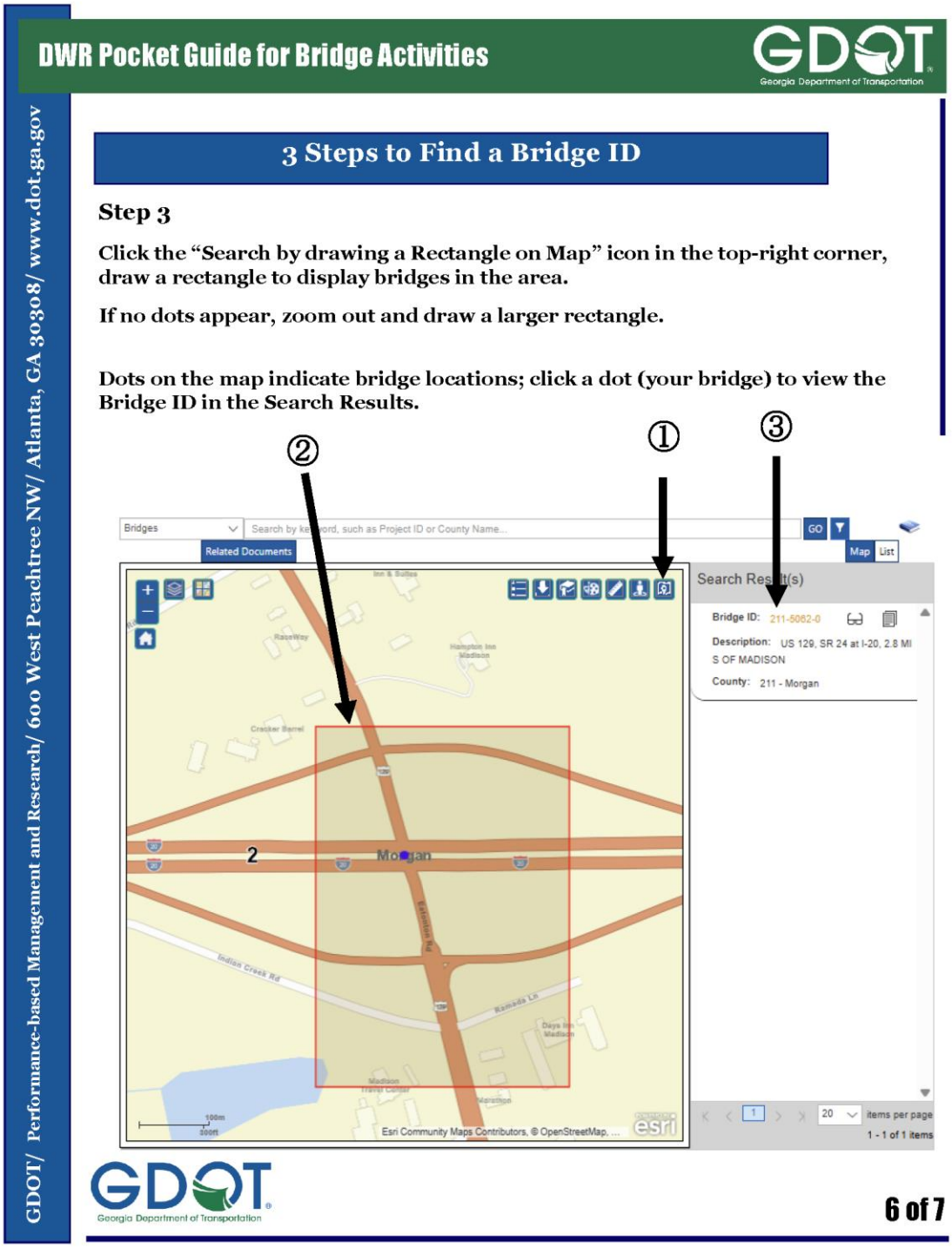

Figure 32. Photo. Sixth page of the pocket guide.

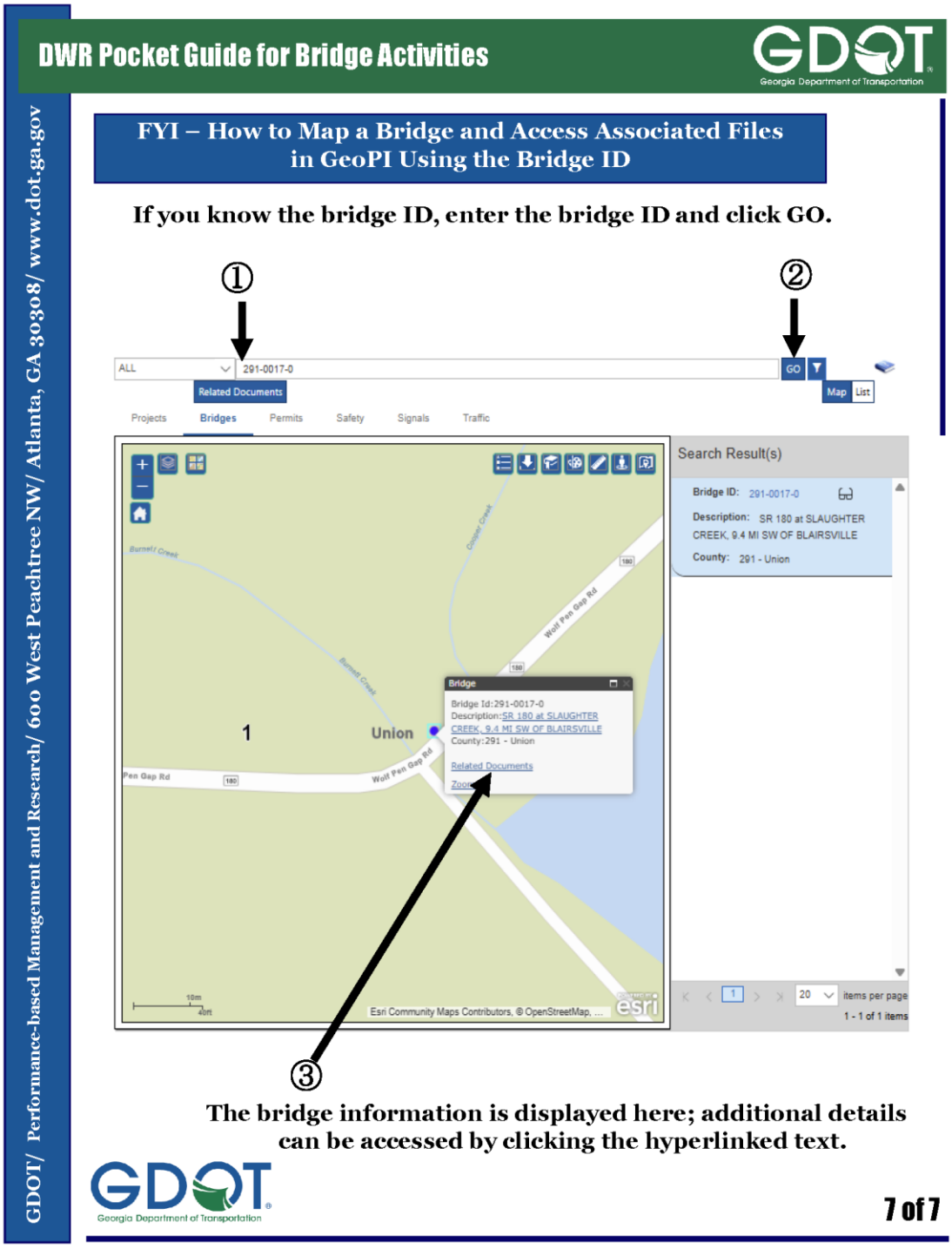

Figure 33. Photo. Seventh page of the pocket guide.

APPENDIX B. MANUAL USER MANUAL — DISTRICT BRIDGE MAINTENANCE & EXPENDITURE DASHBOARD

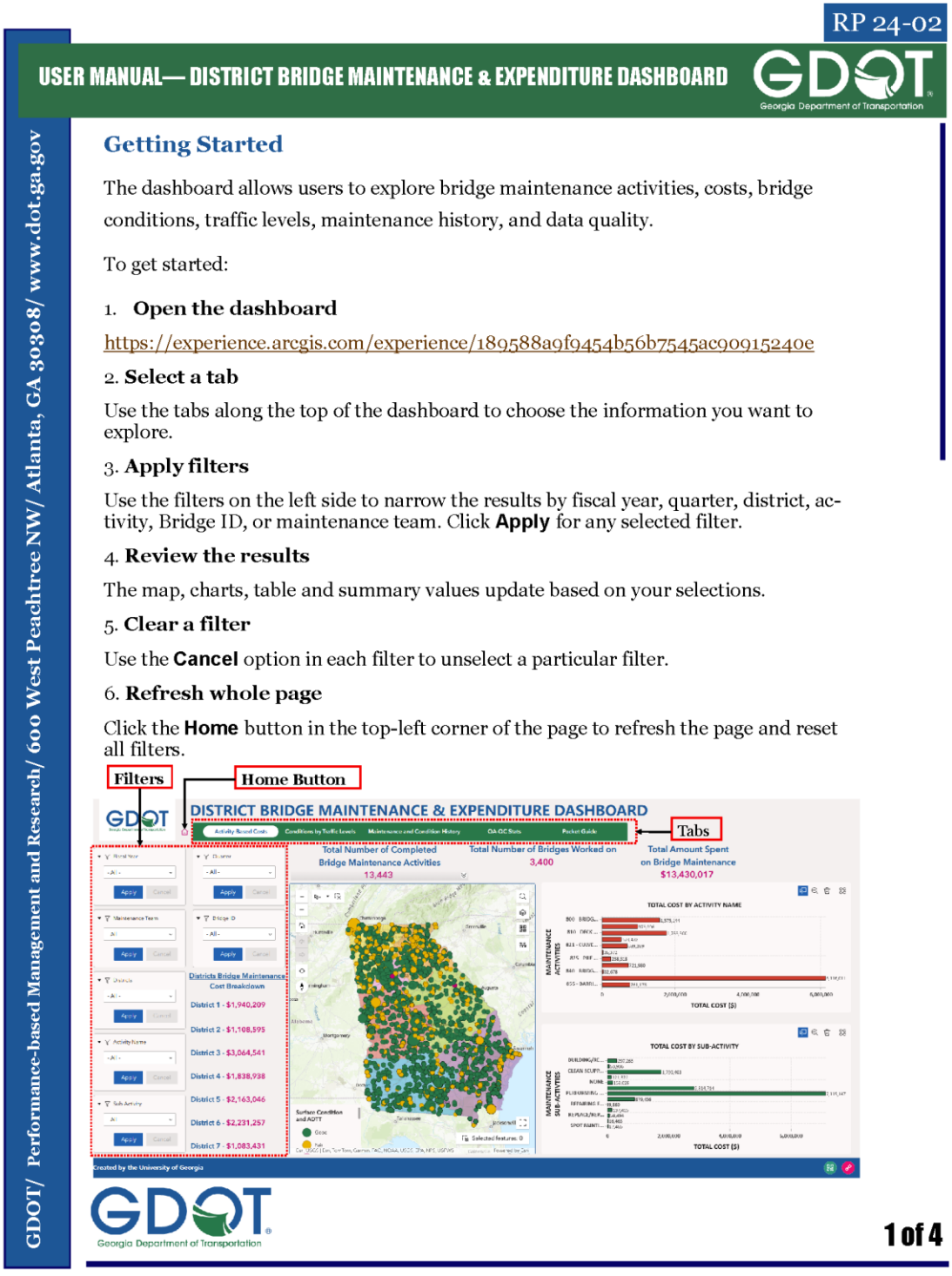

Figure 34. Photo. First page of the dashboard user manual.



Figure 35. Photo. Second page of the dashboard user manual.

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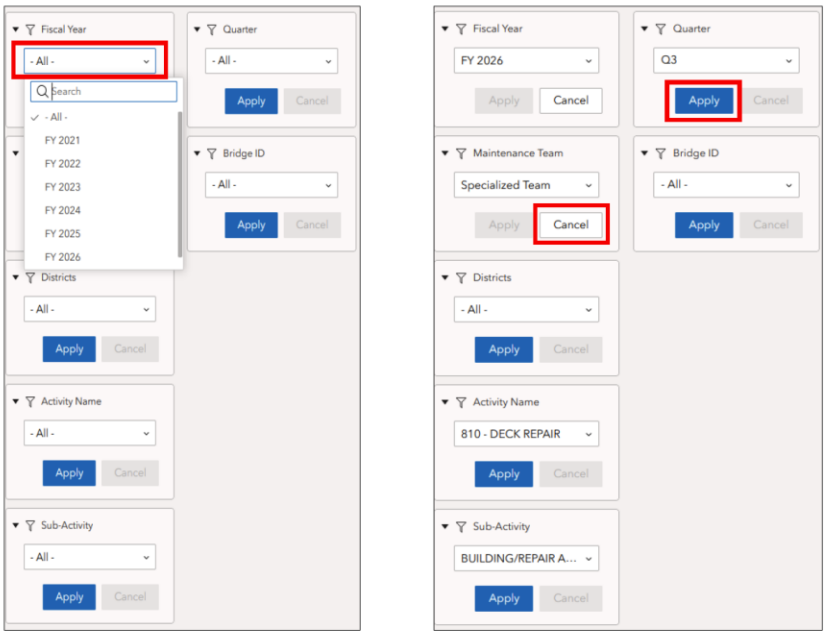
Using the Dashboard

Step 1—Choose a tab

Select the dashboard tab that matches the information you want to review

Step 2—Select your filters

Use the left panel to narrow the dashboard. Click the dropdown arrow for the desired filter, make your selection, and click **Apply**.



A—Select a Value **B—Click Apply/Cancel**

Step 3—Review the updated dashboard

Charts, maps, tables, and summary values update to reflect your selections.

Step 4—Remove a filter

Click **Cancel** option to remove a selected filter.

Figure 36. Photo. Third page of the dashboard user manual.

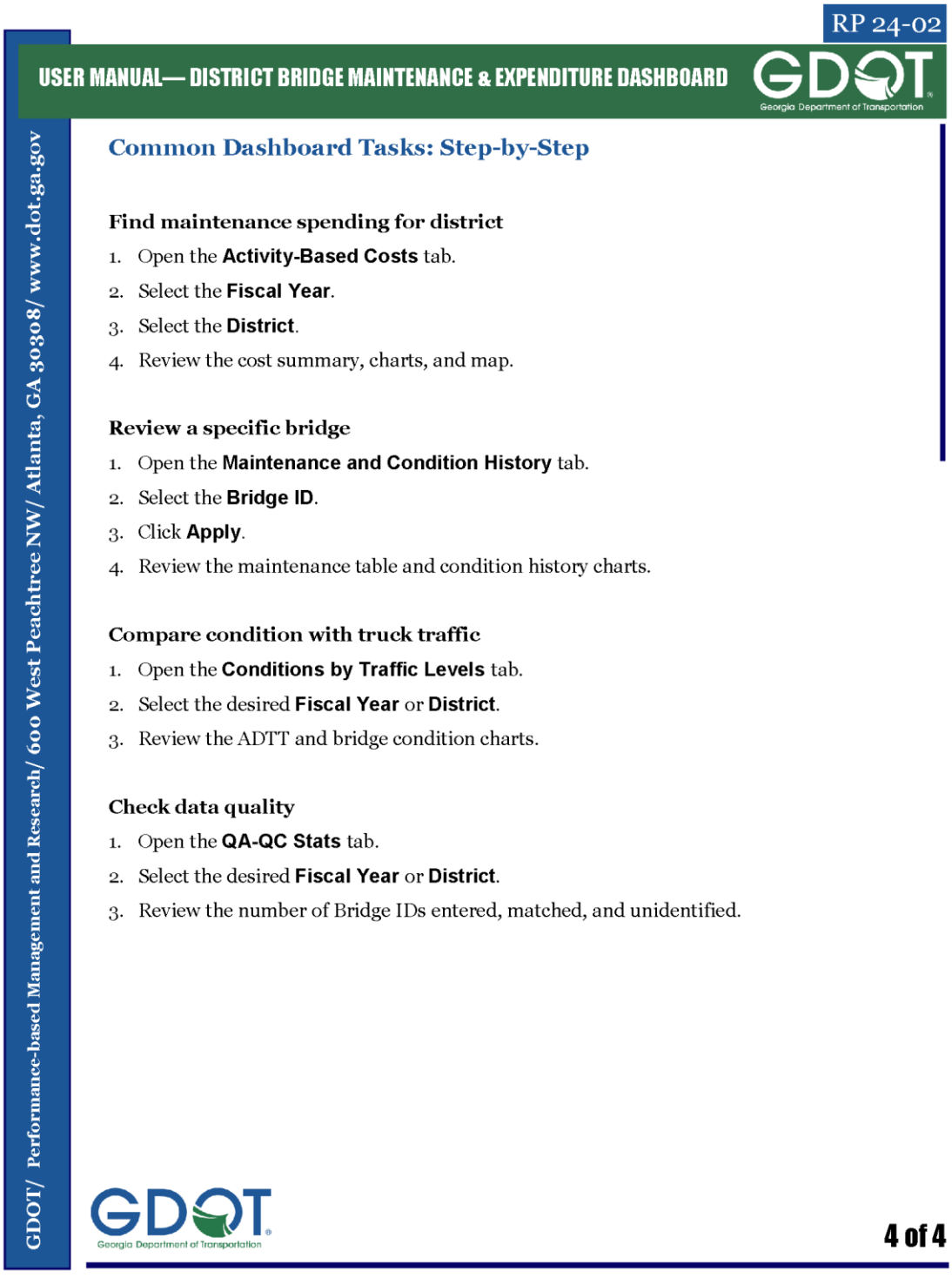


Figure 37. Photo. Fourth page of the dashboard user manual.