May 7, 2024 MIR-24-12

# Contact of *Queen City* Tow with Vane Dike

On March 28, 2023, about 0224 local time, the towing vessel *Queen City* was downbound on the Ohio River in high-water conditions, pushing an 11-barge tow, when the tow struck the Vane Dike at the arrival point for the McAlpine Locks and Dam in Louisville, Kentucky, and broke apart.[1] No pollution or injuries were reported. Total damages to the barges and cargo were estimated to be $1.98 million.


**Figure 1.** *Queen City* underway before the contact. (Source: Dave Beightol)

[1] (a) In this report, all times are eastern daylight time, and all miles are statute miles. (b) Visit ntsb.gov to find additional information in the public docket for this NTSB investigation (case no. DCA23FM025). Use the CAROL Query to search investigations.

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|---|---|
| **Casualty type** | Contact |
| **Location** | Ohio River, mile 604.3, Louisville, Kentucky<br>38°15.69′ N, 85°45.82′ W |
| **Date** | March 28, 2023 |
| **Time** | 0224 eastern daylight time (coordinated universal time –4 hrs) |
| **Persons on board** | 7 |
| **Injuries** | None |
| **Property damage** | $1.98 million est. |
| **Environmental damage** | None |
| **Weather** | Visibility 10 mi, clear, winds north 4 kts, air temperature 43°F |
| **Waterway information** | River, width 1,350 yards, depth 18 ft, current 2–3 kts (est.) |

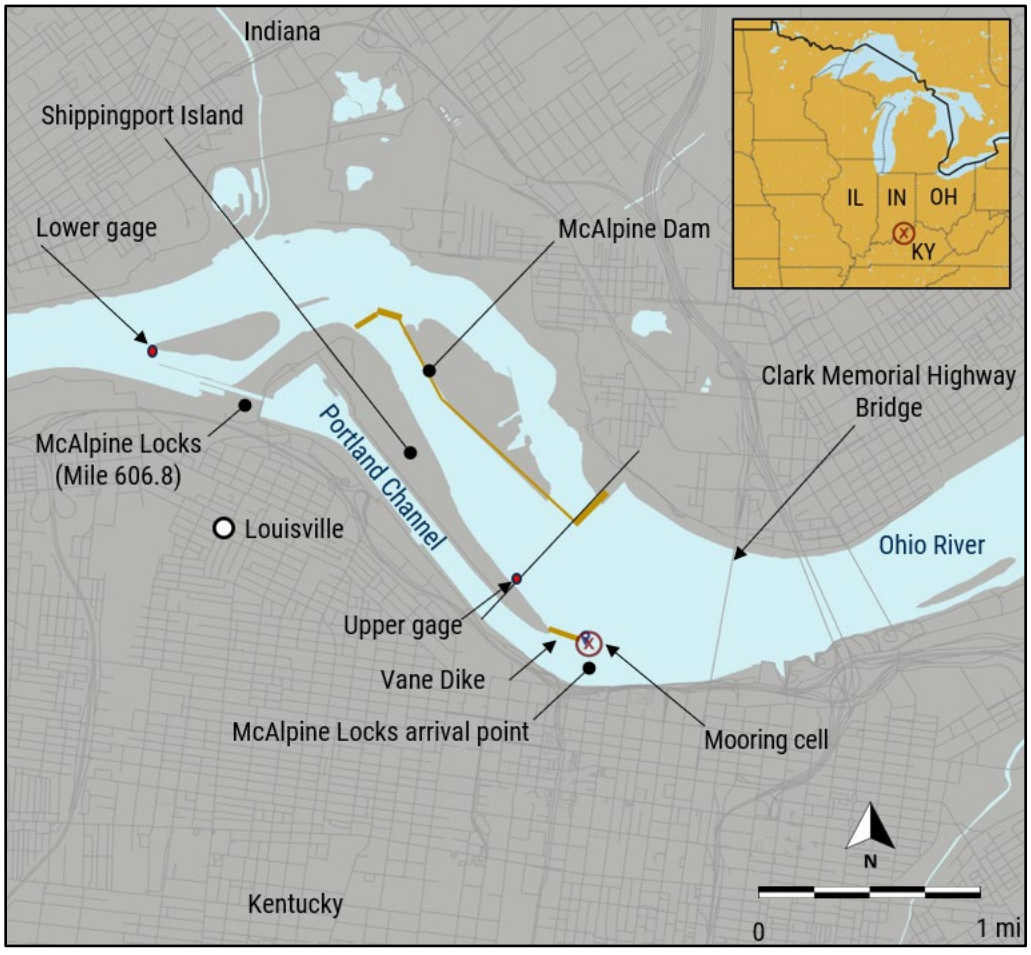


**Figure 2.** Area where the *Queen City* contact occurred, as indicated by a red *X*. (Background source: Google Maps)

# 1 Factual Information

## 1.1 Background

Owned and operated by C&B Marine Equipment, LLC, the *Queen City*, built in 1974, was a 103-foot-long, steel-hulled towing vessel (see figure 1). The vessel had two steering and four flanking rudders, and two 1,500-hp diesel engines each driving a propeller.

The US Army Corps of Engineers operates the McAlpine Locks and Dam. The dam's five upper gates and four lower gates are 22 feet high and 100 feet wide.

The Vane Dike is located in a river bend just off the eastern end of the entrance to Portland Channel, which leads to the McAlpine Locks (see figures 2 and 3). The dike, measuring 200 yards by 10 yards, extends eastward from the end of Shippingport Island, the northern land boundary of the Portland Channel. A mooring cell is at the end of the dike. The US Coast Guard Lifesaver Memorial Light sits on top of the cell.


**Figure 3.** McAlpine Locks and Dam. Shown in the bottom image is a similar-size towing vessel and tow configuration (three across) as that of the *Queen City* at the time of the contact. (Sources: [*Top*] Nimbusphere, YouTube; [*Bottom*] TAPP Channel, YouTube)

## 1.2 Event Sequence

On March 25, 2023, the Ohio River in Louisville, Kentucky, was experiencing its highest water levels of 2023. At 0808, when the McAlpine Locks and Dam upper gage on the Ohio River (at mile 604.6) rose above 13 feet, the Coast Guard activated Vessel Traffic Service (VTS) Louisville in accordance with the Mississippi and Ohio Valley and Tributaries Waterways Action Plan (WAP) (see section 1.3.4 for more information about the WAP).[2] Vessels were required to check in with the VTS when operating on the Ohio River between Twelve Mile Island (mile 593) and the McAlpine Locks and Dam (mile 606). The Broadcast Notice to Mariners that announced the activation advised mariners to exercise caution transiting the area because of the high water that increased the speed of outdraft currents.[3]

At 0809, the WAP moved to an "action" phase, defined as when the McAlpine Dam gates were fully open and the upper gage reading was approaching 15 feet and rising. At this phase, the WAP described the river as "Extreme High Water/Extreme High Flow Conditions." (At the time of the contact, gate no. 1 of the lower dam was closed because it had been damaged during a previous barge breakaway. The other eight gates were fully open.)

On March 27, at 0600, the *Queen City* departed from a fleeting area at mile 482 on the Ohio River, in Hebron, Kentucky. The towing vessel was pushing 12 barges and was headed for Paducah, Kentucky, located downriver at mile 934. The tow stopped to drop off a tank barge at mile 539.6 and then proceeded on its route pushing the remaining 11 barges (see figure 4).

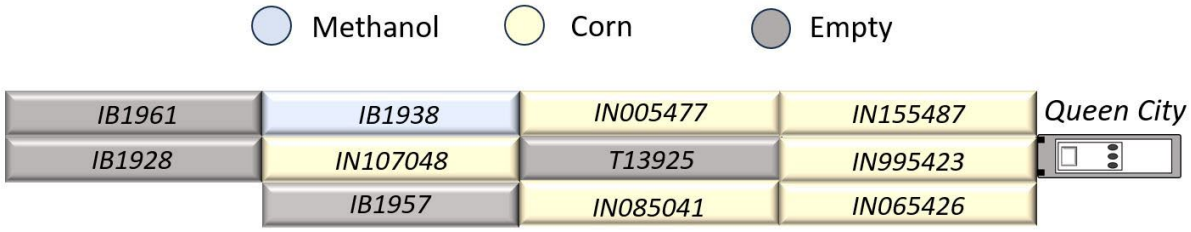


**Figure 4.** *Queen City* tow arrangement and cargoes at the time of the contact.

About 2330, the pilot relieved the captain of the watch, and they discussed the transit, including the increased outdraft velocity expected at the McAlpine Locks and

[2] VTS Louisville is a vessel movement reporting system designed to enable vessel operators to better cope with problems encountered during high water on the Ohio River between miles 592.0 and 606.0.

[3] *Outdraft currents* are currents moving across a lock entrance toward a dam.

Dam because of the high water on the river.[4] The captain told the pilot to keep the tow "above" (to the left of) the sailing line as he approached the entrance channel to the McAlpine Locks, because the current was going to pull him toward the dam.[5] After entering the VTS Louisville area, the *Queen City* pilot checked in with the VTS as required, using VHF channel 13, as he passed the checkpoints. When the VTS was activated, the VTS watchstander notified participating vessels of the location of other vessels, any known hazards within the VTS Louisville area, and any operating restrictions. At the time, the upper gage at the locks measured a river level of about 17.5 feet.

On March 28 at 0218, the pilot was alone in the wheelhouse as the *Queen City* passed through the 802-foot-wide channel span of the Clark Memorial Highway Bridge. The entrance to the locks was 800 yards downriver. The pilot told investigators that, as soon as he cleared the bridge, the current "started grabbing me, it wasn't looking good," so he ordered the on-watch deckhand to get the captain. The vessel was on the sailing line at 0220:24. However, as the pilot steered toward the locks entrance, the tow was set to the north, toward the Vane Dike. About 0224, the starboard sides of the second and third barges in the starboard string struck the Vane Dike mooring cell.

The captain had just gotten out of his bed when a deckhand told him the pilot wanted his assistance in the wheelhouse; during that exchange, the captain heard the vessel's general alarm. On the way to the wheelhouse, the captain felt the *Queen City* strike the Vane Dike mooring cell.

In the moments before the contact, automatic identification system (AIS) data showed the tow setting farther to the north, or to the right of the sailing line and the tow's intended track. By 0224:38, the tow had been pulled about 109 yards to the right of the sailing line, in the direction of the lower dam gates (see figure 5). The vessel was sliding (moving sideways) toward the lower dam gates at about 33 yards per minute (1.1 mph).

[4] *Pilot* is a term used aboard towing vessels on inland waterways for a person, other than the captain, who navigates the vessel.

[5] The *sailing line* on inland navigational charts is the preferred or recommended route within the reaches of a navigable channel. A vessel's orientation to a sailing line (above or below) depends on the direction of its movement, upriver or downriver, and the direction of the outdraft. When downbound on the Ohio River and approaching the McAlpine Locks and Dam, a vessel above the sailing line would be to the left of the sailing line on a nautical chart, and a vessel below the sailing line would be to the right of the sailing line on a nautical chart.

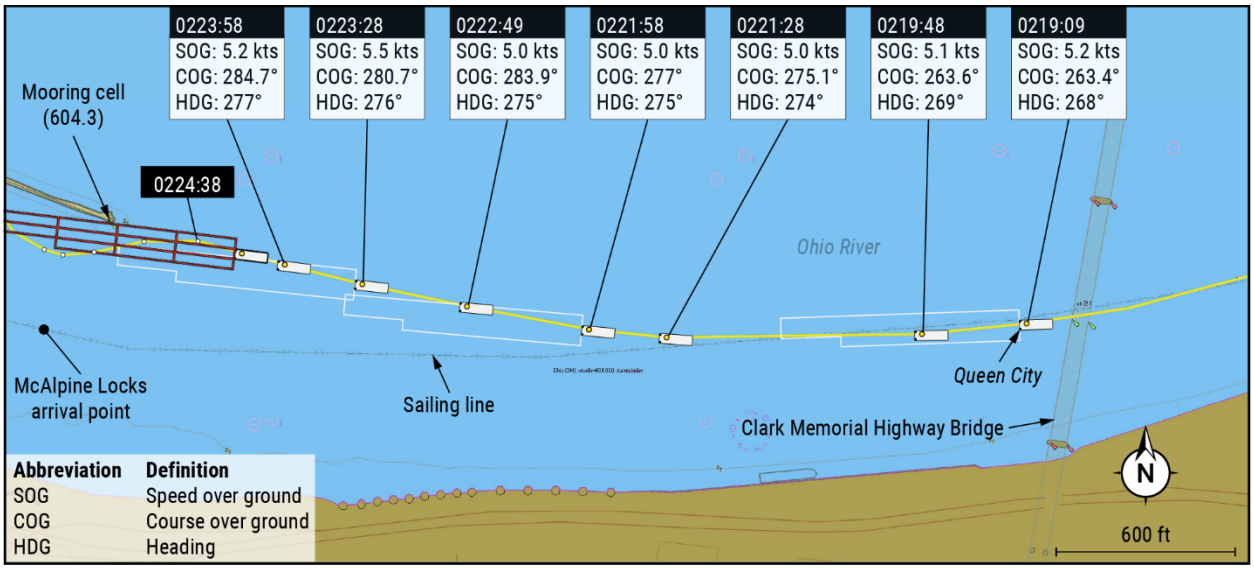


**Figure 5.** AIS positions, tow outlines (barges), and track of the *Queen City*.

The tow broke apart after striking the Vane Dike mooring cell. The *Queen City* crew retrieved one barge, the *IB1961*, and tied it off in a nearby fleeting area. Another towing vessel crew retrieved the *IN085041* and tied it off to the same fleeting area. Six barges went through the lower dam gates; three were pinned against the lower dam gates: *IN995423*, *T13925,* and the only barge loaded with hazardous material (methanol), *IB1938*.

Due to the immediate threat to public safety associated with the flammability of methanol, air and water monitoring began, and the river was closed. A unified command was established that included local, state, and federal agencies, as well as representatives of the vessel owner/operator. The vessel's owner/operator activated the vessel response plan. The designated salvor responded on scene, completed water and air monitoring, conducted vessel surveys, developed lightering and salvage plans, lightered the methanol barge while it was pinned against the dam, and salvaged all damaged barges from the waterway (see figure 6).


**Figure 6**. Barges *IN995423* and *IB1938* against the lower dam gates. *IB1913* is receiving methanol from *IB1938* through a cargo transfer hose. (Background source: Coast Guard)

## 1.3 Additional Information

### 1.3.1 Damage

The *Queen City* was not damaged. Nine barges were damaged, with an estimated cost of $1.475 million. There was also about $500,000 of lost cargo (corn).

### 1.3.2 Personnel Information

The pilot had been working for 7 years as a mariner on rivers and for 2 years as a mate (pilot). He held a credential as a master of towing vessels upon Western Rivers. He had been employed with C&B Marine for 2 years and was the pilot for the

*Queen City* for 1.5 years. He was on a 2-week-on/2-week-off crew rotation schedule and had just returned to the vessel on March 23. He told investigators that the largest tow he had pushed was 20 barges and estimated he had transited the McAlpine Locks downriver 15 times. He further said that this was the highest water he had ever experienced during a transit; in some previous transits, he recalled the water may have been as high as 14 or 15 feet.

The captain, who held a credential as master of towing vessels for 4 years, began serving as the captain of the *Queen City* in August 2023. He had been working on towing vessels for 24 years. Like the pilot, he was on a 2-week-on/2-week-off crew rotation schedule, also having returned to the vessel on March 23.

After the casualty, the captain and pilot were tested for alcohol and other drugs. All results were negative.

### 1.3.3 River Conditions

At the time of the casualty, the upper gage at the McAlpine Locks measured river height at 17.5 feet, and the lower streamgage measured water flow at over 400,000 cubic feet per second. These measurements were nearly the highest compared to readings during the previous 12 months (see figures 7 and 8).

Waterway users estimate the velocity of currents using the volume of water moving at a given time (flow rate). Generally, an increased water flow at any point in a river is associated with a faster river current.

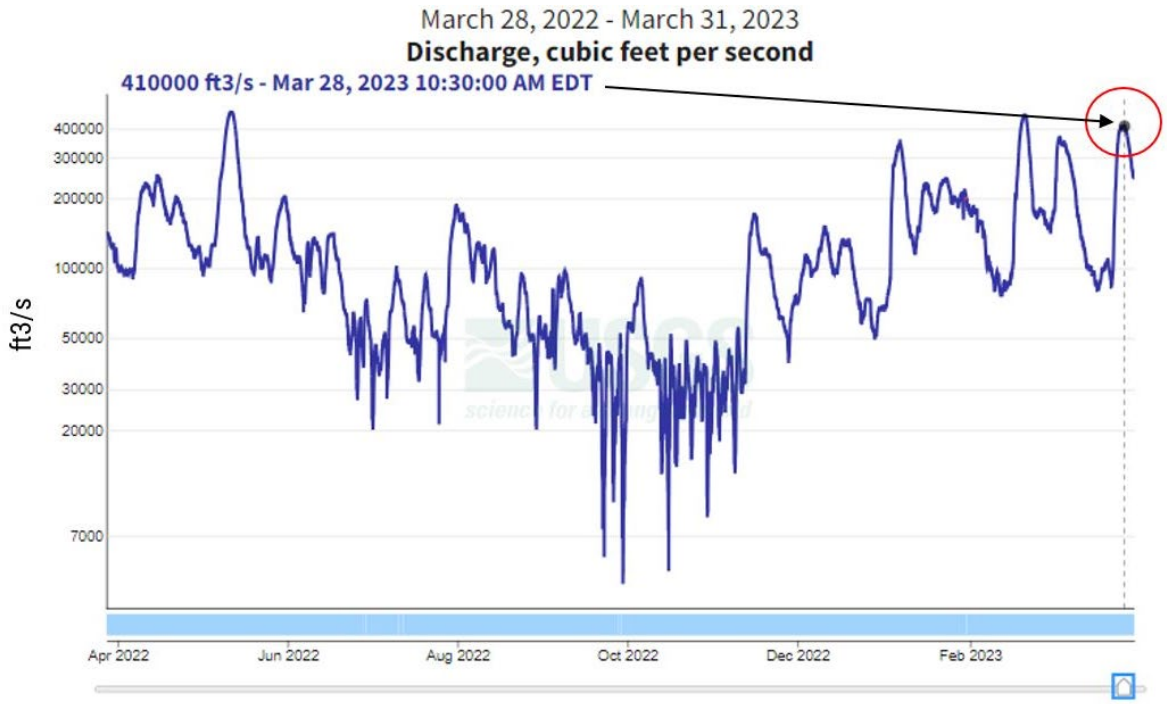


**Figure 7.** Discharge of water on the Ohio River (lower streamgage) at Louisville, Kentucky, from March 28, 2022, to March 31, 2023. (Background source: US Geological Survey)

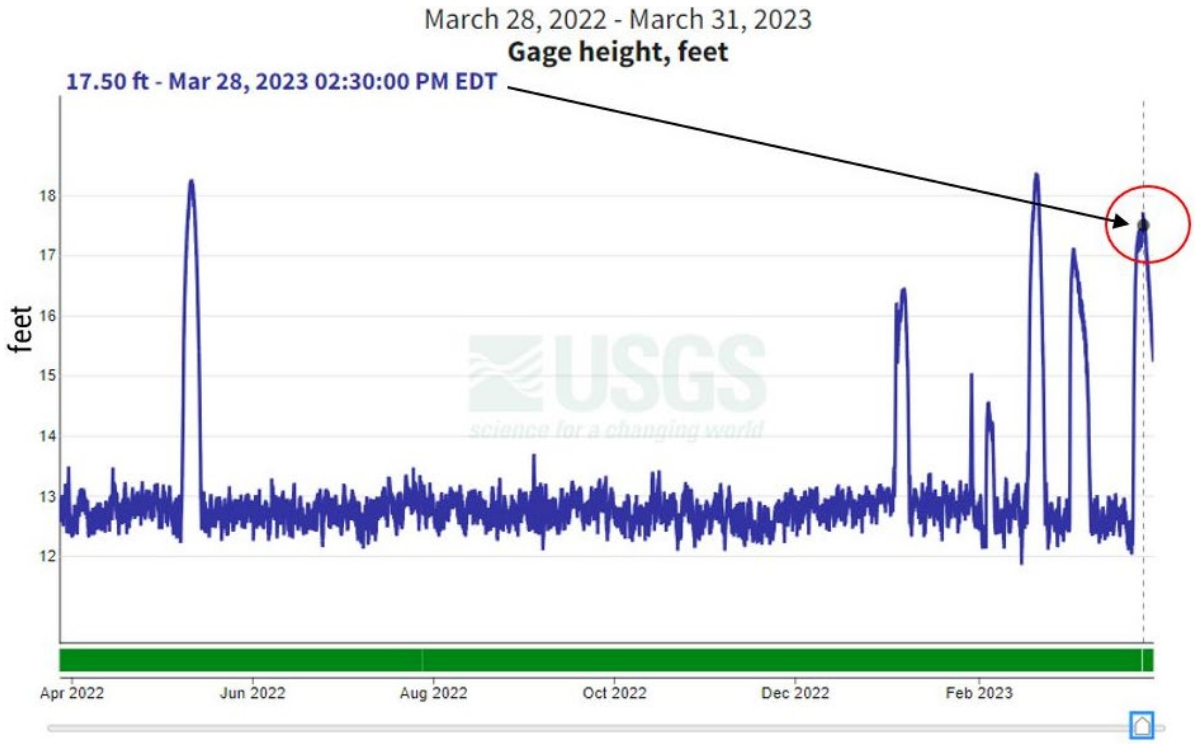


**Figure 8.** Gage height (upper gage) of the Ohio River at the McAlpine Dam from March 28, 2022, to March 31, 2023. (Background source: US Geological Survey)

### 1.3.4 Waterways Action Plan

The Mississippi and Ohio Valley and Tributaries WAP contained information about high-water operations on the Ohio River. The Coast Guard maintained the WAP, which provided maritime industry, government agencies, and State and local governments "with a plan to facilitate safe and orderly movement of traffic during evolving conditions on the inland rivers." According to the WAP executive summary, "The overall goal of this plan is to ensure safety of life and navigation, protection of infrastructure and property, and to prevent marine casualties."

The WAP for the Mississippi and Ohio Valley and Tributaries included this cautionary note:

> The Vane Dike at the entrance to the Louisville and Portland Canal [Portland Channel] at OHR MM [Ohio River mile] 604.3 experiences strong outdrafts on the upstream end during high flows.

It also warned mariners that:

> The potential for vessel allisions with McAlpine L&D [Locks and Dam] tends to increase as water rises and currents increase. Vessels experience outdraft while entering southbound Portland Canal [Channel]. Mariners are advised to exercise extreme caution, enter chambers at slowest safe speed, and prepare for potential outdrafts.

The WAP also stated that, "During high water conditions, industry may reduce tow sizes to allow more positive control over the tow to more effectively utilize towboat horsepower."

The WAP also noted that, in the action phase, the Captain of the Port, Coast Guard Sector Ohio Valley (in coordination with other river stakeholders) would evaluate river and weather conditions, then, "consider: providing local pilot knowledge of river characteristics and/or daylight only transit of south bound vessels." In the past, the Captain of the Port had restricted transits to daylight only when the river gage reached 18 feet.

The Mississippi and Ohio Valley and Tributaries WAP was available on a computer in the wheelhouse of the *Queen City*.

### 1.3.5 Company Policies

C&B Marine did not have specific guidance for contending with high water at the McAlpine Locks and Dam. The company towing policy required a 250-hp-per-barge ratio for hopper, tank, and empty barges. The company's Fleet Size Trigger Point Job Aid limited the number of loads (barges) at river stages at certain

locations on the Ohio River. The company's Voyage Planning guidance document instructed towing vessel pilots to consider the river stage and drift (floating debris such as trees and pilings), among other things, when assessing the horsepower-to-barge ratio.

### 1.3.6 Recent Tow Transits During High-Water Conditions

VTS transit records showed 43 downbound tow transits with 10 or more barges through Louisville between March 25 and April 3, 2023, when the upper gage at the McAlpine Dam recorded water levels above 15 feet.[6] None of the tows pushed more than 15 barges. Thirty-one transits were made by towing vessels of 4,000 hp or more, six transits were made by vessels of 3,600 hp, and six transits were made by vessels of 1,800 hp. Of the vessels that were 3,600 hp or less, AIS data showed that three were set toward the Vane Dike after passing through the Clark Memorial Highway Bridge:

1. March 26 at 2023, 3,600-hp vessel pushing 13 hopper barges, upper gage read 17.3 feet.
2. April 1 at 0900, 1,800-hp vessel pushing 15 barges (13 hopper and 2 other), upper gage read 15.5 feet.
3. April 3 at 0943, 3,600-hp vessel pushing 15 hopper barges, upper gage read 17.0 feet.

Coast Guard investigation records showed two contacts of downbound tows with the Vane Dike mooring cell in February 2022. On February 9, with the upper gage at 16.2 feet, a 5,600-hp towing vessel pushing 15 barges (10 loaded with scrap metal and five empty) struck the Vane Dike mooring cell. On February 26, with the upper gage at 19.4 feet, a 4,300-hp towing vessel pushing 12 barges (nine loaded hopper barges and three empty tank barges) struck the Vane Dike mooring cell. The Coast Guard determined that, in both cases, the captains of the towing vessels misjudged the effects of the current, resulting in the tows being set to starboard, away from the sailing line, as they attempted to enter the lock channel.

[6] An upper gage level reading of 15 feet with a rising trend would trigger an action phase of the WAP.

# 2 Analysis

After the 3,000-hp *Queen City* transited through the center span of the Clark Memorial Highway Bridge pushing an 11-barge tow downbound in the dark, the pilot attempted to move the tow west to enter the Portland Channel (leading to the McAlpine Locks), but the McAlpine Dam's outdraft pulled the vessel away from the sailing line and the channel entrance. Within about 5 minutes after passing through the bridge, the starboard side of the tow struck the Vane Dike mooring cell.

The Coast Guard's Mississippi and Ohio Valley and Tributaries WAP warned that the Vane Dike area experienced strong outdrafts on the upstream end during high flows. At the time of the contact, the upper gage at the McAlpine Locks measured about 17.5 feet and rising, indicating a period of "extreme high water/extreme high flow conditions," according to the WAP. (The lower streamgage measured water flow at over 400,000 cubic feet per second—nearly the highest in the previous 12 months.) The Captain of the Port, Sector Ohio Valley had not imposed any restrictions on the waterway before the *Queen City* tow struck the Vane Dike. In the past, the Captain of the Port, in coordination with other river stakeholders, had restricted the waterway to daylight-only transits when the water level reached 18 feet.

The *Queen City* pilot told investigators that he had previously transited this portion of the Ohio River, but this was his first time doing so with water levels above 15 feet, and he knew the outdraft would set the tow toward the dam. Company guidance left it up to the captain and the pilot to decide if and how to transit the river at high water. The captain and the pilot could have reduced the number of barges—providing a larger horsepower-to-barge ratio, as discussed in the WAP and company policy. (The tow already complied with the company policy to maintain a 250-hp-per-barge ratio, and the *Queen City* pilot was checking in with the VTS as required by the WAP.) However, they decided to steer to compensate for the set from the outdraft. The pilot and the captain had discussed the transit, and the captain told the pilot to keep the tow above (to the left of) the sailing line. They did not discuss reducing the number of barges.

When towing vessel operators decide to steer through an area with strong outdrafts, they must steer a course to account for the set from the outdraft. The *Queen City* pilot intended to steer into the entrance channel to the locks, knowing that an outdraft would set the tow toward the Vane Dike and the dam gates. Although the pilot attempted to steer the tow to the left, he did not anticipate the strength of the outdraft and its effect on the tow. Consequently, his approach to the channel upon passing through the Clark Memorial Highway Bridge did not effectively compensate for the outdraft that set the tow on to the Vane Dike.

# 3 Conclusions

## 3.1 Probable Cause

The National Transportation Safety Board determines that the probable cause of the contact of the *Queen City* tow with the Vane Dike was the pilot not effectively compensating for the strong outdraft while navigating toward the lock channel entrance during a period of high-flow conditions.

## 3.2 Lessons Learned

### Preparing for Dam Outdrafts

High currents resulting from high water pose unique hazards for vessels transiting inland rivers. In addition, near dams, greater dam openings in high-water conditions lead to high flow rates, which can produce outdraft currents near the dam. Mariners should thoroughly assess the potential impact of outdraft currents when entering or exiting locking channels. Vessel horsepower and vessel handling should be carefully considered. Mariners should also consult available resources, such as Waterways Action Plans and company policies, when passage planning.

| Vessel | *Queen City* |
|---|---|
| **Type** | Towing/Barge (Towing vessel) |
| **Owner/Operator** | C&B Marine Equipment, LLC (Commercial) |
| **Flag** | United States |
| **Port of registry** | Covington, Kentucky |
| **Year built** | 1974 |
| **Official number (US)** | 561721 |
| **IMO number** | N/A |
| **Classification society** | N/A |
| **Length (overall)** | 102.5 ft (31.2 m) |
| **Breadth (max.)** | 34.0 ft (10.4 m) |
| **Draft (casualty)** | 7.5 ft (2.3 m) |
| **Tonnage** | 446 GRT |
| **Engine power; manufacturer** | 2 x 1,500 hp (1,119 kW); EMD 12-645-E6 diesel engines |

NTSB investigators worked closely with our counterparts from **Coast Guard Sector Ohio Valley** throughout this investigation.