

**HYDRAULIC MODEL STUDY
OF THE
FLAMINGO WASH/WINNICK AVENUE DROP INLET STRUCTURE
CLARK COUNTY, NEVADA**

**BY
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Background

A proposed design for conveying the 100-year flood from the Flamingo Wash, through the Imperial Palace Hotel parking structure, along Winnick Avenue to Koval Lane has been completed. The proposed design called for a drop inlet structure at the upstream end of Winnick Avenue to capture 2,500 ft³/s of the 5,000 ft³/s design flow. The remaining 2,500 ft³/s would continue to flow down Winnick Avenue to a drop inlet structure at Koval Lane. The initial design specified a cable type, Federal Highway-designed guardrail to be placed around the upstream inlet to prevent vehicles from entering the inlet during normal traffic and flood stages. Reclamation was contacted by the Clark County Board of County Commissioners to conduct a hydraulic model study and investigate the effectiveness of this design, and to model modifications to the design to improve the effectiveness of the inlet structure.

Conclusions

- The 1:12 scale model was constructed based on the original design prepared by personnel in the Department of Public Works, Clark County. When tested, it confirmed the intended design for interception of 50 percent of the design flow by the inlet. For 5,000 ft³/s, 52 percent of the flow was intercepted (see fig. 1).
- The initial guardrail design failed to prevent vehicles from going into the inlet. When the vehicles were not washed into the inlet, they were held against the chain type guardrail, with water flowing over them (see fig. 4).
- Two additional drop inlet configurations were installed and tested in the model to achieve an acceptable design. A design was selected by Clark County which incorporates a 6-ft-high barrier at a flat angle to the flow. The barrier design used horizontal rails at four locations to slide the vehicles past the inlet as the flow carries them down Winnick Avenue (see fig. 5). The barrier will intercept vehicles at flows up to the design flow and should prevent them from entering the inlet.
- The final design also incorporated a ramp from the upstream end of the inlet to the box culvert invert and a grate covered section across the roadway near the end of the inlet to intercept a larger portion (up to 83 percent) of the smaller floods (discharges under 2,500 ft³/s).

INLET CAPACITIES

Winnick Avenue Inlet

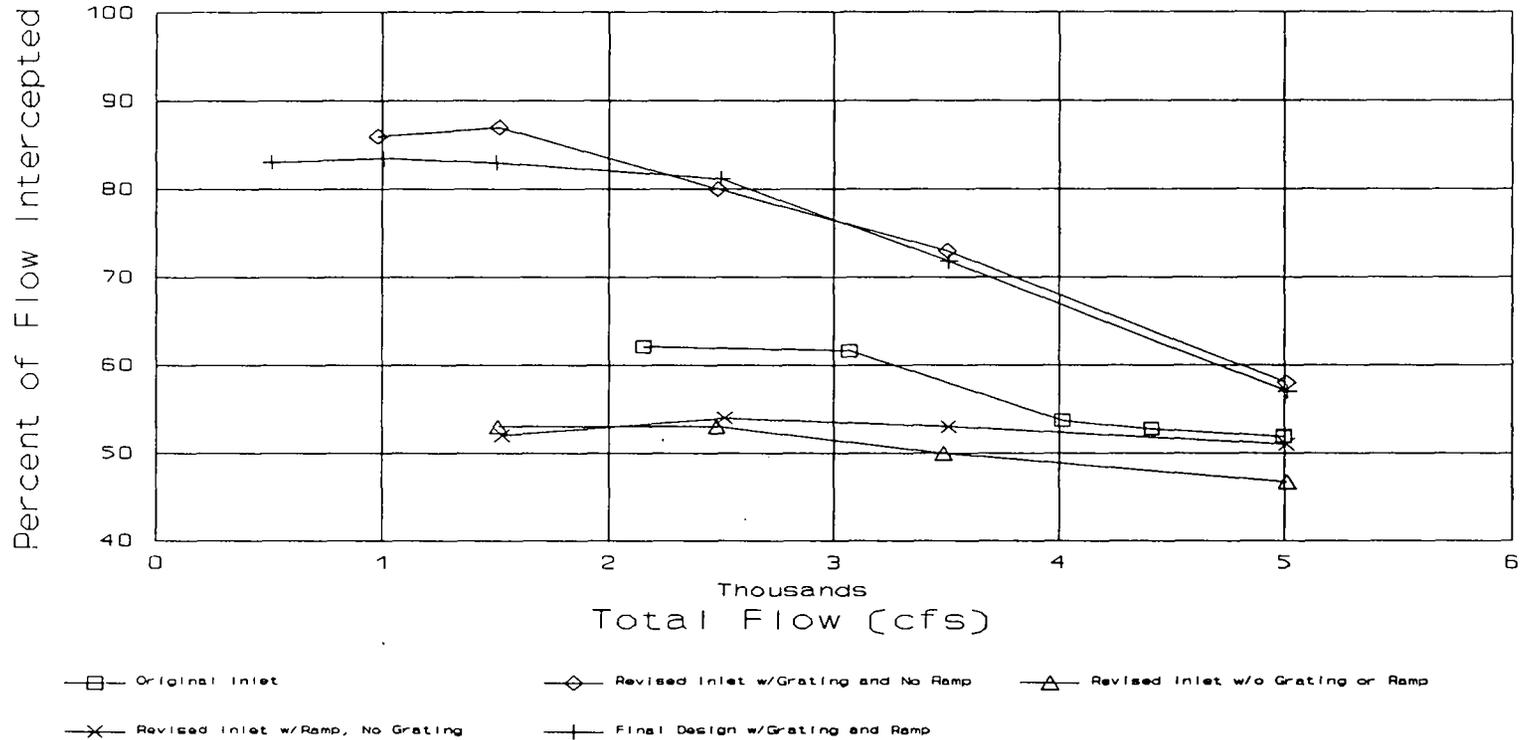


Figure 1 - Percent of flow captured at the Winnick Drop structure during a flood event.

Model

A 1:12 scale Froude based hydraulic model was designed and constructed in the hydraulics laboratory of the Bureau of Reclamation in Denver, Colorado, to study a drop inlet structure downstream from the Imperial Palace Hotel. Ten ft³/s in the model simulates 5,000 ft³/s in the prototype. The model included the exit from the Imperial Palace parking structure, the intersection with Winnick Avenue, the proposed drop inlet structure with the roadway above and the box culverts below, and a portion of Winnick Avenue downstream from the proposed drop inlet structure. The inlet was constructed with Plexiglas sidewalls to allow viewing the flow through the sidewalls. A cable type guardrail was placed around the inlet to represent the initial design. A general layout of the model is shown in figure 2.

Flow to the model was controlled and measured by the hydraulic laboratory supply and measurement system. Flow captured by the inlet was measured with a standard rectangular contracted weir which was incorporated into the model under Winnick Avenue at the end of the box culverts. Flow not intercepted by the inlet proceeded down Winnick Avenue, and plunged over the weir box, returning to the laboratory water storage reservoir. The intercepted flow percentage is calculated as the ratio of the flow through the weir box to the total flow supplied to the model.

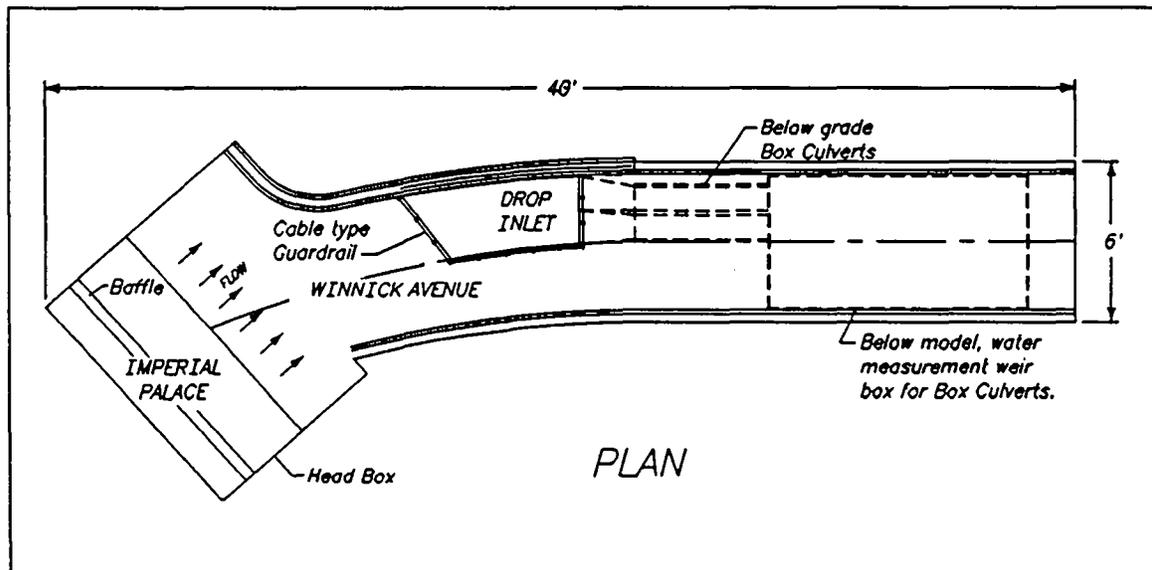


Figure 2 - Original Model Design.

Test Procedure

Flows of 1,000, 1,500, 2,000, 3,500, and 5,000 ft³/s were tested to determine the percentage of the flow captured by the inlet (see fig. 1). A major goal of the model study was to prevent vehicles from being washed into the inlet. Therefore, tests were run using properly scaled and weighted model vehicles to simulate the effect of the flow washing out of the parking structure toward the inlet. The windows in the vehicles were covered with tape to simulate buoyancy. A guardrail was placed around the inlet to simulate the prototype design. Initially, flows of 2,500 and 5,000 ft³/s were tested. After consulting with Clark County, the design of the inlet and barrier was changed twice to improve the performance. In addition, there was a desire to capture as much flow as possible at flows less than 2,500 ft³/s. A steeper cross slope (3.5 percent as opposed to the original 2 percent) was tried on the south side of the inlet. When the tests were repeated, only a few percentage points in efficiency were gained.

Further design modifications as shown in figure 3 were tested and video taped. The final tests were run at 500, 1,000, 1,500, 2,500, 3,500, and 5,000 ft³/s. In addition to the changes requested by Clark County, a "Jersey rail" was added to the downstream end of the inlet. This addition prevents vehicles and pedestrians from falling into the inlet and builds up the water depth during a flood and slightly increases efficiency. (see fig. 3, Final Design).

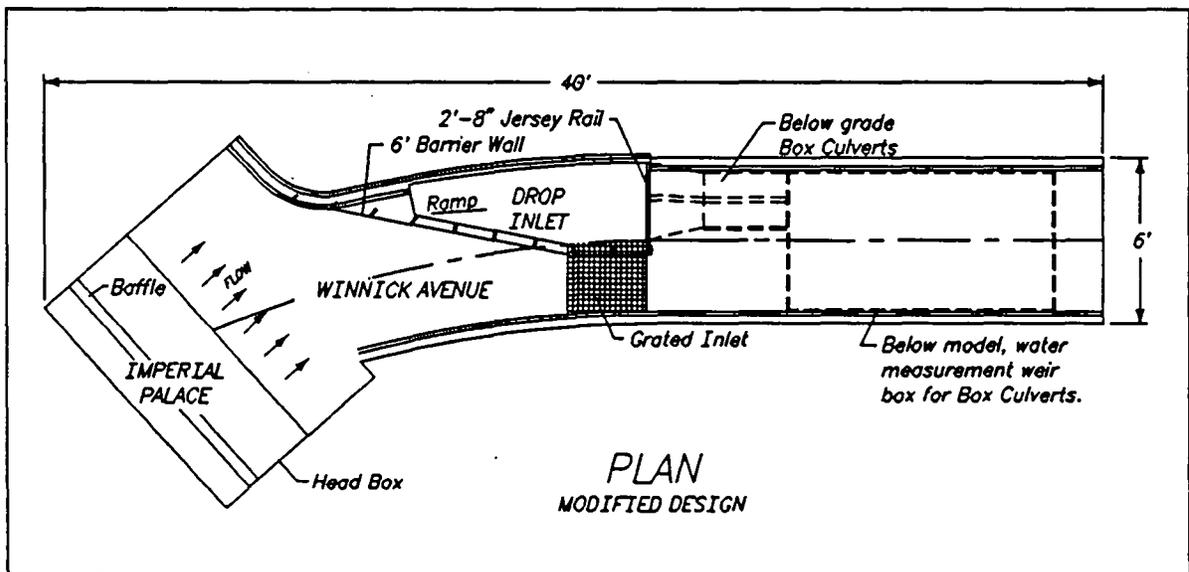


Figure 3 - Final Design.



Figure 4 - Photograph of the water overtopping the cars being held by the guardrail. Discharge is approximately $2,500 \text{ ft}^3/\text{s}$.

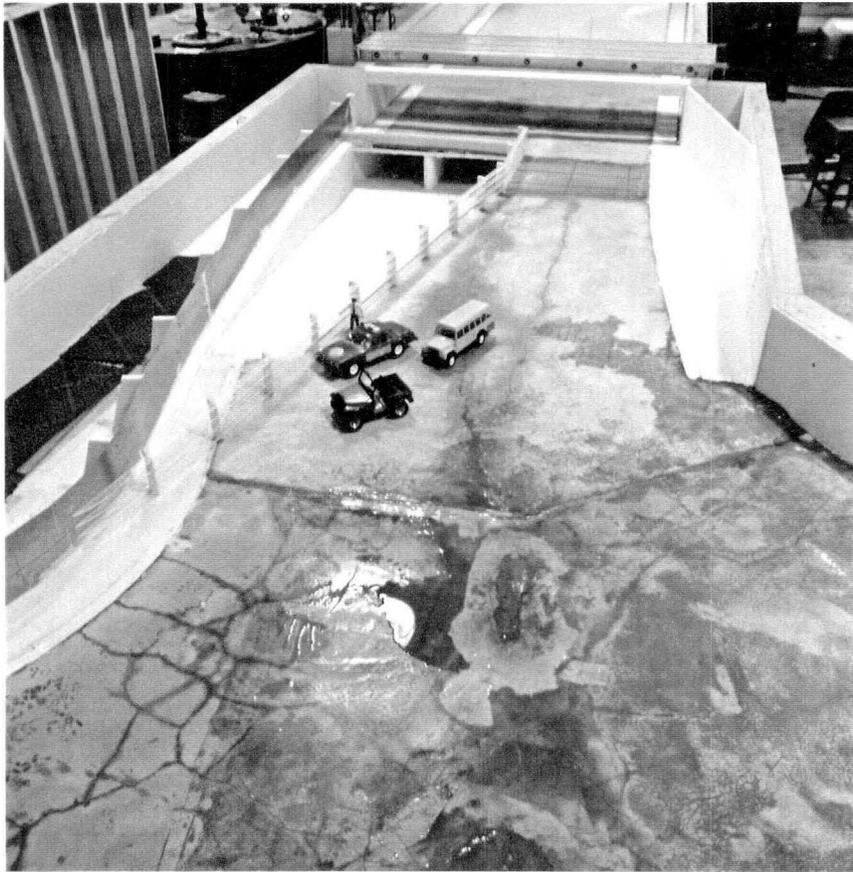


Figure 5 - Photograph of the Model with the Final Design.