WASHINGTON DEPARTMENT OF FISH AND WILDLIFE

Over / Under Gate

Ramp Design & Flushing Operation

A gate-specific guide for operations, maintenance, engineering, and fisheries staff

Developed and designed by the WDFW Yakima Screen Shop • Early 1990s

Minimum bypass design criteria

Baseline criteria for bypass sizing and flush-gate geometry.

01

BYPASS FLOW

5%

For diversions of 20 cfs or greater, minimum design bypass flow must be at least 5% of the total diverted flow.

Unless otherwise approved by NMFS.

02

PIPE FLOW DEPTH

40%

Free-surface flow depth in the bypass pipe must be at least 40% of the pipe diameter.

Unless otherwise approved by NMFS.

03

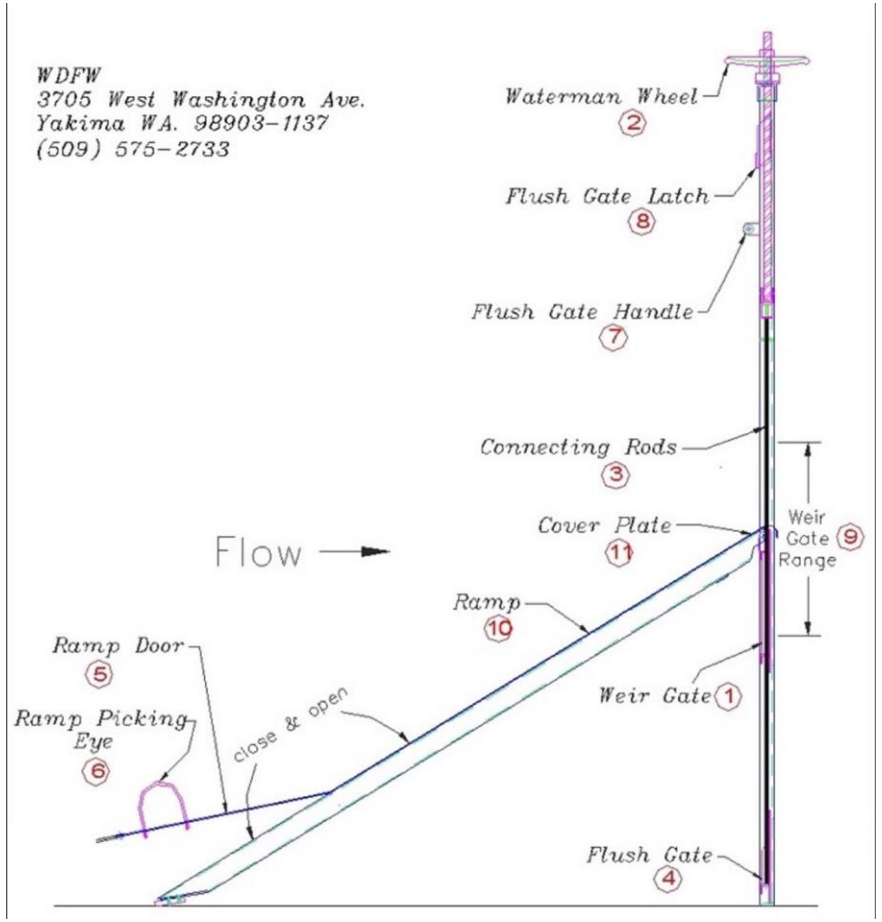
BYPASS INLET WIDTH

18 in

Minimum bypass channel inlet width.

The ramp-and-flush assembly defines this O/U gate design

The inclined ramp combines fine water-surface control with a deliberate low-level flushing path.



Inclined ramp

Guides flow toward the weir gate and carries the hinged ramp door.

Hinged ramp door

Opens before flushing to clear the low-level discharge path.

Weir gate

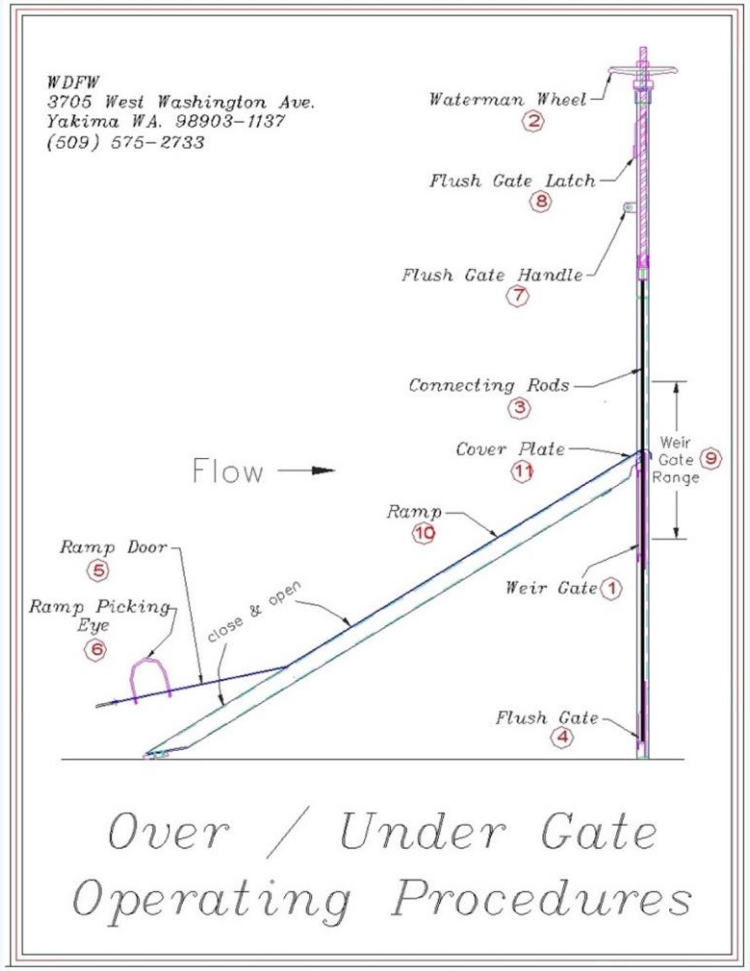
Raises or lowers with the ramp to trim bypass-inlet water surface elevation.

Flush gate

Opens independently to sluice accumulated sediment and debris.

Design print: complete O/U gate and ramp assembly

Callouts 1–11 identify the operating components referenced throughout this presentation.

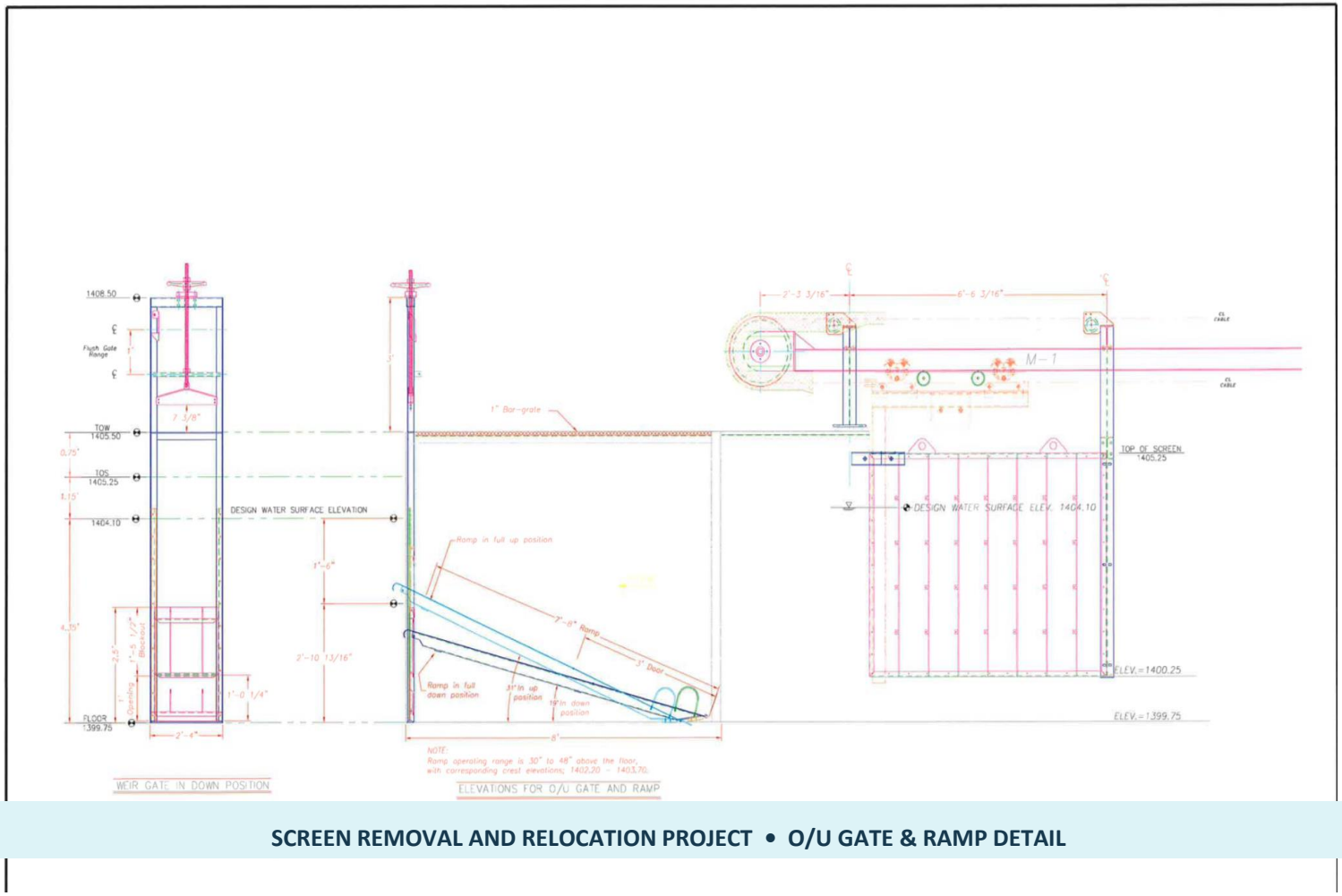


DRAWING INDEX

1 Weir gate
2 Waterman wheel
3 Connecting rods
4 Flush gate
5 Ramp door
6 Ramp picking eye
7 Flush-gate handle
8 Flush-gate latch
9 Weir-gate range
10 Ramp
11 Cover plate

Snow Creek plan sheet: O/U gate and ramp detail

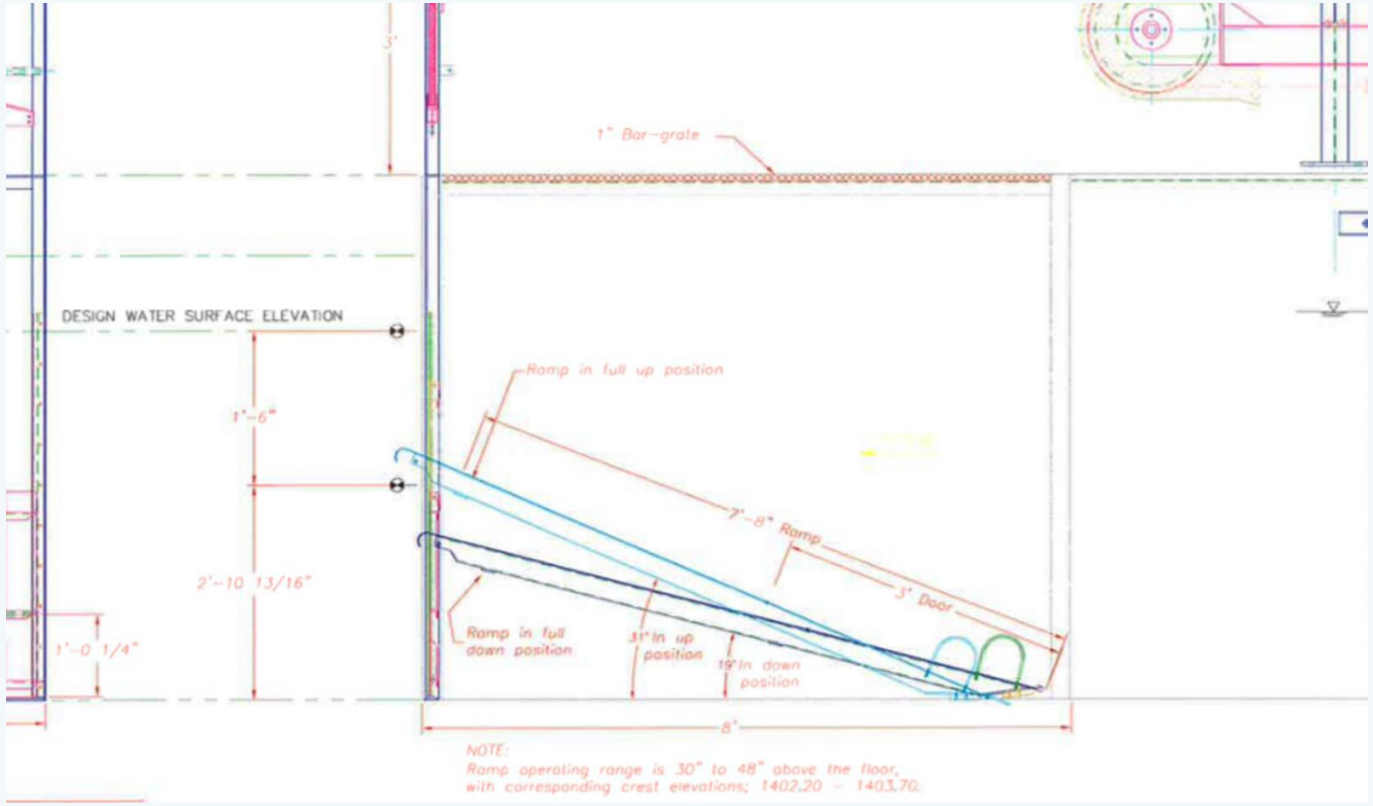
A site-specific print ties the gate, ramp, screen, and design water-surface elevation into one coordinated assembly.



SCREEN REMOVAL AND RELOCATION PROJECT • O/U GATE & RAMP DETAIL

The site print defines the ramp's full operating envelope

The elevation view documents the ramp's full-down operating position and full-up flushing/access position.



FULL DOWN

Normal operating position with the ramp seated.

FULL UP

Raised position for flushing or maintenance access.

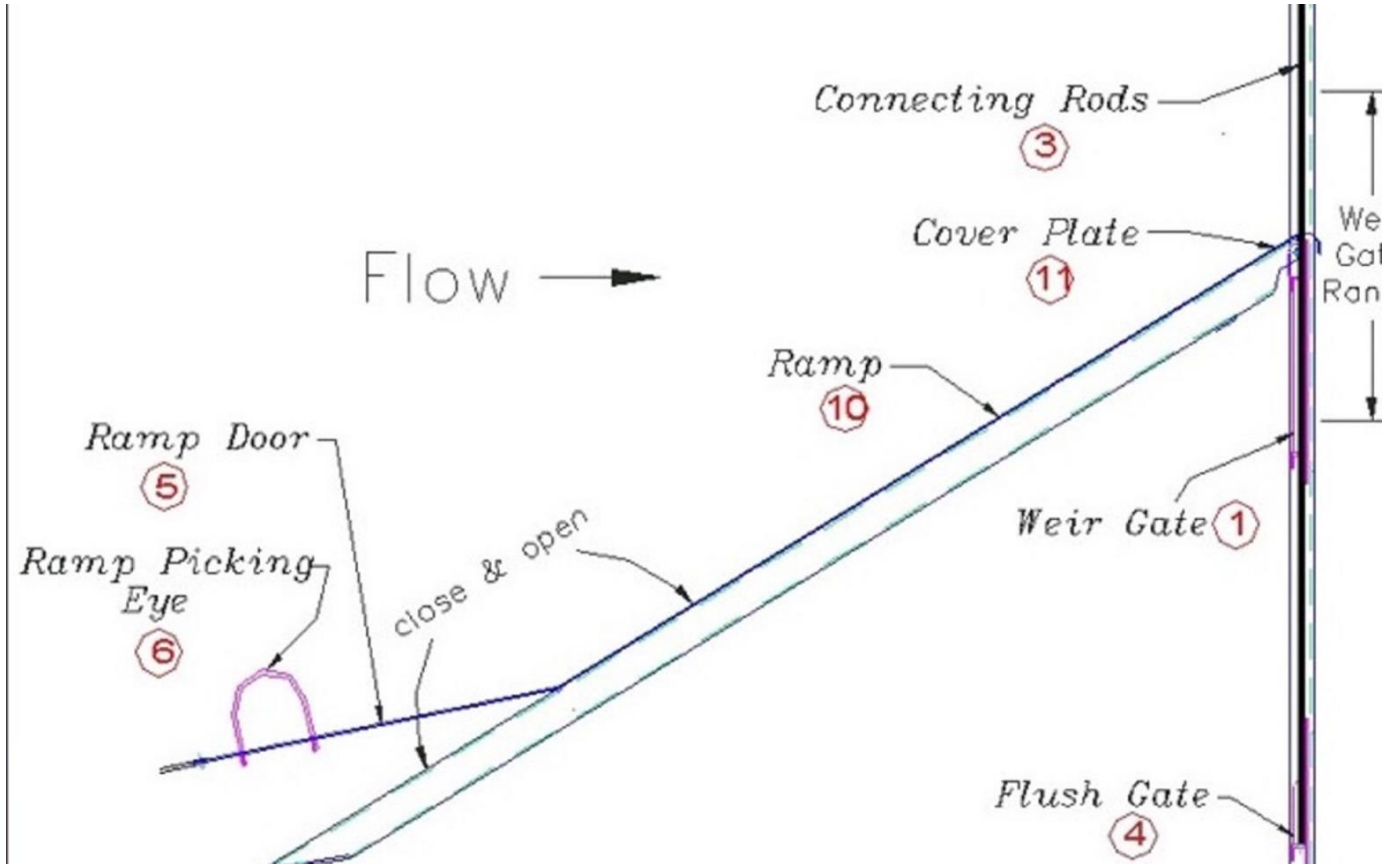
DESIGN WATER SURFACE

The site elevation establishes the approved local hydraulic setting.

The ramp's geometry and operating range are engineered as part of the site—not treated as a separate accessory.

The ramp combines a flush door with side brush seals

Each component keeps the flow path controlled while limiting places where fish or debris can become trapped.



Brushes run along both ramp edges where the ramp meets the concrete walls.

RAMP • 10

Inclined transition to the weir gate.

RAMP DOOR • 5

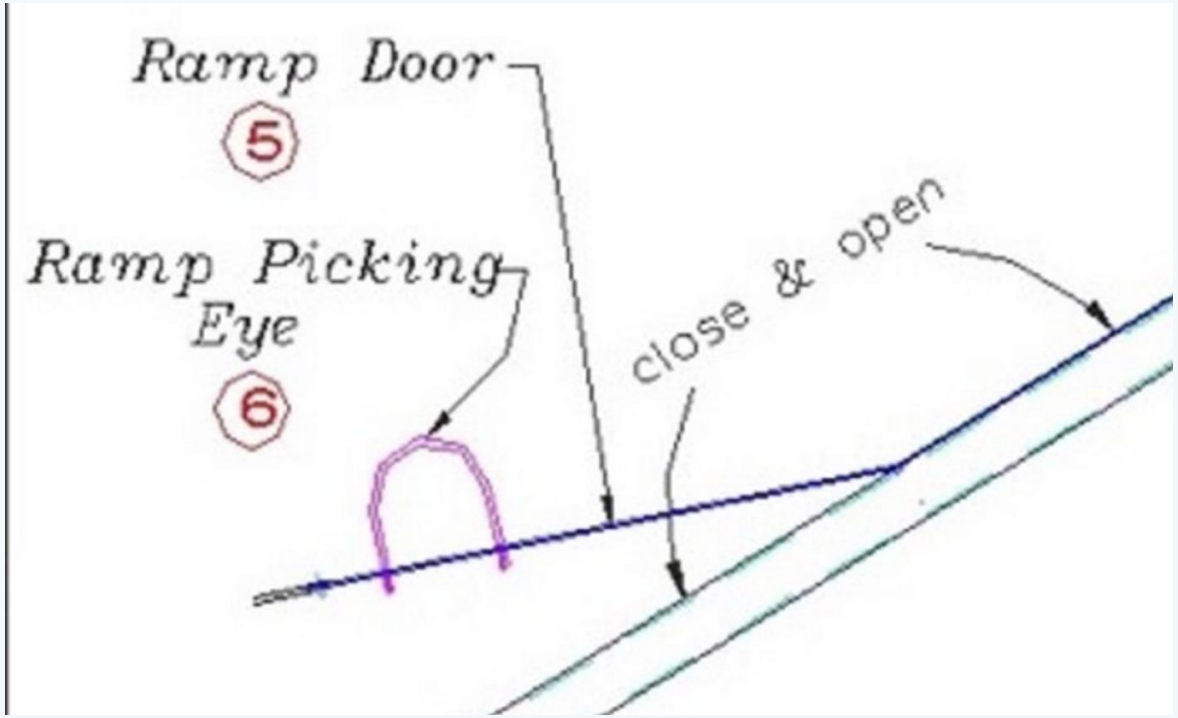
Raise the hinged tail section before opening the flush gate.

PICKING EYE • 6

Lift point for a pike pole or rock rake.

Fish-screen sealing materials complete the ramp interfaces

WDFW uses proven screen-seal and screen-brush materials at the floor transition and along both concrete walls.



RAMP-TO-FISHWAY-FLOOR TRANSITION

Urethane or EPDM rubber provides the flexible transition.

FLOOR SEAL

Mounted where the ramp meets the fishway floor. The urethane or EPDM rubber is the same type of material used for WDFW fish-screen seals.

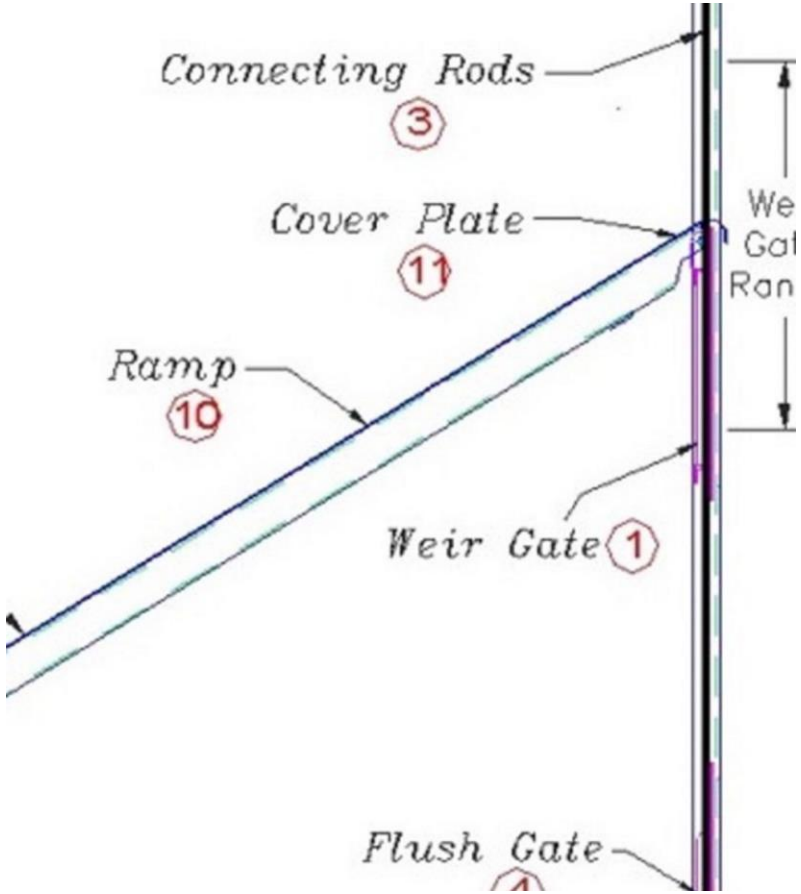
SIDE BRUSH SEALS

The ramp brushes use the same material as WDFW plate-wiper screen brushes and seal the ramp-to-wall voids on both sides.

Together, the seals maintain a continuous transition that keeps fish and debris on the intended path over the ramp.

A curved steel transition cap protects downstream passage

The ramp-to-gate connection and receiving pool work together to provide a smooth, safe transition into the bypass.



01 Curved steel transition cap

The curved cap at the ramp-to-gate attachment provides a smooth transition into the spill pool immediately downstream of the gate.

02 Adequate plunge pool

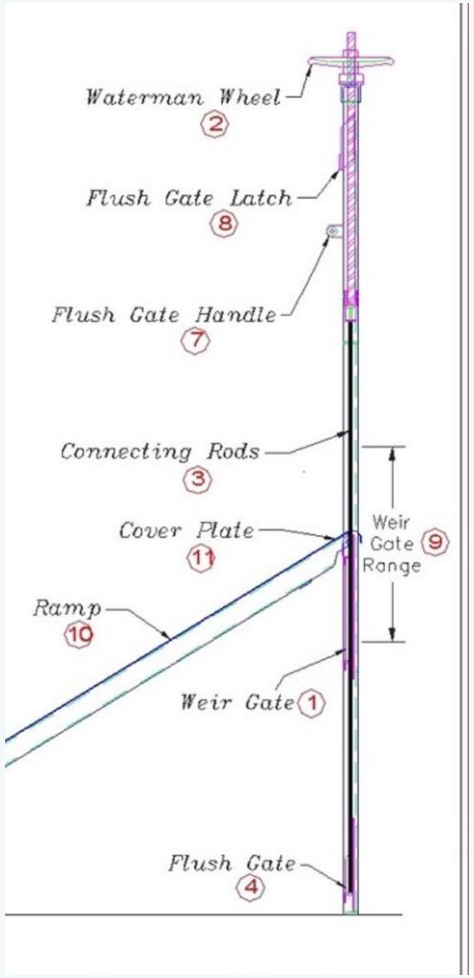
The receiving pool is critical for fish safety and must provide a suitable landing condition after passage over the O/U gate.

03 Bypass pipe or ditch

Flow and fish leave the plunge pool through the site's bypass conveyance.

The vertical assembly separates adjustment from flushing

The Waterman wheel moves the ramp and weir gate; the flush handle opens a separate low-level gate.



Waterman wheel • 2

Raises or lowers the ramp and weir gate through the connecting rods.

Connecting rods • 3

Transmit wheel movement—never force the wheel because the rods can bend.

Flush handle + latch • 7–8

Raise slowly and secure the handle only after the ramp door is open.

Flush gate • 4

Creates the low-level sluice opening used during an intentional flush.

MINIMUM FLUSH-GATE HEIGHT	6 in

The O/U gate fine-tunes bypass-inlet water surface elevation

Primary diversion control is established upstream; this gate provides the final local adjustment.

PRIMARY CONTROL

Head gate

Establishes the overall diversion and flow condition.

COARSE ADJUSTMENT

LOCAL CONTROL

O/U gate

Raises or lowers the ramp and weir gate to maintain the approved bypass-inlet water surface elevation (WSE).

FINE ADJUSTMENT

Do not use the O/U gate as the primary diversion control.

Flushing follows one documented seven-step sequence

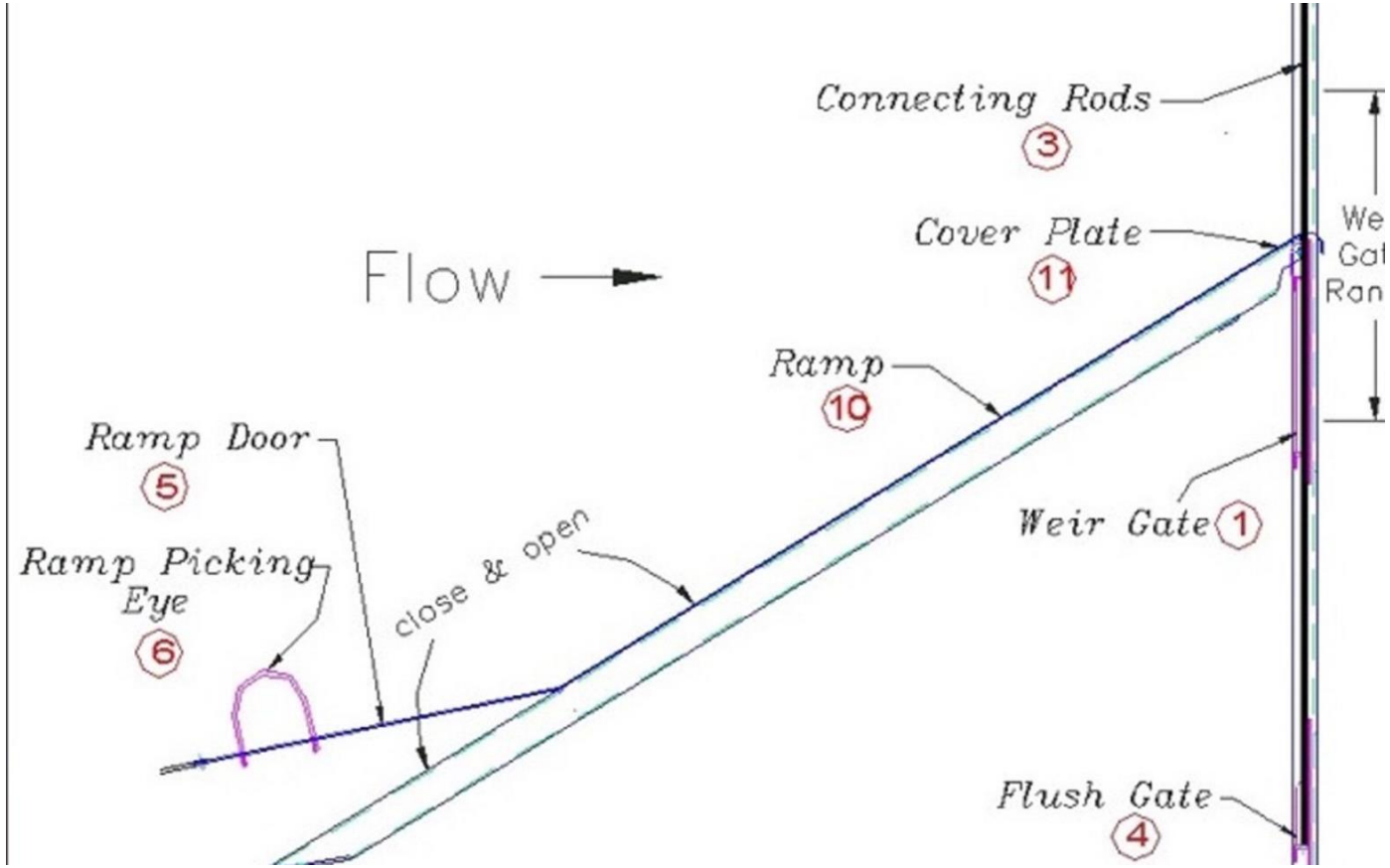
The ramp door must be raised before the flush gate—this mechanical interlock protects the assembly.

1. **Raise weir gate**
   Shut off water flow.
2. **Raise hinged ramp door**
   Use the picking eye.
3. **Raise flush handle slowly**
   Secure with the latch.
4. **Flush for 5–10 minutes**
   Sluice sediment and debris.
5. **Close flush-gate handle**
   Return gate fully down.
6. **Close and seat ramp door**
   Push down until seated.
7. **Restore weir-gate setting**
   Return to prior position.

NEVER raise the flush gate while the ramp door is closed.

Open ramp and flush gates create a direct sluice path

Opening both components creates a low-level path for sediment and debris.



1. SHUT OFF FLOW

Raise the weir gate.

2. OPEN THE RAMP DOOR

Lift at the picking eye to clear the flush opening.

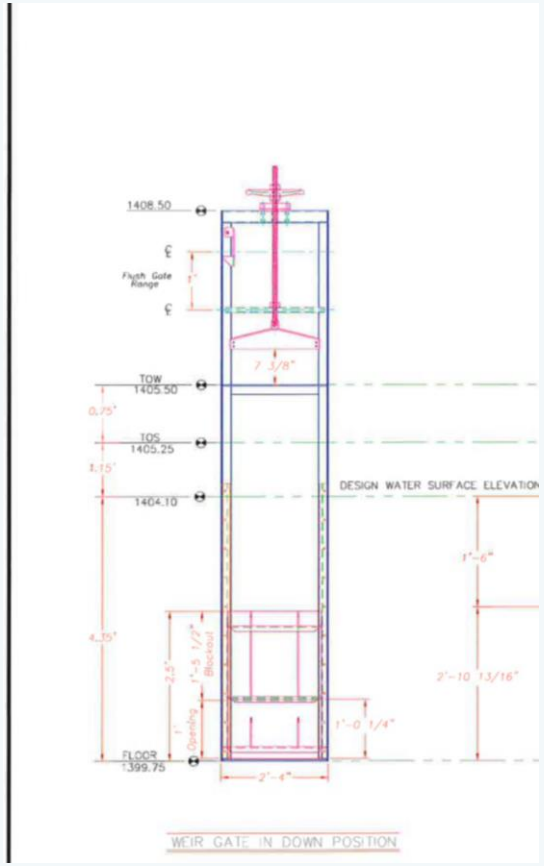
3. OPEN THE FLUSH GATE

Raise slowly, latch securely, and flush for 5–10 minutes.

Sequence matters: ramp door first, flush gate second.

Construction-integrated guides support and seal the gate

The receiving guides or embedded supports are installed as part of site construction before the gate is set.



1. Guides or embedded supports

Construction establishes the receiving structure and final gate alignment.

2. Main frame installed in the guides

The gate is lowered into the prepared supports and secured for operation.

3. Downstream edge sealed

WDFW applies foam tape between the gate's downstream edge and the guide to limit leakage.

Material selection and coating protect the main frame

WDFW has used several fabrication and corrosion-protection approaches as site needs and practices evolved.

MAIN FRAME

Mild steel

The standard frame material used for current gate fabrication.

Earlier gates were also fabricated from stainless steel.

PROTECTION OPTIONS USED BY WDFW

POLYARMOR COATING

Thermoplastic powder melts onto heated steel and hardens into a continuous protective film as it cools.

TWO-PART MARINE EPOXY

Field-proven barrier coating system.

GALVANIZING

Zinc protection for exposed steel.

STAINLESS STEEL

Used on some of the earliest gate frames.

Final material and coating selection should match the site's water chemistry, access, and maintenance strategy.



FIELD APPLICATION

One design. Many sites.

6–150

cubic feet per second

This style of O/U gate is in operation at many sites across Washington State.

Representative fish-screen facility

Use the WDFW procedure sheet for field execution

This presentation explains the design; approved project documents and site-specific procedures govern final actions.

FIELD SEQUENCE

1. Shut off flow by raising the weir gate.
2. Raise the hinged ramp door.
3. Raise and latch the flush gate.
4. Flush for 5–10 minutes.
5. Close the flush gate.
6. Close and seat the ramp door.
7. Restore the prior weir-gate setting.

RAMP + FLUSH

Open ramp door before raising the flush gate.

5–10 MINUTES

Documented flushing duration.

Washington Department of FISH & WILDLIFE

Michael L. Maier
Fish Passage and Screening Supervisor

Work 509-575-2743
Cell 509-961-0040

Kevin Fulks
Construction and Fabrication Supervisor

509-454-7825
509-952-5598