

# UPSTREAM LEVEL CONTROL

## WATERMAN TYPE "C"

### TYPE "C"

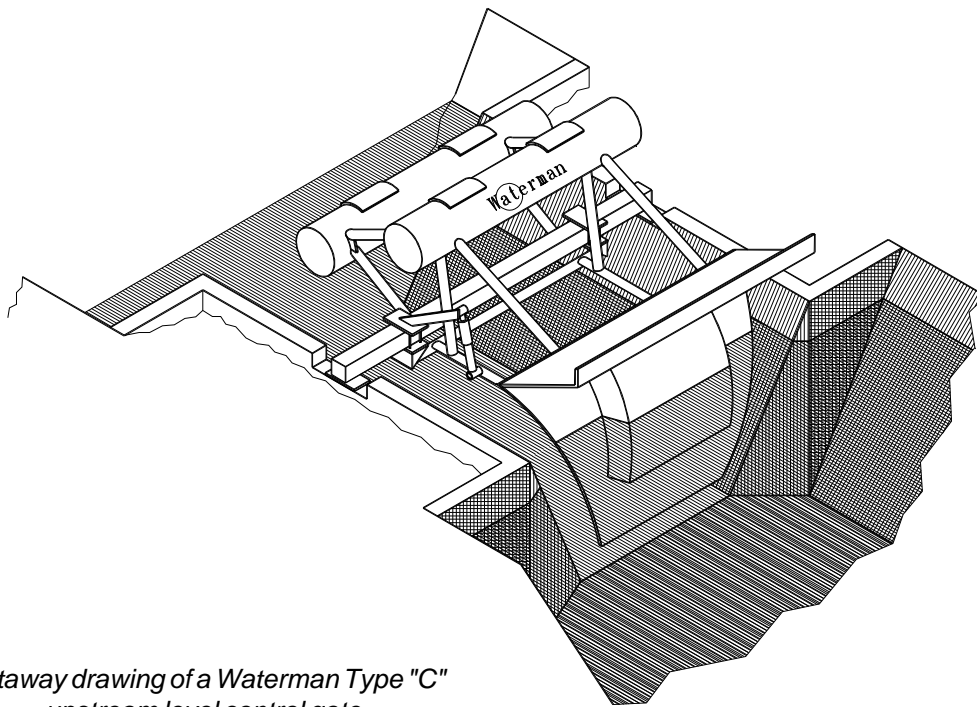
The Waterman Type "C" gate automatically maintains a *constant* water level on the *upstream* side of the gate section.

#### Features :

- Operates without any outside power or motor
- Free of any manual intervention
- Irrespective of the volume of incoming flow
- Independent of the downstream level

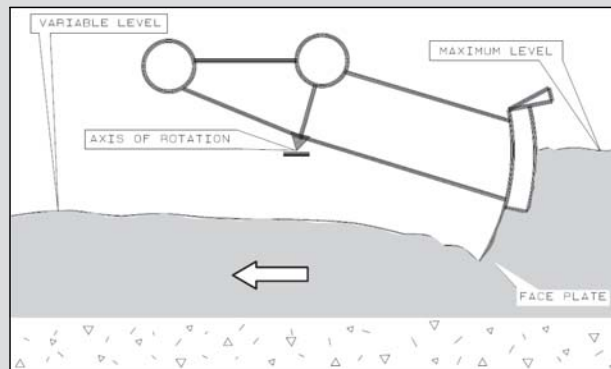
#### Used for :

- Flood control
- Irrigation and water management
- Wastewater treatment



Cutaway drawing of a Waterman Type "C"  
upstream level control gate

## TYPE "C" CONSTANT UPSTREAM LEVEL CONTROL GATES



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# UPSTREAM LEVEL CONTROL

## FEATURES

The Waterman Type "C" gate is directly actuated by the water level it controls. Bothering hoists, cables, floats, floatwells, and other structural complications have been completely eliminated. Instead, the upstream side of the radial face plate is simply provided with a specially designed buoyant compartment. The supporting frame rotates about a horizontal shaft and includes ballast containers for easy and accurate balancing of the gate. Frictionless, non-stick operation is guaranteed by the tapered shape of the leaf and matching sluice.

**On drainage canals,** the Waterman Type "C" gate controls the water table at the desired elevation: closed during dry weather to prevent abnormal lowering of the ground water, it starts to open just as soon as there is any inflow of water to the system.

**On recreation lakes,** the Waterman Type "C" gate maintains a pleasantly constant water level in all seasons.

**On flood control or water supply reservoirs,** the Type "C" gate permits a large increase in storage volume without sacrificing spillway capacity or reliability.

**On wastewater treatment plants,** the Type "C" gate acts to provide a constant level to the clarifier effluent trough, preventing odor stripping.

**On irrigation canals,** the Type "C" gate maintains a high and constant head on turnouts, irrespective of flow in the canal or through the turnouts. Used in series along the distribution network, at different check structures, Type "C" gates insure an automatic, safe, reliable, and flexible irrigation program, at sharply reduced labor costs.

## BENEFITS OF USING WATERMAN TYPE "C" GATES

### Savings on Operational Cost

Once installed, a Waterman Type "C" gate requires no further adjustment; there is no need for any manual intervention. Ever! There is also no need for expensive power supplies.

### Savings on Canal and Structure Investment

A smaller freeboard is permissible, without the risk of overtopping; so:

- for new canals, design capacities can be met by smaller cross-sections, therefore lower construction costs
- for old canals, capacities through existing cross-sections can be increased
- for both old and new canals, higher heads are made available at turnouts

### Savings on Emergency Canal Repairs

Damage due to overtopping of banks is eliminated, because check structures equipped with Type "C" gates are always ready to operate instantly as needed, and are not subject to human or power failure.

Other unscheduled expenses are avoided because banks are no longer subject to dangerous under pressures caused by water level fluctuations. Also, wet lining is no longer periodically exposed to the sun.

### Savings on Maintenance

The Waterman Type "C" gate has only one sturdy moving part of strong, heavy-gauge steel

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## BENEFITS OF USING WATERMAN TYPE "C" GATES

plate; frame and bearings remain above water. It has been designed for easy access to all surfaces requiring paint.

Bottom flow past the gate reduces sediment deposits; side flow prevents the accumulation of trash at the check structure.

### Savings of Water in Distribution Networks

Canal operation becomes much simpler because manual intervention is unnecessary at Type "C" check structures. Thus a more accurate and far more flexible distribution system is available, reducing costly water waste.

Quiet	Efficient
Fast	Reliable
Automatic	Accurate
Expense-Free Operation	

... a system that knows how to adjust instantly to changing flows at any time.

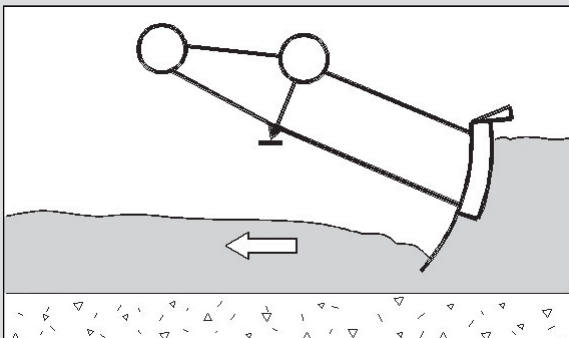
In addition, Waterman Type "C" gates have been designed to complement the esthetic appearance of water management projects. They give a feeling of balance and their pleasant silhouette blends well with canal landscaping.

## OPERATING PRINCIPLE

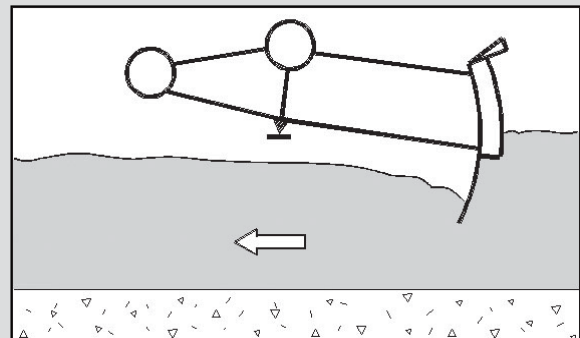
The Waterman Type "C" gate maintains the upstream water level constant for any given discharge.

The torques generated by the hydraulic thrust on the face plate and the weight of the gate are equal and opposite for all angular positions of the Waterman Type "C" gate only when the upstream water level is at the elevation of the gate trunnion axis.

As long as this condition is fulfilled, the gate will remain motionless, in complete equilibrium. Whenever the flow varies and the upstream water level has a tendency to rise or fall, the gate adjusts its opening immediately, automatically passing the exact discharge required to keep the upstream water level constant.



**SMALL FLOW**  
The gate is almost completely closed



**LARGER FLOW**  
The gate has opened to handle larger discharge

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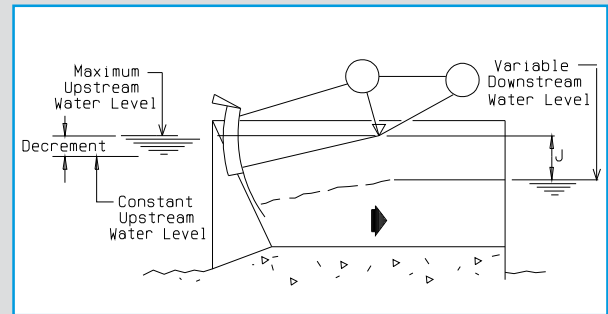
# UPSTREAM LEVEL CONTROL

## SELECTING YOUR WATERMAN TYPE "C" GATE

Type "C" gates are manufactured in 21 standard sizes, designated C-1 through C-21.

Plot on the chart below the point corresponding to:  
1. Maximum discharge to be handled at the gate.  
2. Minimum head differential available at maximum discharge for the equipped structure.

The gate to be selected is the smallest one (smallest index number) whose head-discharge curve, represented on the selection charts, encompasses the point plotted.



CONSULT THE FACTORY FOR THE GATE SELECTION CHART (HEAD DIFFERENTIAL VS. FLOW)

## EXAMPLES

### Example 1:

The water level must be kept constant at elevation 1650 cm in a canal, at a location where the maximum discharge is 3250 L/s. Maximum tailwater elevation is 1643 cm. Which gate is suitable?

The *minimum head differential* available for the equipped structure is  $J_m = 1650 - 1643 = 7$  cm. The Point on the chart corresponds to  $Q_m = 3250$  L/s and  $J_m = 7$  cm. The suitable gate size is the C-14.

Note that for a head differential of 7 cm, the C-14 capacity is 3520 L/s.

### Example 2:

The free surface elevation of a lake has to be maintained constant. The maximum discharge at the outlet is equal to 3250 L/s and the drop is 76cm. Which gate is suitable?

Plotting on the chart a point that corresponds to the above data, the suitable gate size is now the C-12.

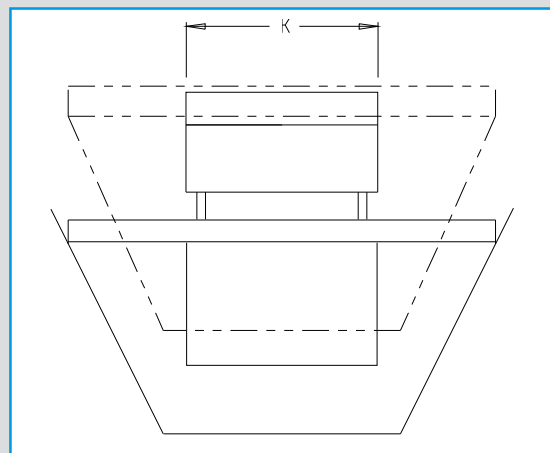
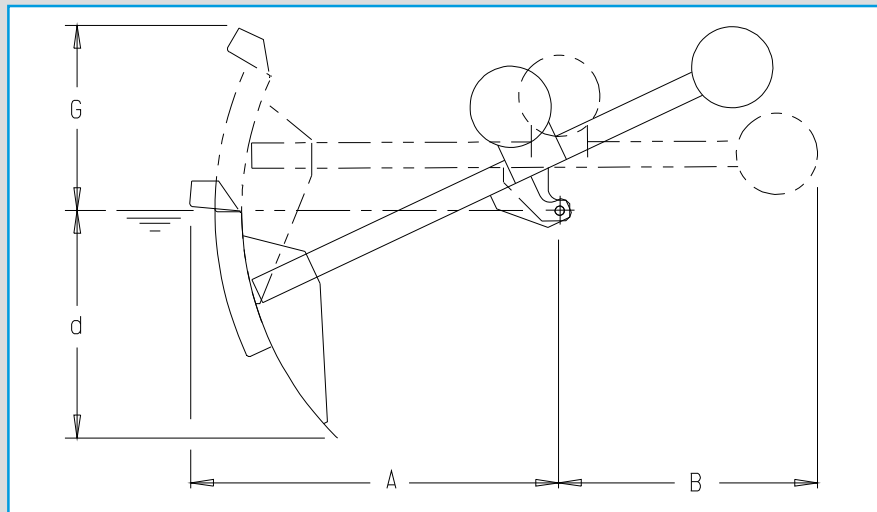
Note that the C-12 has a maximum capacity of 4000 L/s.

**Two or more Waterman Type "C" gates can be installed side by side (in parallel) to increase capacity, to reduce head differential or to better match structure and site.**

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# UPSTREAM LEVEL CONTROL

## WATERMAN TYPE "C" GATE OVERALL DIMENSIONS AND CLEARANCES



MODEL	A	B	G	K	d
C-1	74	51	34	56	36
C-2	74	51	36	55	40
C-3	74	51	37	55	45
C-4	74	51	42	55	50
C-5	103	71	43	74	56
C-6	104	71	50	74	63
C-7	107	71	60	74	71
C-8	143	101	68	90	80
C-9	146	101	73	90	90
C-10	148	101	85	90	100
C-11	185	117	91	160	112
C-12	188	117	105	160	125
C-13	233	145	112	200	140
C-14	236	145	135	200	160
C-15	290	185	146	250	180
C-16	295	185	170	250	200
C-17	364	236	179	430	224
C-18	370	236	211	430	250
C-19	463	300	233	550	280
C-20	472	300	265	550	315
C-21	527	334	300	640	360

Dimensions in cm

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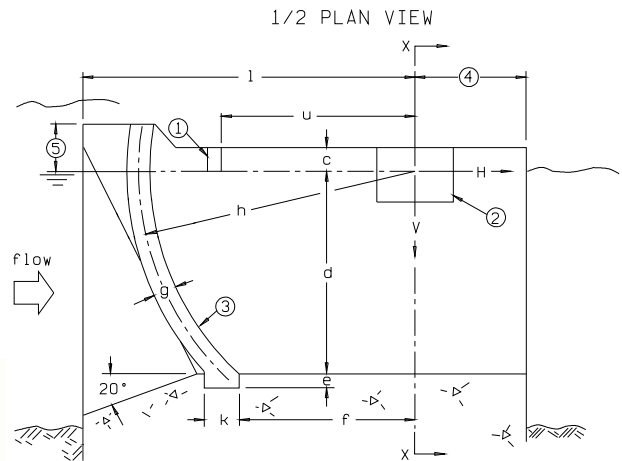
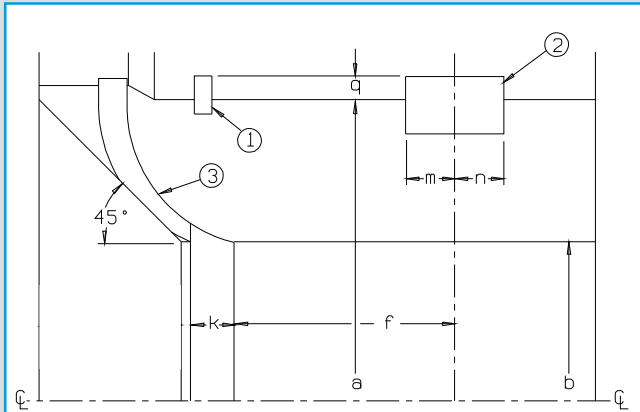
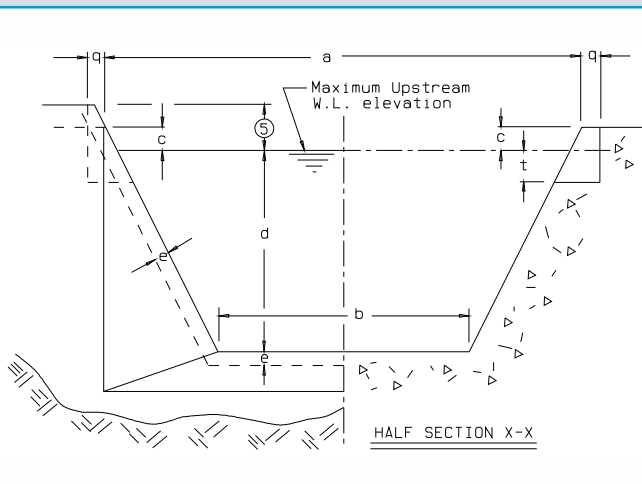
# UPSTREAM LEVEL CONTROL

## HOW TO DESIGN THE STRUCTURE

The leaf of Waterman Type "C" gate is shaped to a radial trapezium. The standard structure design is made up of a matching trapezium shaped sluice way and of upstream and downstream transitions.

Other structure designs may be used (for instance, to suit local site requirements) leading, perhaps, to slightly different hydraulic characteristics. In this case a layout should be submitted to Waterman for further advice.

All dimensions are related to the gate trunnion axis O. Remember that the elevation of this axis is also the nominal value of the maximum upstream W.L. to be controlled by the gate. Note that this W.L. can be adjusted, within the limits, after gate installation (to correct a small error in gate setting, or to control a different W.L., etc.)



- (1) On left bank only, for C-17 and larger.
- (4) Determined by structure stability and concrete strength requirements.
- (5) Freeboard according to local conditions.

Blockout areas (1), (2) and (3) are provided in first stage concrete for grouting in gate components. Grout to be smoothed out flush with wall surface.

H and V are horizontal and vertical components of gate thrust on each (one) bank.

Larger structure drawing, with additional details, available upon request.

	a cm	b cm	c cm	d cm	e cm	f cm	g cm	h cm	k cm	l cm	m cm	n cm	q cm	t cm	u cm	H kN	V kN
C-1	85	45	4	36						76	15	15	15	15	-	0.49	0.49
C-2	95	50	5	40						76	15	15	15	15	-	0.49	0.49
C-3	106	56	5	45	N/A	N/A	N/A	N/A	N/A	76	15	15	15	15	-	0.49	1.00
C-4	118	63	6	50						76	15	15	15	15	-	0.49	0.98
C-5	132	71	7	56						108	18	18	20	20	-	1.00	1.50
C-6	150	80	8	63	N/A	N/A	N/A	N/A	N/A	108	18	18	20	20	-	0.98	1.47
C-7	170	90	9	71						108	18	18	20	20	-	1.50	1.95
C-8	190	100	10	80	15	86	15	125	30	150	23	23	20	20	-	1.95	2.93
C-9	212	112	10	90	15	76	15	125	30	150	23	23	20	20	-	2.93	3.91
C-10	236	125	12	100	15	62	15	125	30	150	23	23	20	20	-	3.91	3.91
C-11	265	140	13	112	15	104	15	160	30	192	25	25	25	15	-	7.82	4.89
C-12	300	160	15	125	15	87	15	160	30	192	25	25	25	15	-	9.80	7.82
C-13	335	180	20	140	15	128	20	200	40	240	25	25	30	17	-	14.50	9.80
C-14	375	200	20	160	15	102	20	200	40	240	25	25	30	17	-	19.57	14.67
C-15	425	224	20	180	15	159	20	250	40	300	33	33	35	22	-	29.30	19.50
C-16	475	250	24	200	15	133	20	250	40	300	33	33	35	22	-	39.10	29.30
C-17	530	280	26	224	15	207	20	315	40	378	60	40	20	60	200	48.90	39.10
C-18	600	315	30	250	15	175	20	315	40	378	60	40	20	60	200	78.30	48.90
C-19	670	355	35	280	15	272	20	400	40	480	70	50	30	80	250	97.86	78.30
C-20	750	400	40	315	15	230	20	400	40	480	70	50	30	80	250	137.0	97.86
C-21	850	450	40	360	15	253	20	450	40	540	80	50	40	90	275	198.0	184.0

Dimensions are approximate and subject to change

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# UPSTREAM LEVEL CONTROL

## TYPICAL SPECIFICATIONS FOR TYPE "C"

**MANUFACTURER QUALIFICATION.** Gates shall be Waterman or approved equal in quality, characteristics and performance, of a manufacturer regularly engaged with a previous experience in manufacturing similar automatic level control gates of ten years prior to bid opening.

**GATE CONSTRUCTION.** The gate shall be designed to withstand the pressure forces produced by the upstream water level at its maximum elevation, with no tailwater. The gate shall mainly consist of a radially shaped faceplate, suitably reinforced and matching trapezoidal-shaped sluice way, a framework including the float and ballasting compartments, and two bearings to be anchored in the concrete structure. The gates shall include an adjustable counterweight, suitable for accurate, sensitive and stable gate operation. The gate shall be carefully checked and adjusted to tolerances required in the factory for straight forward field assembly, erection and proper operation.

### SUBMITTALS.

**Submittal Drawings.** Submittal drawings shall include a complete list of equipment and materials, including manufacturer's descriptive and technical literature, performance charts, catalog cuts, and installation instructions. Drawings shall show proposed layout and anchorage of the system and appurtenances, design of structure to receive gates and equipment relationship to other parts of the work including clearances for maintenance and operation. Submittal data shall include weights of the ballast which shall be supplied by the customer.

**Certificate of Compliance.** A certificate of compliance that the gates furnished are in conformance with the drawings and specifications shall be submitted to the project engineer.

**Operating Instructions.** Operating characteristics and instructions outlining procedure required for system start-up and system operation shall be furnished.

**Maintenance Instructions.** O&M manuals detailing the maintenance instructions and listing routine maintenance procedures, possible breakdown and repairs shall be submitted.

**SHIPMENT AND DELIVERY.** Gates shall be shipped from factory in components or sub-assemblies to be bolted together in the field to the exclusion of any field welding. The dimensions of individual components shall be compatible with rail or road transportations clearances. Match marks shall be provided on the heaviest components to facilitate field erection. When shipping and delivering gate components, the gate shall be handled carefully to ensure a sound, undamaged condition. Particular care shall be taken not to damage any coating.

**MATERIALS.** All materials used in construction of the gate shall be new and selected according to the best engineering practice for this type of equipment. The steel used in construction shall be DIN 17100 ST 37-2.

# UPSTREAM LEVEL CONTROL

## TYPICAL SPECIFICATIONS FOR TYPE "C"

**OPERATION REQUIREMENTS.** The gate shall operate automatically, regulating the upstream water level with no external power, motor or level sensors and hoists, and no manual intervention, under the desired head differential and flows, irrespective of the downstream level conditions, gate opening and discharge rates.

**SURFACE PREPARATION AND PAINTING.** Surface preparation shall consist of blast cleaning of all surfaces. Mechanical surfaces shall be protected by appropriate masking. Protective coating shall consist of:

- a. On machined surfaces, one coat of gasoline-soluble, rust-preventing compound.
- b. On all other surfaces, including surfaces to be grouted in, two coats of factory applied epoxy paint.



## UPSTREAM LEVEL CONTROL

**Q:** How accurately does the Waterman Type "C" gate maintain that constant upstream level?

**A:** A tolerance of 1.5 cm is readily obtained at maximum discharge.

**Q:** What happens if the incoming flow should accidentally exceed the gate's capacity?

**A:** The Waterman Type "C" gate will remain fully open, resting against its limit stop.

**Q:** How long does it take to install a Waterman Type "C" gate?

**A:** Once the concrete support structure is ready, erection of the gate and ballasting can be completed in one or two days.

**Q:** Are Waterman Type "C" gates watertight when closed?

**A:** Inasmuch as Waterman Type "C" gates have dispensed with any seals, a small leakage can be expected, but no more than 0.2%.

**Q:** How much maintenance do Waterman Type "C" gates require?

**A:** Practically maintenance free. Bearings and damper greased once a year, and gate repainted as necessary.

**Q:** Can reservoir capacity be increased by installing Waterman Type "C" gates on the spillway?

**A:** With Waterman Type "C" gates, more water can be stored because water surface is safely maintained at a higher level.

### WATERMAN TYPE "C" GATE TYPICAL APPLICATIONS

- |  |   |
|--|---|
| <b>Drainage Canals</b>                 | - Retainage of high water surface in the drainage system automatically provides for ground water recharge and wetlands management during dry seasons.   |
| <b>Recreation Lakes and Reservoirs</b> | - Water level is maintained in all seasons without sacrificing spillway capacity or reliability.  |
| <b>Flood Control</b>                   | - Automatic protection of flood zones by using the Waterman Type "C" Gate as an inlet to storm water retention system.  |
| <b>Irrigation Canals</b>               | - Automatic canal check gates for reliable turn-out control at all flows.   |
| <b>Wastewater Treatment</b>            | <ul style="list-style-type: none"><li>- With the Waterman Type "C" Gate placed at the outlet of a clarifier the water level can be raised without sacrificing flow capacity, thereby reducing the release of odorous gases.</li><li>- Flow through the headworks can be equalized during peak and off-peak hours by using the Waterman Type "C" or Adjustable Sliding Weir Gate as an automatic bypass.</li><li>- Automatic level control for U.V. disinfection channels.</li><li>- Automatic regulation of sedimentation basin levels during fluctuating flow rates.</li></ul> |
| <b>Hydro-Electric</b>                  | <ul style="list-style-type: none"><li>- Optimization of forebay levels while providing instant bypass during scheduled or unscheduled plant shut-downs.</li><li>- Increase hydro profitability by drawing stream diurnal flow increases into the forebay while maintaining minimum required fish and recreation flows in the stream.</li></ul>  |