Dam Simulation and Notification System

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December 7, 2024

Project Overview

The Dam simulation and notification system is designed to model the operation of a dam with functionalities related to water inflow, outflow, depth management, and automatic control. It involves menu-driven functions for changing control components like inlets, outlets, depth control, and dynamic simulation of the dam's water levels and pH over time. It alerts the user when the dam is full or dry, and allows modifications to basic parameters such as depth, and the number of inlets and outlets.

Objective

To simulate and manage the operations of a dam system, focusing on monitoring and controlling water inflow, outflow, and overall water level.

Features/Functionality

- Update inlet data
  - To be recorded from external devices and feeded.
- Operate outlets
  - Change the gate open status from 0 to 100 percent
- Simulate for desired time
  - Give the state of dam after desired time
- Autopilot
  - Changes state of outlets maintain constant water volume
- Change depth of the dam
- Include new outlets or inlets
- Calculate present water volume, pH of water, and water level affected by:
  - Inlets
  - Outlets
  - Erosion/deposition
- Check dam
  - Open outlets to 90 percent if dam is full
  - Closes all the outlets if dam is dry

- Update depth matrix based on outlet and inlet actions:
  - Erosion due to outgoing water from outlets will increase depth of area near the outlet
  - Deposition of particles in incoming water of inlets will decrease the depth of area near the inlets
- Print a size-reduced depth matrix if it is too large to display

Classes and its Contents

Class	Data Members	Attributes or Member Functions
Dam	Name, Location, Current water level, Inlets, Outlets, Dam water, Depth matrix	validatevolume(int) const, bool validatecoordinates(const int, const int, int, int)const, bool addinletwater(Inlet&), bool reduceoutletwater(Outlet&), void adddepth(int), void Addoutlet(), void Addinlet(), void simulate(int), void autopilot(), bool checkdam()
Water	Volume, pH	void operator += (const Water&), void operator -= (const Water&), float validatepH(float)
Component	-	virtual void display(), virtual void operate(int), virtual ~Component();
Inlet	Index, Inlocation, Inflowrate, Incoming pH	void input(int val, int pval)
Outlet	Index, Max outflowrate, Status, Outlet volume	Outlet(), void operate(int)
Depth	Depth matrix, Area	int validatevolume(int), void calculatemaxdepth(), void calculatearea(), Depth& operator + (const int), Depth& operator - (const int), Depth& operator = (const Depth&), void updatedepth (int, int), void updatedepth (int, float), void reduce (Depth&) const
Dimension	Length, Breadth, maxdepth	Dimension(int, int, int)

Incorporation of OOP Concepts

Operator Overloading

- **Class Water:**
  - += to add different volumes of water with different pH to existing water and derive the resultant pH.
  - -= to remove a certain amount of water volume from the existing water.
- **Class Dam:**
  - << to display dam status.
  - >> to assign values to dam's changing parameters.
- **Class Depth:**
  - = to deep copy an object to another object.
  - + to add an integer to all elements in the depth matrix.
  - << to display the depth matrix.
  - >> to take the depth from the user and initialize all elements in the matrix to that value.

Function Overloading

- **Class Depth** has Updatedepth overloaded to perform the effect of:
  - Outlet water: void updatedepth (int, float)
  - Inlet water: void updatedepth (int, int)
- **Class Outlet** has Operate overloaded to update the status of the gate:
  - By custom percent from the user: void operate()
  - Automatically by the system: void operate(int)

Class Composition

- Class Dam is composed of classes Inlet, Outlet, Depth, and Water.

Data Encapsulation

- Methods and data members are meaningfully bound together in all classes.

Inheritance

- Class Depth is inherited from class Dimension to utilize the length, breadth, and max depth for dam data validation.

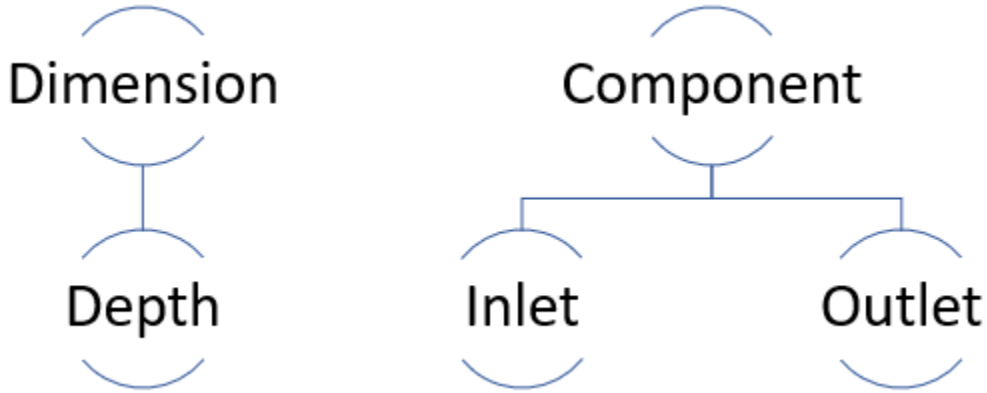
Polymorphism

- class component has pure virtual functions which are overrided by class Outlet and Inlet

Exception Handling

- For checking out of range values for number of outlets and inlets
- To get valid value from user while adding/subtracting depth in advanced settings

Class composition



Inheritance Hierarchy

Outputs and Expalnations

```
Enter Dam Name:
ABC
Enter Dam Location city:
XYX
Enter number of inlets and outlets of dam: 3 2
Enter Length, breadth: 20 20
Enter location of inlet 0 in depth coordinates: 19 4
Enter location of inlet 1 in depth coordinates: 4 0
Enter location of inlet 2 in depth coordinates: 17 19
Enter Max water discharge of outlets: 60
Enter maxdepth of dam: 8
Initial water stored and pH: 1600 7.145


                OPERATE
1-Dispaly dam status
2-Update inlets data
3-operate outlets
4-Simulate for n seconds
5-Auto pilot
6-Exit
7-Advanced Settings
 :1

##############################################
Name         : ABC
Location     : XYX
Water Stored : 1600 m^3
pH of water  : 7
Water Level  : 4 m/8.00 m
Inlets water supply:
0 0 0 m^3/s
Outlets water discharge:
0 0 m^3/s
Depth matrix(in metres):
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Fig 1: Initialised dam parameters and printed -

Fig 2: Updated inlet and outlet data

```
                OPERATE
1-Dispaly dam status
2-Update inlets data
3-operate outlets
4-Simulate for n seconds
5-Auto pilot
6-Exit
7-Advanced Settings
 :4
no of Seconds: 5

simulated for 5 seconds
##############################################
Name         : ABC
Location     : XYX
Water Stored : 1660 m^3
pH of water  : 7
Water Level  : 4.15 m/8.02 m
Inlets water supply:
50 70 0 m^3/s
Outlets water discharge:
60 48 m^3/s
Depth matrix(in metres):
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Fig 3: Simulated for 5 seconds and you can see the marked changes in depth matrix

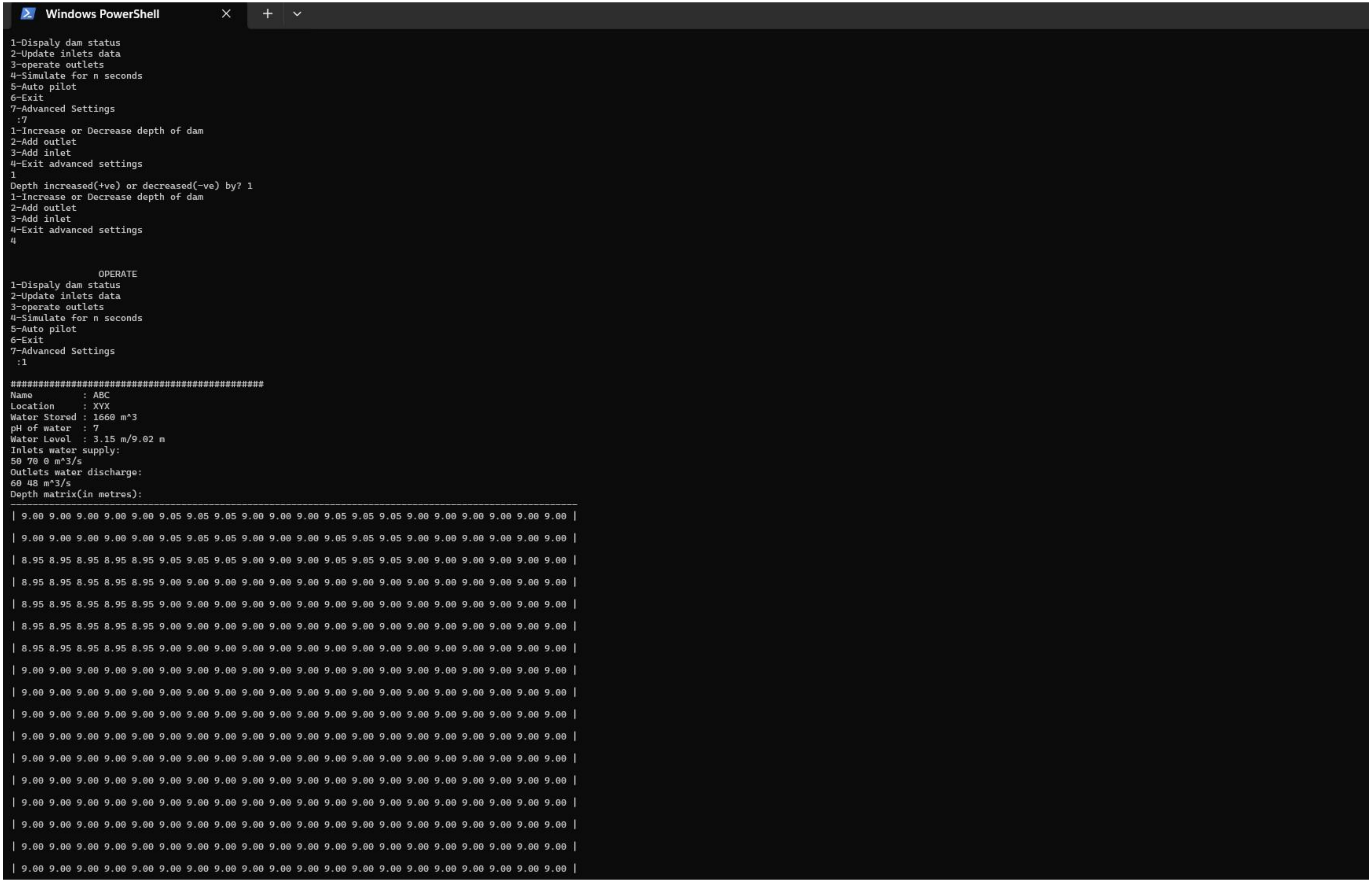

Fig 4: In Advanced settings increased depth by 1 and displayed the changes made to water level, max depth, depth matrix

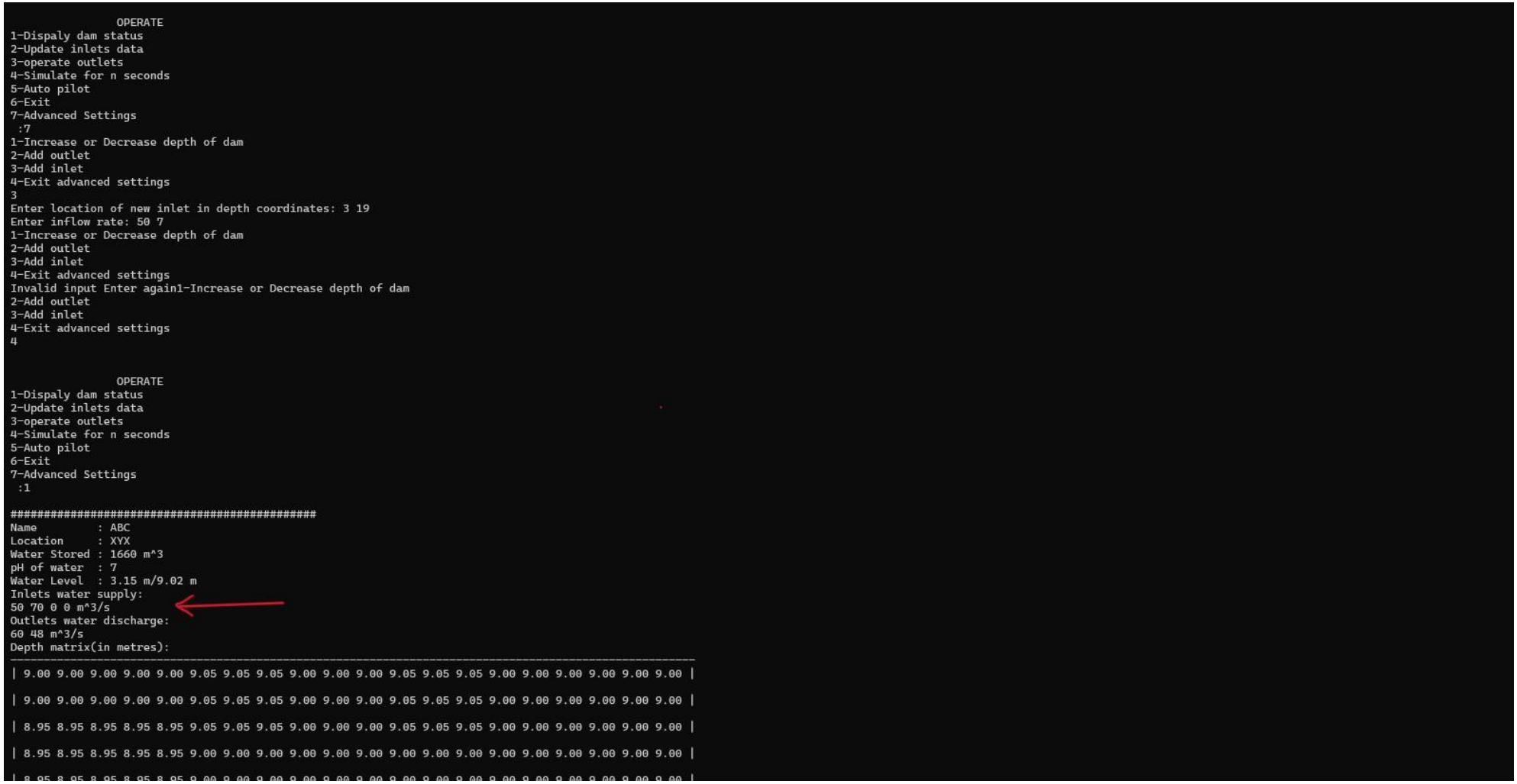

Fig 5: In Advanced settings a new inlets is added so now a one extra discharge rate is showing (previously 3 now 4)

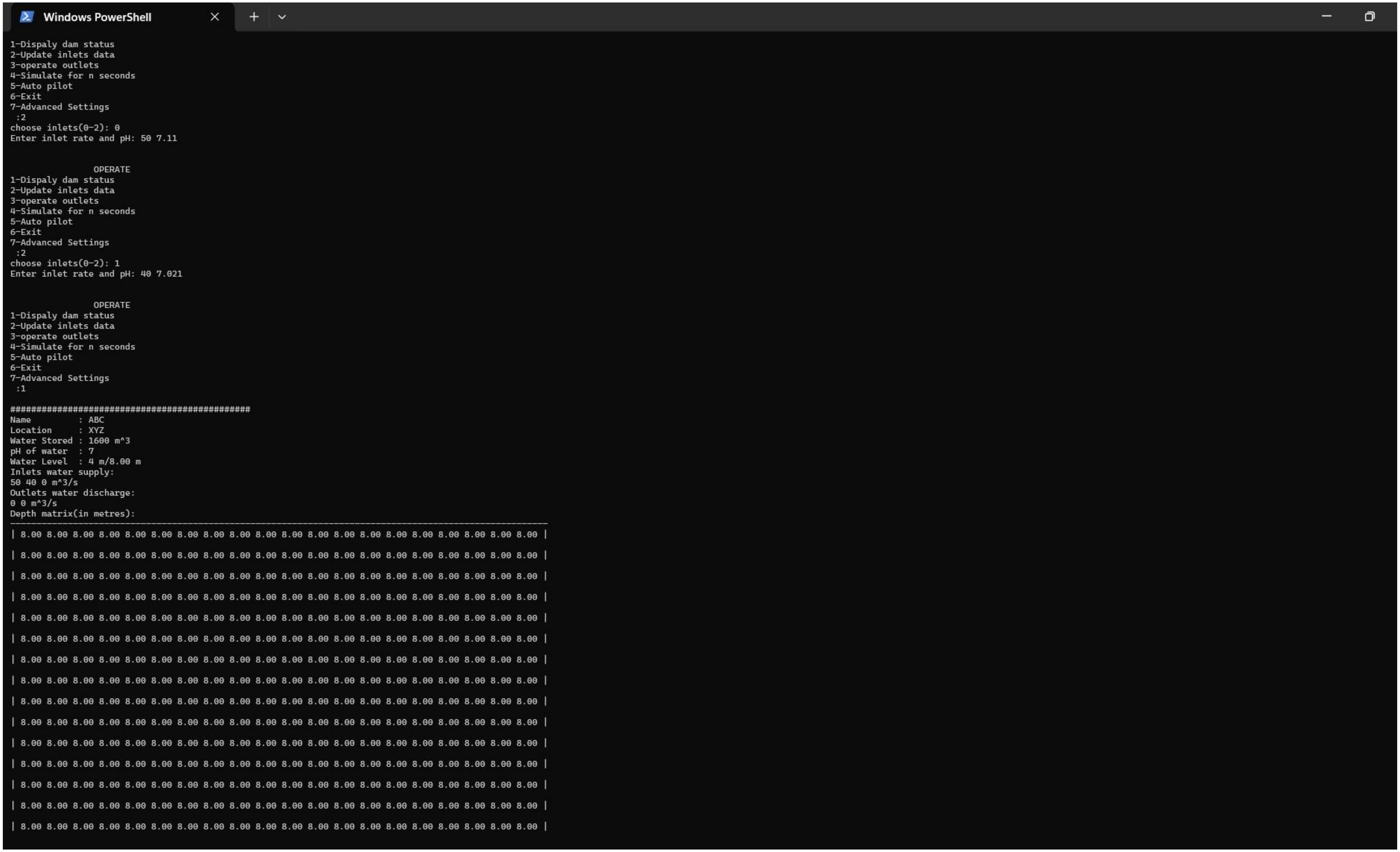

Fig 6: Initialized and displayed Dam status to test drive the Autopilot feature(next page)

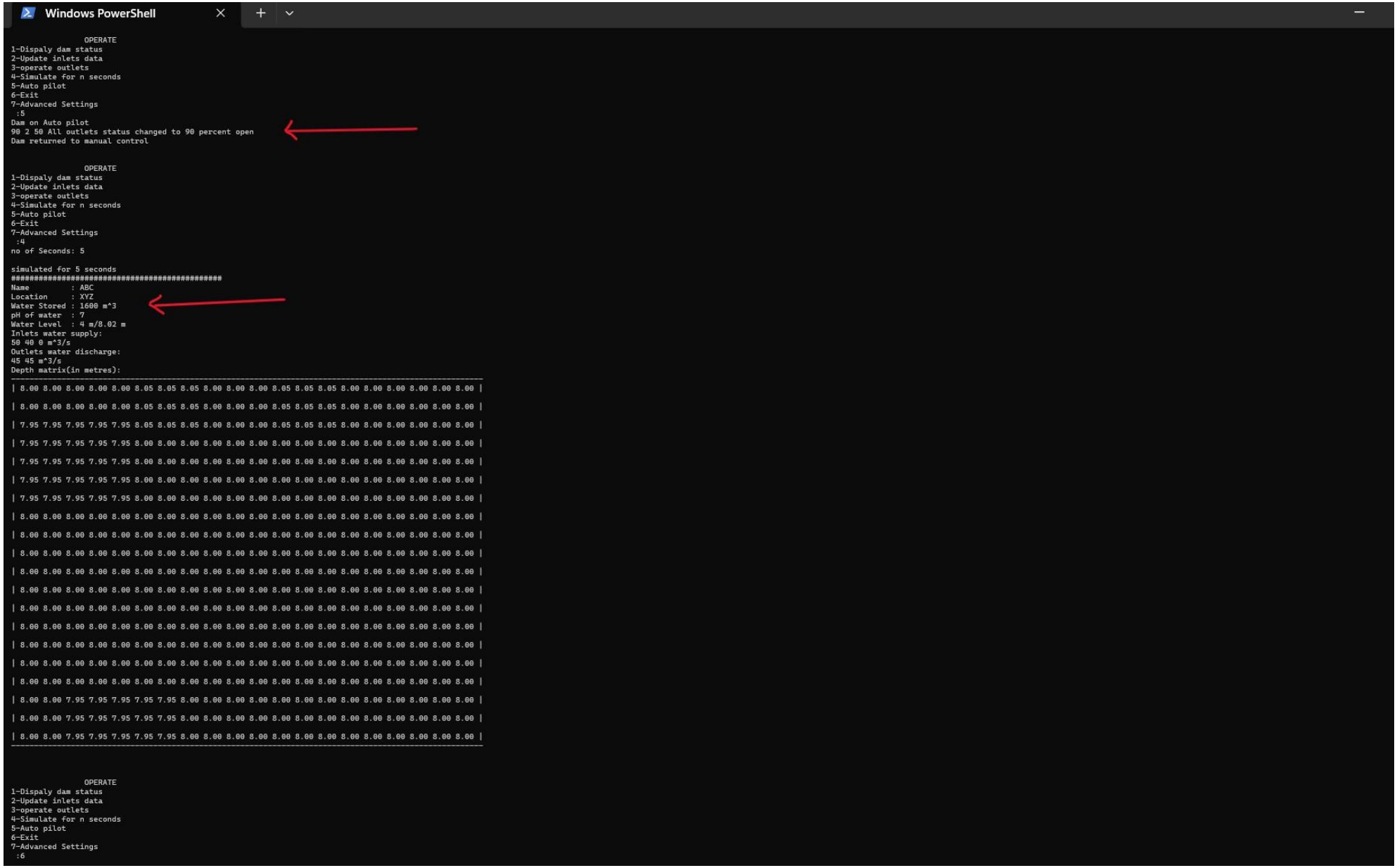

Fig 7: Auto pilot changed all outlets to open 90 percent to match the incoming water flow so, Even after simulating for a time the volume in dam remained constant

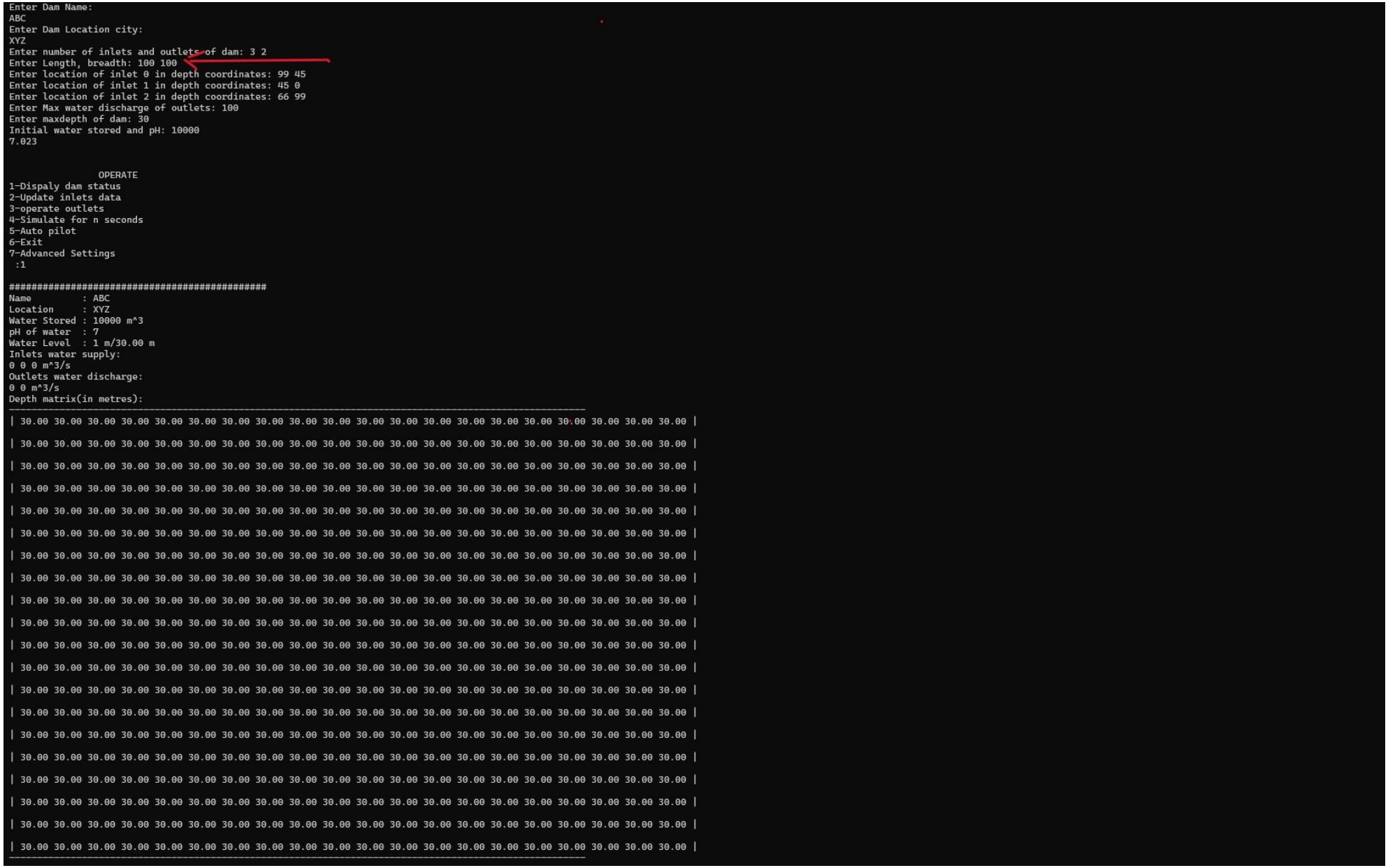

Fig 8: Even though the original matrix is 100 X 100 compressed form 20 X 20 is displayed

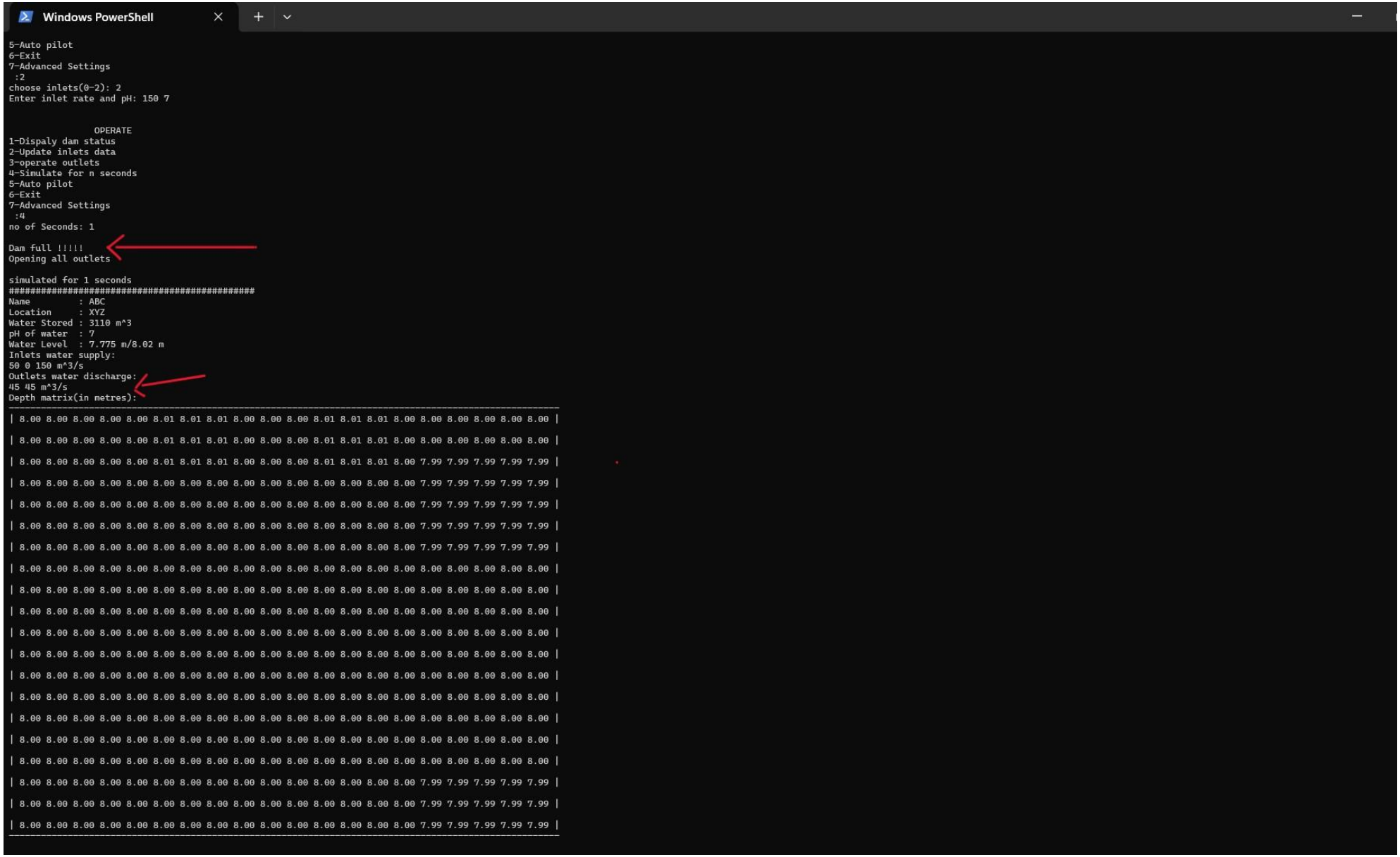

Fig 9: Dam is full notification is made and all oulets are opened 90 percent.

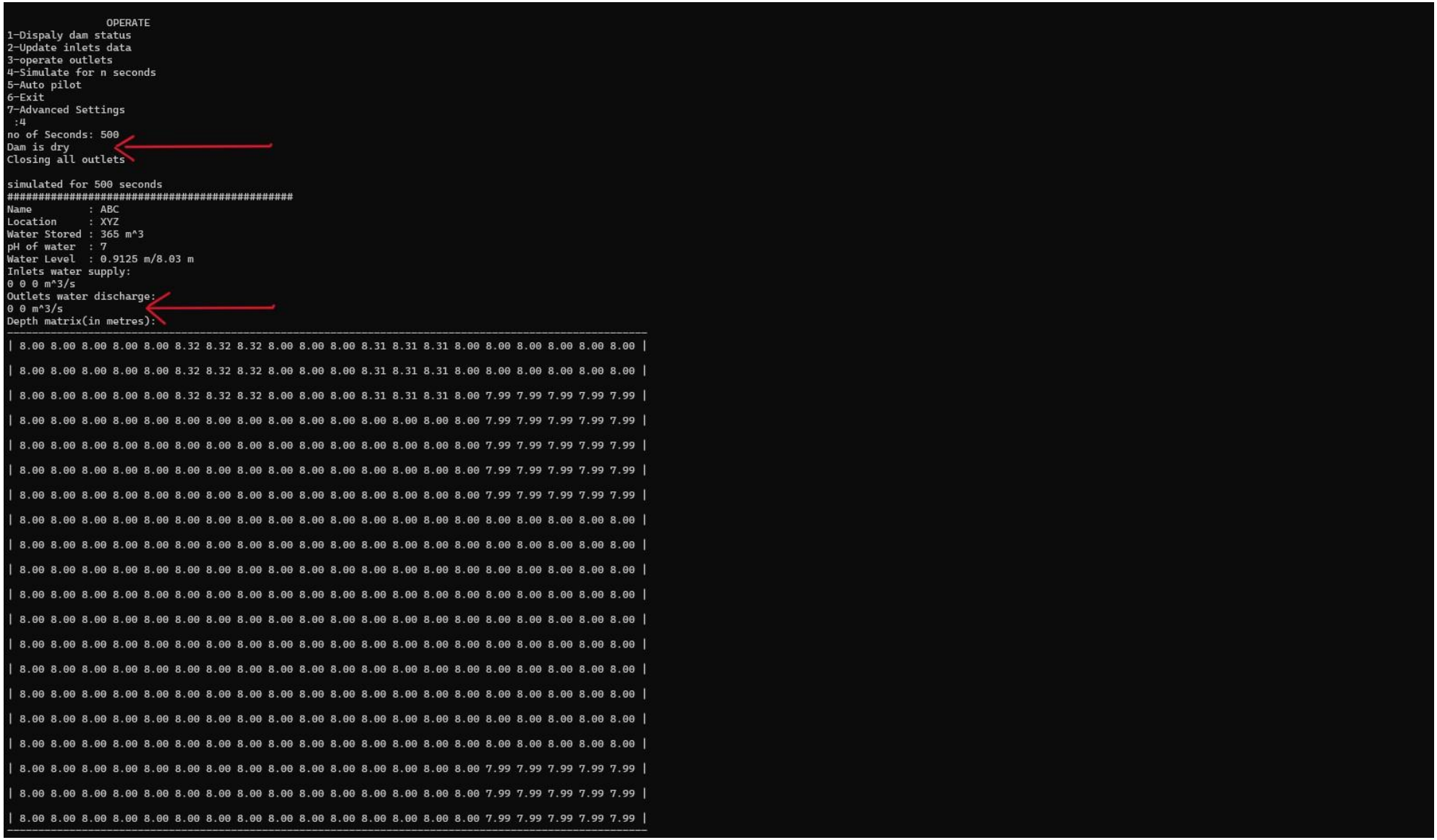

Fig 10: Dam is dry notification is made and all outlets are closed.

Exception Handling

```
1-Dispaly dam status
2-Update inlets data
3-operate outlets
4-Simulate for n seconds
5-Auto pilot
6-Exit
7-Advanced Settings
 :3
choose outlets(0-1): 3
Invalid outlet index!
```

```
                    OPERATE
1-Dispaly dam status
2-Update inlets data
3-operate outlets
4-Simulate for n seconds
5-Auto pilot
6-Exit
7-Advanced Settings
 :2
choose inlets(0-2): 4
Invalid inlet index!
```

```
1-Increase or Decrease depth of dam
2-Add outlet
3-Add inlet
4-Exit advanced settings
1
Depth increased(+ve) or decreased(-ve) by? fg
Invalid input! Please enter a valid integer.
```