## 4.6 System Testing

For the system testing, we conduct two types of tests: unit testing and integration testing.

# 4.6.1 Unit Testing

We conduct unit testing on the water level estimation algorithm, web application, and notification system as follow:

## 4.6.1.1 Water level estimation algorithm

In total, there are 13 test cases, with 5 cases for the Water level estimation algorithm and 8 cases for the Water level data insertion criteria.

Table 4.8 Water level estimation algorithm unit test cases from ID 1 to 5

П	Function	Priority	Description	Inputs	Expected output	Actual output	Test result
				1. Water level estimation algorithm	ithm		
1	Image	High	Verify the ability to	https://noc.nakhoncity.org/	PNG image file	PNG image file	Pass [Punn
	capturing		capture an image from the	live-cctv			10/05/ 2024
			Public Nakhon website				16:01]
2	Image	High	Verify that the system	PNG image file	Perspective corrected	Perspective corrected	Pass [Punn
	perspective		correctly applies		PNG image file	PNG image file	10/05/ 2024
	transformation		perspective transformation				16:12]
			to a 1140 mage me				
$\kappa$	Canny Edge	High	Verify that the system able	Perspective corrected PNG	Binary image of Canny	Binary image of Canny	Pass [Punn
	Detection		to detect edges on a	image file	edge detection result	edge detection result	10/05/ 2024
			perspective corrected				16:20]
			image				
4	Waterline	High	Verify that the system can	Binary image of Canny edge	y coordinate of waterline	y coordinate of waterline	Pass [Punn
	detection		correctly detect the	detection result	position	position	10/05/ 2024
			waterline in a binary				16:42]
			image of Canny edge				
			detection result				
5	Water level	High	Verify that the system able	y coordinate of waterline	Water level, water zone	Water level, water zone	Pass [Punn
	estimation		to estimate the water level	position, predefined y			10/05/ 2024
			based on the coordinate of	coordinates of water level and			16:55]
			the waterline position and	zone			
			the predefined water level				

Table 4.9 Water level estimation algorithm unit test cases from ID 6 to 8

	Function	Priority	Description	Inputs	Expected output	Actual output	Test result
				2. Water level data insertion criteria	ıteria		
9	Retrieve two latest water	High	Verify that two latest water level data can be	SELECT * FROM waterLevelRecord WHERE	["cctvID": "1", "dateTime": "2024-05-11	["cctvID": "1", "dateTime": "2024-05-11	Pass [Jidapa 11/05/2024
	level records		retrieved correctly from the "waterLevelRecord"	cctvID = 1 ORDER BY dateTime DESC LIMIT 2	09:02:01.000000 UTC", "waterLevel": "1",	09:02:01.000000 UTC", "waterLevel": "1",	09:03]
			database in Google Cloud BigQuery.		"zone": "0", "cctvID": "1",	"zone": "0", "cctvID": "1", "dateTime":	
					"dateTime":"2024-05-11 09:00:01.000000 UTC",	"2024-05-11 09:00:01.000000 UTC",	
					"waterLevel": "1", "zone": "0"]	"waterLevel": "1", "zone": "0"]	
7	Water level	High	Verify that if the	The actual water level from	Insert water level $= 1$ into	Insert water level $= 1$ into	Pass [Jidapa
	data insertion		difference between the	the water level estimation	the database.	the database.	11/05/2024
	criteria		actual water level and	algorithm and latest water			09:20]
	validation		latest water level exceeds	level. Given the actual water			
			±1 level, then replace the	level = 3 and $latest$ water			
			actual water level with the	eve  = 1			
			latest one and insert it to				
			the database.				
8	Water level	High	Verify that if the second	The actual water level from	Update the latest level = $1$	Update the latest level = $1$	Pass [Jidapa
	data insertion		latest level is lower than	the water level estimation	and insert the actual water	and insert the actual water	11/05/2024
	criteria		the latest level, and the	algorithm, latest, and second	level = 1 to the database	level $= 1$ to the database.	09:30]
	validation		second latest level	latest water level. Given the			
			matches the actual water	actual level = 1, latest level =			
			level, then update the	2, and second latest level = $1$			
			latest recorded level in the				
			database to match the				
			second latest level and				
			insert the actual water				
			level to the database				

 Table 4.10 Water level estimation algorithm unit test cases from ID 9 to 11

П	Function	Priority	Description	Inputs	Expected output	Actual output	Test result
				2. Water level data insertion criteria	iteria		
6	Water level	High	Verify that if the second	The actual water level from	Update the latest level = $3$	Update the latest level = 3	Pass [Jidapa
	criteria		the latest level, and the	algorithm, latest, and second	and insert the actual water level $= 3$ to the database.	and insert the actual water level $= 3$ to the database.	11/03/2024 09:40]
	validation		second latest level	latest water level. Given the			
			matches the actual water	actual level = 3, latest level =			
			level, then update the	2, and second latest level = $3$			
			latest recorded level in the				
			database to match the				
			second latest level and				
			insert the actual water				
			level to the database				
10	Water level	High	Verify that if the second	The actual water level from	Insert water level = $3$ into	Insert water level $= 3$ into	Pass [Jidapa
	data insertion		latest, latest, and actual	the water level estimation	the database	the database	11/05/2024
	criteria		water levels are all	algorithm, latest, and second			[05:60]
	validation		identical, then insert the	latest water level. Given the			
			actual water level into the	actual level = 3, latest level =			
			database	3, and second latest level = $3$			
11	Water level	High	Verify that if the second	The actual water level from	Insert water level = $2$ into	Insert water level $= 2$ into	Pass [Jidapa
	data insertion		latest level is lower than	the water level estimation	the database	the database	11/05/2024
	criteria		the latest level, and the	algorithm, latest, and second			10:00]
	validation		latest level matches the	latest water level. Given the			
			actual water level, then	actual level = 2, latest level =			
			insert the actual water	2, and second latest level $= 1$			
			level to the database.				

Table 4.11 Water level estimation algorithm unit test cases from ID 12 to 13

	Function	Priority	Priority Description	Inputs	Expected output	Actual output	Test result
				2. Water level data insertion criteria	iteria		
12	Water level	High	Verify that if the second	The actual water level from	Insert water level = $2$ into	Insert water level = $2$ into	Pass [Jidapa
	data insertion		latest level is greater than	the water level estimation	the database	the database	11/05/2024
	criteria		the latest level, and the	algorithm, latest, and second			10:10]
	validation		latest level matches the	latest water level. Given the			
			actual water level, then	actual level = 2, latest level =			
			insert the actual water	2, and second latest level = $3$			
			level to the database				
13	Water level	High	Verify that if no case is	The actual water level from	Insert water level = $2$ into	Insert water level = $2$ into	Pass [Jidapa
	data insertion		matched, then insert the	the water level estimation	the database	the database	11/05/2024
	criteria		actual water level to the	algorithm, latest, and second			10:30]
	validation		database	latest water level. Given the			
				actual level = 2, latest level =			
				1, and second latest level $= 1$			

In the unit testing of the water level estimation algorithm, which consists of 13 test cases, we found that all test cases successfully passed. This indicates that the algorithm works correctly and provides accurate results.

#### 4.6.1.2 Web application

We conduct unit testing on two components of the web application: the Front-end and APIs. In total, there are 28 test cases, with 25 cases for the front-end and 3 cases for the APIs.

#### 1. Front-end unit testing

Our web application comprises three main pages: Homepage, Dashboard, and Manual. We conduct unit testing for components and features across all three pages, totaling 25 test cases. Specifically, there are 8 test cases for the Homepage, 11 for the Dashboard, and 2 for the Manual page. Additionally, each page undergoes 2 general test cases, and there are 2 test cases dedicated to user devices.

Table 4.12 Front-end unit test cases from ID 14 to 18

П	Function	Priority	Description	Inputs	Expected output	Actual output	Test result
				1. All pages			
14	Launch website	High	Verify that the website can be	http://27.254.145.207/	Website homepage	Website homepage	Success- fully
			accessed via web browsers				launch on all
			such as Microsoft Edge,				web browsers
			Google Chrome, Mozilla				[Jidapa 04/04/
			Firefox, and Safari using the				2024 11:14]
			link.				
15	Verify	High	Verify that clicking each	Clicking each navigation	It directs to the correct	All clicked tabs direct to	Pass [Jidapa
	navigation tab		navigation tab leads to the	tab, including Home,	page corresponding to the	their correct pages.	04/04/ 2024
	click		correct page.	Dashboard, and Manual.	clicked tab.		11:30]
				2. Homepage			
16	Verify the	High	Verify that all elements on the	Access the homepage	The homepage loads	The homepage loads	Pass [Jidapa
	loading of the		homepage load correctly		without errors, and all	correctly, and all elements	04/04/ 2024
	homepage		without any errors within a		page elements are visible	are displayed in less than	11:50]
			1-minute interval.		within a 1-minute interval.	2 seconds.	
17	Language	High	Verify that when selecting a	Clicking the language	The content changes based	The content changes	Pass [Jidapa
	selection		language, the content will	option within the	on the selected language.	correctly based on the	05/04/ 2024
			change correctly according to	navigation tab		selected language.	10:00]
			the selected language.				
18	CCTV camera	High	Verify that clicking to select a	Selecting each CCTV	It displays the water level	It displays the water level	Pass [Jidapa
	location		CCTV camera location from	camera location from the	data corresponding to the	data corresponding to the	05/04/ 2024
	selection		the drop-down menu on the	drop-down menu	selected CCTV camera	selected CCTV camera	10:30]
	drop-down		homepage will display the		correctly.	correctly.	
	menn		water level data correctly for				
			each selected CCTV camera.				

 Table 4.13 Front-end unit test cases from ID 19 to 23

2. Homepage  Clicking on each CCTV  camera icon on the map  ata,  to Selecting a year for  records from the  drop-down menu  Clicking the download  button after selecting a  CCTV camera and year  from the drop-down menu  CCTV camera and year  from the drop-down menu  CCTV camera and year  from the drop-down menu  button after selecting a  CCTV camera and year  from the drop-down menu  At 11:32, the water level  and 11:32.  At 11:32, the water level  and 11:32.	ID	Function	Priority	Description	Inputs	Expected output	Actual output	Test result
CCTV camera Low Verify that when elicking on a Clicking on each CCTV It switches to a different icon map map to care a not the map map, located on the map message regarding CCTV camera data, allowing for a single selection.  Year selection High Verify that users can click to drop-down menu aderated a year for downloading water level menu homepage.  Download High Verify that the downloading downloading water level high variet level records from the drop-down menu on the drop-down menu on the houton button appears when both the drop-down menu selected.  Download High Verify that when clicking the CIrcking the download Historical water level data within the level data within the level data within a 1-minute interval.  Water level data in papears within the water level data within the downloaded onto the user's device in Excel file format within a 1-minute interval.  Water level High Verify that the water level data at 11:30 data is updated every two data updated and the update data is updated every two data updated.  Water level data is updated every two data is updated.					2. Homepage			
icons on the map located on the map located on the map located on the homepage, results in it changing to a different icon and displaying a message regarding CCTV camera data, allowing for a single selection High Verify that users can click to bounload High Verify that the downloading water level records from the houton button bu	19	CCTV camera	Low	Verify that when clicking on a	Clicking on each CCTV	It switches to a different	It switches to a different	Pass [Jidapa
map, located on the homepage, results in it changing to a different icon and displaying a message regarding CCTV camera data, allowing for a single regarding CCTV camera data, allowing for a single selection.  Year selection High Verify that users can click to Selecting a year for the drop-down menu on the drop-down menu on the drop-down menu on the drop-down menu on the homepage.  Download High Verify that the download Selecting a CCTV camera and year are button button appears when both the and year from the selected and water level data within the records historical water level data within the selected year range will be from the downloaded onto the user's device in Excel file format within a Liminute and II.32. Ha water level data is updated every two and II.32.  Water level High Verify that the water level data at II.30 data is updated. minutes on the homepage.		icons on the		CCTV camera icon on the	camera icon on the map	icon and displays a pop-up	icon and displays a pop-up	05/04/2024
changing to a different icon and displaying a message regarding CCTV camera data, allowing for a single selection.  Year selection High Verify that users can click to selecting a year for downloading water level records from the drop-down menu on the drop-down menu on the button appears when both the and year from the download High Verify that the download  Download High Verify that the download button appears when both the and year from the and year from the button appears when both the and year from the download button, historical water level data within the cords  Water level High Verify that the water level data within the water level data at 11:30 At 11:32, the water level data is updated every two and 11:32.  Water level High Verify that the water level water level data is updated every two and 11:32.  Water level data is updated every two		map		map, located on the		message regarding CCTV	message regarding CCTV	11:00]
regarding CCTV camera data, allowing for a single selection High Verify that users can click to drop-down menu menu Mere level records from the drop-down menu on the historical water  Download High Verify that when clicking the level data historical water level data  bownload High Verify that when clicking the level data download button historical water level data  water level data water level data within a 1-minute interval.  Water level High Verify that when clicking the download button and year from the drop-down menu  CCTV camera and year from the cords water level data within the cord data  Water level data  Water level High Verify that when clicking the download button historical water level data within a 1-minute interval.  Water level High Verify that water level water level data a 11:30 At 11:32, the water level data is updated.  Mater level data is updated every woo and 11:32.  Water level data is updated every woo and 11:32.				homepage, results in it		camera data.	camera data correctly.	
and displaying a message regarding CCTV camera data, allowing for a single selection  Year selection High Verify that users can click to button  Download High Verify that the download button  Download High Verify that the download button  Download High Verify that the download button  Download High Verify that when clicking the download historical water level data records  Download High Verify that when clicking the download historical water level data records  Mater level High Verify that when clicking the download data update  Mater level High Verify that when clicking the download data update  Mater level High Verify that when clicking the download data update  Mater level data  Mater level data at 11:30  Mater level data is updated every two minutes on the homepage.				changing to a different icon				
regarding CCTV camera data, allowing for a single selection.  Year selection High Verify that users can click to downloading water level records from the drop-down menu on the homepage.  Download High Verify that the download button button appears when both the button appears when both the level data water level data water level data and year are cords  Download High Verify that when clicking the download button thistorical water level data within the level data and year rank downloade onto the user's device in Excel file format within a 1-minute interval.  Water level High Verify that the water level data at 11:30. At 11:32, the water level data is updated every two data update minutes on the homepage.				and displaying a message				
Year selection   High   Verify that users can click to   Selecting a year for drop-down				regarding CCTV camera data,				
Year selection         High verify that users can click to downloading         Selecting a year for downloading downloading water level records from the drop-down menu on the button         Trecords from the drop-down menu.         It can select a year from the drop-down menu.           Download         High verify that the download         Selecting a CCTV camera button appears when both the lotton appears when both the lotton appears.         Selecting a CCTV camera and year are cordy and the lotton download button, historical water level data within the cords         CIcking the download onto the downloaded onto the user's device in Excel file format within a 1-minute interval.         CICTV camera and year range will be downloaded onto the user's device in Excel file format within a 1-minute interval.         At 11:32, the water level data is updated.           Walter level         High Verify that the water level water level data is updated every two minutes on the homepage.         Water level data at 11:30         At 11:32, the water level water level water level data is updated.				allowing for a single				
Year selection         High select a year for downloading mater level records from the drop-down menu on the homepage.         Selecting a CCTV camera and year are level data and year are level data         It can select a year from downloading water level the drop-down menu.           Download         High button appears when both the button appears when both the selected.         Selecting a CCTV camera and year are drop-down menu selected.         The download button and year are drop-down menu selected.           Download         High Verify that when clicking the download button, historical water level data within the records         CCTV camera and year and year and year and year and year and year ange will be from the drop-down menu format within a 1-minute interval.         Historical water level data within the water level data at 11:30         At 11:32, the water level data is updated every two and 11:32.				selection.				
drop-down menu select a year for downloading downloading water level records from the drop-down menu on the homepage.  Download High Verify that the download button button appears when both the button cCTV camera and year are selected.  Download High Verify that when clicking the download historical water level data water level data within the records  Download High Verify that when clicking the download historical water level data within the selected year range will be from the drop-down menu selected year range will be from the drop-down menu water level data is updated every two and 11:32. He water level data is updated every two minutes on the homepage.	20	Year selection	High	Verify that users can click to	Selecting a year for	It can select a year from	It can select a year from	Pass [Jidapa
menu         water level records from the drop-down menu on the homepage.         records         from the drop-down menu on the homepage.         records         Free conds         Perify that the download button appears when both the button appears when both the button and year are cords.         Selecting a CCTV camera and year from the and year from the and year from the drop-down menu.         The download button historical water level data           Download         High         Verify that when clicking the download button, historical water level data         CIcking the download onto the user's downloaded onto the user's selected year range will be from the drop-down menu format within a 1-minute interval.         Interval.         Interval.           Water level         High         Verify that the water level data at 11:30         At 11:32, the water level data is updated every two and 11:32.         At 11:32, the water level data is updated.		drop-down		select a year for downloading	downloading water level	the drop-down menu.	the drop-down menu.	05/04/2024
Download High Verify that the download button button button appears when both the button button button appears when both the button appears when both the careful and year from the selected.   CCTV camera and year are careful and year from the drop-down menu   Selected		menn		water level records from the	records from the			11:30]
Download       High       Verify that the download       Selecting a CCTV camera       The download button         Download       High       Verify that the download button appears when both the button appears when both the selected.       and year from the and year from the and year from the download button, historical water level data       Ariting the download button, historical water level data within the cecords       CCTV camera and year selecting a button after selecting a is downloaded onto the user's device in Excel file format         records       selected year range will be downloaded onto the user's device in Excel file format       from the drop-down menu format within a 1-minute interval.         Water level       High       Verify that the water level       Water level data at 11:30       At 11:32, the water level data is updated.         data update       minutes on the homepage.       and 11:32.       data is updated.				drop-down menu on the	drop-down menu			
Download         High button appears when both the button appears when both the button appears when both the selected.         Selecting and year from the and year from the and year from the and year from the selected.         The download button appears.           Download         High Verify that when clicking the download button, historical water level data historical water level data         CCTV camera and year level data within the ccords         CCTV camera and year is device in Excel file format         CCTV camera and year level data within a 1-minute interval.         At 11:32, the water level data within a 1-minute interval.           Water level         High Verify that the water level data is updated every two minutes on the homepage.         Water level data at 11:30         At 11:32, the water level data is updated.				homepage.				
button appears when both the drop-down menu selected.  Download High Verify that when clicking the download historical water level data water level data water level data within the records downloaded onto the user's device in Excel file from the drop-down menu downloaded onto the user's device in Excel file format within a 1-minute interval.  Water level High Verify that the water level data at 11:30 At 11:32, the water level data is updated every two minutes on the homepage.	21	Download	High	Verify that the download	Selecting a CCTV camera	The download button	The download button	Pass [Jidapa
CCTV camera and year are selected.  Download High Verify that when clicking the download historical water level data water level data water level data within the records downloaded onto the user's device in Excel file format within a 1-minute interval.  Water level High Verify that the water level data is updated every two and 11:32. He water level data is updated.  CCTV camera and year is downloaded onto the user's device in Excel file format within a 1-minute interval.  Water level High Verify that the water level data at 11:30 At 11:32, the water level minutes on the homepage.		button		button appears when both the	and year from the	appears.	appears.	05/04/2024
Download High Verify that when clicking the download historical water level data download button, historical water level data within the records downloaded onto the user's device in Excel file format within a 1-minute interval.  Water level High Verify that the water level data at 11:30 At 11:32, the water level data is updated every two minutes on the homepage.				CCTV camera and year are	drop-down menu			12:00]
Download historical waterHigh download button, historical water level dataVerify that when clicking the download button, historical water level dataClicking the download button after selecting a button after selecting a from the drop-down menu from the drop-down menu format within a 1-minute minutes on the homepage.Historical water level data from the downloaded onto the minutes on the homepage.Clicking the download from the download from the drop-down menu format within a 1-minute interval.Water level data updateHighVerify that the water level data is updated every two minutes on the homepage.Water level data at 11:30 and 11:32.At 11:32, the water level data is updated.				selected.				
historical water level data within the records water level data within the records selected year range will be from the drop-down menu format within a 1-minute device in Excel file format within a 1-minute interval.  Water level data update High Verify that the water level data is updated every two data update minutes on the homepage.	22	Download	High	Verify that when clicking the	Clicking the download	Historical water level data	Historical water level data	Pass [Jidapa
level data       water level data within the selected year range will be downloaded onto the user's       CCTV camera and year of from the drop-down menu format within a 1-minute downloaded onto the user's device in Excel file format       from the drop-down menu format within a 1-minute interval.         Water level       High       Verify that the water level data is updated every two data is updated every two minutes on the homepage.       Water level data is updated.       At 11:32, the water level data is updated.		historical water		download button, historical	button after selecting a	is downloaded onto the	is downloaded onto the	09/04/2024
records selected year range will be from the drop-down menu format within a 1-minute downloaded onto the user's device in Excel file format within a 1-minute interval.  Water level High Verify that the water level data at 11:30 At 11:32, the water level data is updated every two and 11:32.  Mater level High Verify that the water level data at 11:30 data is updated.  minutes on the homepage.		level data		water level data within the	CCTV camera and year	user's device in Excel file	device in Excel file format	10:00]
device in Excel file format       device in Excel file format       interval.         Water level       High       Verify that the water level data at 11:30       At 11:32, the water level data is updated every two and 11:32.         data update       minutes on the homepage.       and 11:32.       data is updated.		records		selected year range will be	from the drop-down menu	format within a 1-minute	in less than 40 seconds.	
Water levelHighVerify that the water levelWater level data at 11:30At 11:32, the water leveldata updatedata is updated every two minutes on the homepage.and 11:32.data is updated.				downloaded onto the user's		interval.		
Water level High Verify that the water level data at 11:30 At 11:32, the water level data update data is updated every two minutes on the homepage.				device in Excel file format				
Water levelHighVerify that the water levelWater level data at 11:30At 11:32, the water leveldata updatedata is updated every twoand 11:32.data is updated.minutes on the homepage.				within a 1-minute interval.				
data is updated every two and 11:32. data is updated. minutes on the homepage.	23	Water level	High	Verify that the water level	Water level data at 11:30	At 11:32, the water level	At 11:32, the water level	Pass [Jidapa
minutes on the homepage.		data update		data is updated every two	and 11:32.	data is updated.	data is updated.	09/04/2024
				minutes on the homepage.				11:32]

Table 4.14 Front-end unit test cases from ID 24 to 29

ID	Function	Priority	Description	Inputs	Expected output	Actual output	Test result
				3. Dashboard page			
24	Verify the	High	Verify that all elements on the	Access the dashboard	The dashboard page loads	The dashboard page loads	Pass [Jidapa
	loading of the		dashboard page load correctly	page	without errors, and all	correctly, and all elements	04/04/2024
	dashboard page		without any errors within a		page elements are visible	are displayed in less than	12:00]
			1-minute interval.		within a 1-minute interval.	30 seconds.	
25	Date selection	High	Verify that the dashboard can	Selecting a start and end	A start and end date are	A start and end date are	Pass [Jidapa
	on the		select a start and end date	date using a calendar or	selected.	selected.	09/04/2024
	dashboard		using a calendar or slider.	slider on the dashboard			11:50]
26	The available	Medium	Verify that the date range	Selecting 25/03/2024 as	The start date cannot be	The start date cannot be	Pass [Jidapa
	date range for		selection on the dashboard	the start date and	selected.	selected.	10/04/2024
	selection on the		should only allow users to	10/04/2024 as the end date			10:00]
	dashboard		choose dates within current				
			one-month period.				
27	The validity of	High	Verify that the dashboard only	Selecting 09/04/2024 as	The start date cannot be	The start date cannot be	Pass [Jidapa
	the date		allows selecting a start date	the start date and	selected.	selected.	10/04/2024
	selection on the		that comes before the end	05/04/2024 as the end date			11:00]
	dashboard		date.				
28	Single selection	High	Verify that the dashboard only	Clicking the first and	The second CCTV camera	The second CCTV camera	Pass [Jidapa
	option for		allows the selection of one	second CCTV camera	cannot be selected.	cannot be selected.	10/04/2024
	CCTV cameras		CCTV camera option at a	options			11:30]
	on the		time.				
	dashboard						
29	CCTV camera	High	Verify that when clicking on a	Clicking on a CCTV	The dashboard displays	The dashboard displays	Pass [Jidapa
	selection on the		CCTV camera option, the	camera option	data corresponding to the	data corresponding to the	11/04/2024
	dashboard		dashboard displays water		selected CCTV.	selected CCTV.	10:00]
			level data corresponding to				
			the selected CCTV.				
				*			

Table 4.15 Front-end unit test cases from ID 30 to 34

30 Water level criteria image on the dashboard 31 Stacked area chart on the	High					
	High		3. Dashboard page			
		Verify that the image	Clicking on a CCTV	The dashboard displays a	The dashboard displays a	Pass [Jidapa
		displaying water level criteria	camera option	water level criteria image	water level criteria image	11/04/2024
		corresponds correctly to the		corresponding to the	corresponding to the	10:30]
		selected CCTV camera.		selected CCTV.	selected CCTV.	
chart on the	High	Verify that the water level	Selecting 01/04/2024 as	The stacked area chart	The stacked area chart	Pass [Jidapa
		data on the stacked area chart	the start date and	displays water levels	displays water levels	11/04/ 2024
dashboard		is displayed within the	05/04/2024 as the end date	within 01/04/2024 to	within 01/04/2024 to	11:00]
		selected date range.	and clicking on a CCTV	05/04/2024.	05/04/2024.	
			camera option.			
32 Lowest and	High	Verify that the lowest and	Selecting 01/04/2024 as	The lowest water level is 1	The lowest water level is 1	Pass [Jidapa
highest water		highest water levels are	the start date and	and highest water level is	and highest water level is	11/04/2024
levels on the		displayed correctly according	10/04/2024 as the end	2.	2.	11:30]
dashboard		to the selected CCTV camera	date. The CCTV camera			
		and date range.	option is the Tha Yai			
			canal.			
33 Map on the	Low	Verify that each marker on the	Clicking on each CCTV	Position of each marker is	Position of each marker is	Pass [Jidapa
dashboard		dashboard map correctly	camera option	displayed correctly.	displayed correctly.	11/04/2024
		represents the latitude and				11:50]
		longitude of each CCTV				
		camera location.				
34 Dashboard	High	Verify that the dashboard	Dashboard and water level	At 13:45, the dashboard	At 13:45, the dashboard	Pass [Jidapa
update		updates its data every 15	data at 13:30 and 13:45.	updates the water level	updates the water level	11/04/2024
		minutes.		data.	data.	13:45]

Table 4.16 Front-end unit test cases from ID 35 to 38

35 Verify the loading of the manual page 36 Video tutorial Non the manual page 37 The Excel file Excel file 38 The name of Note the downloaded Excel file					4	
Verify the loading of the manual page Wideo tutorial on the manual page The downloaded Excel file The name of the downloaded Excel file			4. Manual page			
loading of the manual page Video tutorial on the manual page downloaded Excel file the downloaded Excel file	High	Verify that all elements on the	Access the manual page	The manual page loads	The manual page loads	Pass [Jidapa
Video tutorial on the manual page  The downloaded Excel file the downloaded Excel file		manual page load correctly		without errors, and all	correctly, and all elements	04/04/2024
Video tutorial on the manual page The downloaded Excel file the downloaded Excel file		without any errors within a		page elements are visible	are displayed in less than	14:00]
Video tutorial on the manual page  The downloaded Excel file the downloaded Excel file		1-minute interval.		within a 1-minute interval.	3 seconds.	
on the manual page  The downloaded Excel file the downloaded Excel file	Medium	Verify that the video tutorial is	Video tutorial	The video tutorial can be	The video tutorial can be	Pass [Jidapa
The downloaded Excel file the downloaded the downloaded Excel file		displayed for users to watch.		watched	watched	11/04/2024
The downloaded Excel file The name of the downloaded Excel file						14:00]
The downloaded  Excel file  The name of the downloaded			5. User's device			
downloaded Excel file The name of the downloaded Excel file	High	Verify that the downloaded	The downloaded Excel	The file can be opened	The file can be opened	Pass [Jidapa
Excel file The name of the downloaded		Excel file can be opened and	file	and contains water level	and contains water level	09/04/2024
The name of the downloaded		contains water level data		data within the selected	data within the selected	10:30]
The name of the downloaded		within the selected year range		year range, consisting of 5	year range, consisting of 5	
The name of the downloaded		consisting of 5 columns:		columns.	columns.	
The name of the downloaded		CCTV ID, CCTV camera				
The name of the downloaded		name, date and time, water				
The name of the downloaded		level, and zone.				
the downloaded	Medium	Verify that the Excel file	The downloaded Excel	The file name contains the	The file name contains the	Pass [Jidapa
Excel file		name contains the selected	file	selected CCTV ID and	selected CCTV ID and	09/04/2024
דיארפו ווופ		CCTV ID and year. For		year.	year.	11:00]
		instance, the file name should				
		be in the format "waterLevel-				
		Data_cctvId1_year 2024",				
		where the selected CCTV ID				
		is 1 and the selected year is				
		2024.				

In the unit testing of the front-end, which focuses on the three main pages, we conducted a total of 25 test cases. All cases passed, and some even yielded better results than expected. This indicates that the front-end works perfectly for all users.

#### 2. API testing

We have two APIs: one for retrieving water level data from the database and another for down-loading water level data to the user's device. The retrieval API communicates between the website and database, fetching data in JSON format using the GET HTTP method, which is then displayed on the front-end. The download API also communicates between the website and database, retrieving data and downloading it to the user's device in CSV format using the GET HTTP method. We conduct unit testing on both APIs. In total, we have three test cases: 2 test cases for the retrieval API and 1 test case for the download API.

Table 4.17 API unit test cases from ID 39 to 40

П	Priority	Description	HTTP	Inputs	Expected output	Actual output	Test result
			method				
				1. API for retrievi	1. API for retrieving water level data		
39	High	Verify that the	GET	http://27.254.145.207:8000/	["cctvID":1, "dateTime":	["cctvID":1, "dateTime":	Pass [Jidapa
		API can		waterLevel/latest	"2024-04-17 T09:02:00+00:00",	"2024-04-17 T09:02:01+00:00",	17/04/2024
		successfully			"waterLevel":1, "zone":0,	"waterLevel":1, "zone":0,	09:02]
		retrieve water			"cctvID":2, "dateTime":	"cctvID":2, "dateTime":	
		level data,			"2024-04-17 T09:02:00+00:00",	"2024-04-17 T09:02:01+00:00",	
		including CCTV			"waterLevel":2, "zone":0,	"waterLevel":2, "zone":0,	
		ID, date and time,			"cctvID":3, "dateTime":	"cctvID":3, "dateTime":	
		water level, and			"2024-04-17 T09:02:00+00:00",	"2024-04-17 T09:02:01+00:00",	
		zone of all three			"waterLevel":1, "zone":0]	"waterLevel":1, "zone":0]	
		CCTV cameras.					
40	High	Verify that the	GET	http://27.254.145.207:8000/	At 09:04, ["cctvID":1,	At 09:04, ["cctvID":1,	Pass [Jidapa
		API can retrieve		waterLevel/latest, At 09:02,	"dateTime": "2024-04-17	"dateTime": "2024-04-17	17/04/2024
		water level data		["cctvID":1, "dateTime":	T09:04:01+00:00",	T09:04:01+00:00",	09:10]
		updated every 2		2024-04-17	"waterLevel":1, "zone":0,	"waterLevel":1, "zone":0,	
		minutes and		T09:02:01+00:00";	"cctvID":2, "dateTime":	"cctvID":2, "dateTime":	
		query water level		"waterLevel":1, "zone":0,	"2024-04-17 T09:04:01+00:00",	"2024-04-17 T09:04:01+00:00",	
		data correctly		"cctvID":2, "dateTime":	"waterLevel":2, "zone":0,	"waterLevel":2, "zone":0,	
		from the 'water-		2024-04-17	"cctvID":3, "dateTime":	"cctvID":3, "dateTime":	
		LevelRecord'		T09:02:01+00:00";	"2024-04-17 T09:04:01+00:00",	"2024-04-17 T09:04:01+00:00",	
		database.		"waterLevel":2, "zone":0,	"waterLevel":1, "zone":0]	"waterLevel":1, "zone":0]	
				"cctvID":3, "dateTime":			
				2024-04-17			
				T09:02:01+00:00";			
				"waterLevel":1, "zone":0]			

Table 4.18 API unit test case for ID 41

Test result		Pass [Jidapa	17/04/2024	09:20]							
Actual output		The Excel file containing water	level data within a selected year	range and CCTV ID is	successfully downloaded to my	device. It comprises five	columns: CCTV ID, CCTV	camera name, date and time,	water level, and zone.		
Expected output	2. API for downloading water level data	http://27.254.145.207:8000/ The Excel file containing water	level data within a selected year	range and CCTV ID should be	successfully downloaded to my	device. It should comprise five	columns: CCTV ID, CCTV	camera name, date and time,	water level, and zone.		
Inputs	2. API for download	http://27.254.145.207:8000/	download/1/2024	Note: The number '1'	represents the selected	CCTV camera ID, and	'2024' represents the	selected year.			
HTTP method		GET									
Description		Verify that the	API can retrieve	water level data	for the selected	year and CCTV	camera, and save	the water level	data to the user's	device as an	Excel file.
ID Priority		High									
		41									

From the API unit testing, which includes 3 test cases, we found that the output results passed all tests. This indicates that the communication between each module works correctly, retrieving and transmitting data as expected.

#### 4.6.1.3 Notification system

For the notification system, we conduct unit testing with 20 test cases. Since the criteria for sending notification messages vary for each CCTV camera, detailed notification criteria can be found in the flowchart, as shown in Figure 3.26. Consequently, we conduct unit testing on each CCTV camera. We have a total of three CCTV cameras: CCTV ID 1 is Khlong Tha Yai, CCTV ID 2 is Khlong Na Muang, and CCTV ID 3 is Khlong Liap Thang Rot Fai. There are 4 test cases for CCTV ID 1, 4 test cases for CCTV ID 2, 4 test cases for CCTV ID 3, and 8 test cases for all CCTVs.

Table 4.19 Notification system unit test cases from ID 42 to 43

П	Function	Priority	Description	Inputs	Actual output	Test result
			1. All CCTV cameras	meras		
42	'waterLevelNotify' function in	High	Verify that Google Cloud	waterLevelNotify function	waterLevelNotify function is	Pass [Jidapa
	Google Cloud Function		Scheduler can execute the	in Google Cloud Function	executed every 10 minutes.	18/04/ 2024
			'waterLevelNotify' function in			09:40]
			Google Cloud Function every			
			10 minutes.			
43	getFiveLastestWaterLevelData() in	High	Verify that the 5 latest water	SELECT * FROM	[ "cctvID": "1", "dateTime":	Pass [Jidapa
	database.py		level data can be retrieved	depa-smartcity-	2024-04-18 09:48:01.000000	18/04/ 2024
			correctly from the	thailand.waterlevel.waterLe-	UTC", "waterLevel": "1",	09:50]
			'waterLevelRecord' database in	velRecord WHERE cctvID	"zone": "0", "cctvID": "1",	
			Google Cloud BigQuery.	= 1 ORDER BY dateTime	"dateTime": "2024-04-18	
				DESC LIMIT 5;	09:46:01.000000 UTC",	
					"waterLevel": "1", "zone": "0",	
					"cctvID": "1", "dateTime":	
					2024-04-18 09:44:01.000000	
					UTC", "waterLevel": "1",	
					"zone": "0", "cctvID": "1",	
					"dateTime": "2024-04-18	
					09:42:01.000000 UTC",	
					"waterLevel": "1", "zone": "0",	
					"cctvID": "1", "dateTime":	
					2024-04-18 09:40:01.000000	
					UTC", "waterLevel": "1",	
					"zone": "0" ]	

Table 4.20 Notification system unit test cases from ID 44 to 46

Test result		Pass [Jidapa	18/04/2024	09:52]			Pass [Jidapa	4-04-18 18/04/2024	JTC", 09:54]	•					Pass [Jidapa		JTC", 09:56]	•	vID":			JTC",	•	vID":		_		JTC",
Actual output		The mode is 1.					[ "cctvID": "1";	"dateTime": "2024-04-18	09:48:01.000000 UTC",	"waterLevel": "1",	"zone": "0"]				[ "cctvID": "1",	"dateTime": "2024-04-18	e- 09:38:01.000000 L	"waterLevel": "1",	"zone": "0", "cctvID":	"2", "dateTime":	2024-04-18	09:38:01.000000 UTC",	"waterLevel": "1",	"zone": "0", "cctvID":	"3", "dateTime":		2024-04-18	"2024-04-18 09:38:01.000000 UTC";
Inputs		5 latest water levels are	1,1,1,1, and 1.				The 5 latest water level	data and mode							SELECT * FROM	'depa-smartcity-	thailand.waterlevel.waterLe+ 09:38:01.000000 UTC",	velForNotify';										
Description	1. All CCTV cameras	Verify that the mode of the	5 latest water levels,	obtained from getFiveLat-	estWaterLevelData(), can	be correctly calculated.	After calculating the	mode, verify that the latest	water level record that	matches the mode is	returned to	checkAndNotify() as the	variable named	'currentWaterLevelData'.	Verify that the previous	water level data can be	retrieved correctly from	the 'waterLevelForNotify'	database.									
Priority		High					High								High													
Function		Calculate the mode of the water level in	checkAndNotify() function in main.py				findCurrentWaterLevelData() in main.py								getPreviousWaterLevelData() in database.py													
		44					45								46													

Table 4.21 Notification system unit test cases from ID 47 to 49

	Function	Priority	Description	Inputs	Actual output	Test result
			1. All CCTV cameras			
47	criteriaForNotify() in main.py	High	Verify that if no case is	CCTV ID, previous zone,	currentWaterLevelData is	Pass [Jidapa
			matched, then send	current zone, and current	sent to updateDatabase().	18/04/2024
			currentWaterLevelData to	water level that do not		13:30]
			updateDatabase().	match any cases.		
48	updateDatabase() in database.py	High	Verify that	Data from a variable	The data in the	Pass [Jidapa
			currentWaterLevelData is	named	'waterLevelForNotify'	18/04/2024
			updated to the	currentWaterLevelData	database is updated and a	14:00]
			'waterLevelForNotify'		success message is	
			database. If the update is		printed.	
			successful, return a			
			success message;			
			otherwise, return an error			
			message.			
49	sendLineNotify() in main.py	High	Verify that the notification	A message and https://	The message is	Pass [Jidapa
			message can be	notify-api.line.me/api/	successfully sent to Line	18/04/2024
			successfully sent to Line	notify	Notify.	14:30]
			Notify through the API			
			endpoint https://			
			notify-api.line.me/api/			
			notify using the POST			
			method.			

Table 4.22 Notification system unit test cases from ID 50 to 53

	Function	Priority	Description	Inputs	Actual output	Test result
			2. CCTV ID 1 (Khlong Tha Yai)	ai)		
95	criteriaForNotify() in main.py	High	Verify that if the CCTV ID is 1,	CCTV ID is 1, previous	A message is sent to	Pass [Jidapa
			previous zone is 0, current zone	zone is 0, current zone is	sendLineNotify(), and	18/04/2024
			is 1, and current water level is	1, and current water level	currentWaterLevelData is	10:10]
			3, then a message is sent to	is 3.	sent to updateDatabase().	
			sendLineNotify(), and			
			currentWaterLevelData is sent			
			to updateDatabase().			
51	criteriaForNotify() in main.py	High	Verify that if the CCTV ID is 1,	CCTV ID is 1, previous	A message is sent to	Pass [Jidapa
			previous zone is 1, current zone	zone is 1, current zone is	sendLineNotify(), and	18/04/2024
			is 2, and current water level is	2, and current water level	currentWaterLevelData is	10:20]
			6, then a message is sent to	is 6.	sent to updateDatabase().	
			sendLineNotify(), and			
			currentWaterLevelData is sent			
			to updateDatabase().			
52	criteriaForNotify() in main.py	High	Verify that if the CCTV ID is 1,	CCTV ID is 1, previous	A message is sent to	Pass [Jidapa
			previous zone is 2, and current	zone is 2, and current zone	sendLineNotify(), and	18/04/2024
			zone is 1, then a message is sent	is 1.	currentWaterLevelData is	10:30]
			to sendLineNotify(), and		sent to updateDatabase().	
			currentWaterLevelData is sent			
			to updateDatabase().			
53	criteriaForNotify() in main.py	High	Verify that if the CCTV ID is 1,	CCTV ID is 1, previous	A message is sent to	Pass [Jidapa
			previous zone is 1, and current	zone is 1, and current zone	sendLineNotify(), and	18/04/2024
			zone is 0, then a message is sent	is 0.	currentWaterLevelData is	10:40]
			to sendLineNotify(), and		sent to updateDatabase().	
			currentWaterLevelData is sent			
			to updateDatabase().			

Table 4.23 Notification system unit test cases from ID 54 to 57

criteriaForNotify() in main.py  55 criteriaForNotify() in main.py  56 criteriaForNotify() in main.py  57 criteriaForNotify() in main.py		riioiity	Describnon	sindini	Actual output	lest lesuit
		3. C	3. CCTV ID 2 (Khlong Na Muang)	(5)		
	H	High	Verify that if the CCTV	CCTV ID is 2, previous	A message is sent to	Pass [Jidapa
			ID is 2, previous zone is 0,	zone is 0, current zone is	sendLineNotify(), and	18/04/2024
			current zone is 1, and	1, and current water level	currentWaterLevelData is	10:50]
			current water level is 4,	is 4.	sent to updateDatabase().	
			then a message is sent to			
			sendLineNotify(), and			
			currentWaterLevelData is			
			sent to updateDatabase().			
	H	High	Verify that if the CCTV	CCTV ID is 2, previous	A message is sent to	Pass [Jidapa
			ID is 2, previous zone is 1,	zone is 1, current zone is	sendLineNotify(), and	18/04/2024
			current zone is 2, and	2, and current water level	currentWaterLevelData is	11:00]
			current water level is 7,	is 7.	sent to updateDatabase().	
			then a message is sent to			
			sendLineNotify(), and			
			currentWaterLevelData is			
			sent to updateDatabase().			
	H	High	Verify that if the CCTV	CCTV ID is 2, previous	A message is sent to	Pass [Jidapa
			ID is 2, previous zone is 2,	zone is 2, and current zone	sendLineNotify(), and	18/04/2024
			and current zone is 1, then	is 1.	currentWaterLevelData is	11:10]
			a message is sent to		sent to updateDatabase().	
			sendLineNotify(), and			
			currentWaterLevelData is			
			sent to updateDatabase().			
	H	High	Verify that if the CCTV	CCTV ID is 2, previous	A message is sent to	Pass [Jidapa
			ID is 2, previous zone is 1,	zone is 1, and current zone	sendLineNotify(), and	18/04/2024
			and current zone is 0, then	is 0.	currentWaterLevelData is	11:20]
			a message is sent to		sent to updateDatabase().	
			sendLineNotify(), and			
			currentWaterLevelData is			
			sent to updateDatabase().			

Table 4.24 Notification system unit test cases from ID 58 to 61

criteriaForNotify() in main py High Verify that if the CCTV D3 (Khlong Liap Thang Rot Fai)  High Verify that if the CCTV CTV ID is 3, previous  High Verify that if the CCTV C		Function	Priority	Description	Inputs	Actual output	Test result
High Verify that if the CCTV Dis 3, previous cane is 0, and current cone and current cone is 1, then an exerger is sent to and current cone is 1, then an exerger is sent to be current/WaterLevelData is sent to be current/WaterLevelData is sent to be current/WaterLevelData is sent to updateDatabase().  Sent to updateD			Carrons A	The state of the s			
criteriaForNotify() in main py  High Verify that if the CCTV Dis 3, previous one is 0, and current zone and current zone is 1, then is 1.  current/Warefl-evelData is sent to updateDatabase().  Exert to updateDatabase().  High Verify that if the CCTV Dis 3, previous and is 1, and current zone send LineNotify() and and current/Warefl-evelData is a message is sent to updateDatabase().  CCTV Dis 3, previous A message is sent to updateDatabase().  Sent to updateDatabase().  CCTV Dis 3, previous and is 2, then is 2.  Sent to updateDatabase().  CCTV Dis 3, previous and is 3, previous and is 1, and current zone send LineNotify(), and current zone is 1, and current zone send LineNotify(), and and current/Warefl-evelData is sent to updateDatabase().  High Werify that if the CCTV Dis 3, previous A message is sent to 1 bis 3, previous and is 2, and current zone send LineNotify(), and and current/Warefl-evelData is sent to updateDatabase().  CCTV Dis 3, previous A message is sent to an essage is sent to an essage is sent to updateDatabase().  High Werify that if the CCTV Dis 3, previous A message is sent to an essage is sent to an essage is sent to updateDatabase().  High Dis 3, previous zone is 2, and current zone send LineNotify(), and current zone is 1, and current zone send LineNotify(), and current zone is 1, and current zone send LineNotify(), and current zone is 1, and current zone send LineNotify(), and current zone is 1, and current zone send LineNotify(), and current zone is 1, and current zone send LineNotify(), and current zone is 1, and current zone send LineNotify(), and current zone is 1, and current zone send to updateDatabase().  Sent t				/ ID 3 (Khlong Liap Thang Re	ot Fai)		
Dis 3, previous zone is 0, and current zone and current zone is 1, then and current zone is 2, then and current zone is 3, previous zone is 1, and current zone zone is 1, and current zone zone is 2, then and current zone zone is 1, then zone zone is 1, then zone zone zone zone zone zone zone zo	28	criteriaForNotify() in main.py	High	Verify that if the CCTV	CCTV ID is 3, previous	A message is sent to	Pass [Jidapa
and current zone is 1, then is 1.  and current zone is 1, then is 1.  sent to updateDatabase().  sent to updateDatabase().  High Verify that if the CCTV  CTV ID is 3, previous  and current zone is 2, then is 2, and current zone sent to updateDatabase().  sent to updateDatabase().  To si 1, and current zone sent to an exage is sent to be an exage is sent to be an exage is sent to updateDatabase().  sent in to updateDatabase().  sent in the CCTV  CTV ID is 3, previous  and current zone is 2, and current zone sent to updateDatabase().  sent to updateDatabase().  By servious zone is 2, and current zone sent to be sent to and current zone is 1, and current zone sent to sent to an exage is sent to sent to sent to an exage is sent to sent to an exage is sent to sent involvity(), and current zone is 1, and current zone sent to updateDatabase().				ID is 3, previous zone is 0,	zone is 0, and current zone	sendLineNotify(), and	18/04/2024
a message is sent to current/MeterLevelData is current/MeterLevelData is sent to updateDatabase().  High Verify that if the CCTV  CCTV ID is 3, previous  Current/MeterLevelData is sent to updateDatabase().  But the CCTV  CCTV ID is 3, previous  Current/MeterLevelData is sent to updateDatabase().  But the CCTV  CCTV ID is 3, previous  Current/MeterLevelData is sent to updateDatabase().  But the CCTV  CCTV ID is 3, previous  Current/MeterLevelData is sent to updateDatabase().  CCTV ID is 3, previous  CCTV ID is 3, previous  CCTV ID is 3, previous  A message is sent to sendLineNotify(), and current/MeterLevelData is sent to updateDatabase().  Send in updateDatabase().  Send in updateDatabase().  CCTV ID is 3, previous  A message is sent to send in updateDatabase().  Sen				and current zone is 1, then	is 1.	currentWaterLevelData is	11:30]
eriteriaForNotify() in main.py  High Verify that if the CCTV  Di is 3, previous zone is 1, zone is 1, and current zone send LineNotify(), and and current zone is 2, then is 2.  Bern to updateDatabase().  Send LineNotify() in main.py  High Verify that if the CCTV  CCTV ID is 3, previous and current zone send LineNotify(), and current zone send to updateDatabase().  Send LineNotify() and in the CCTV  CCTV ID is 3, previous and current zone send to updateDatabase().  Send to updateDatabase().  But is 3, previous zone is 1, then is 1.  Send to updateDatabase().  High Verify that if the CCTV  CCTV ID is 3, previous and current zone is 2, and current zone send inteNaterLevelData is sent to updateDatabase().  Send to updateDatabase().  High Verify that if the CCTV  CTV ID is 3, previous and current zone is 0, then is 0.  Send in updateDatabase().  Send to updateDatabase().  Send to updateDatabase().  Send to updateDatabase().  Send to updateDatabase().  Sent to updateDatabase().				a message is sent to		sent to updateDatabase().	
criteriaForNotify() in main py High Verify that if the CCTV UE (CTV ID is 3, previous Bent to updateDatabase().  CriteriaForNotify() in main py High Verify that if the CCTV UE (CTV ID is 3, previous and current zone is 1, and current zone is 2, then is 2.  CriteriaForNotify() in main py High Verify that if the CCTV UE (CTV ID is 3, previous and current zone is 2, and current zone is 3, previous zone is 1, and current zone is 2, and current zone is 1, and				sendLineNotify(), and			
criteriaForNotify() in main.py High Verify that if the CCTV and current Zone is 1, and current zone and current Zone is 2, then is 2, then is 2.  criteriaForNotify() in main.py High Verify that if the CCTV CCTV ID is 3, previous  High Verify that if the CCTV CCTV ID is 3, previous  and current Zone is 2, and current zone send LineNotify(), and current zone criteriaForNotify() in main.py High Verify that if the CCTV CCTV ID is 3, previous  and current Zone is 2, and current zone send LineNotify(), and current zone send LineNotify(), and current zone send LineNotify(), and current zone and current Zone is 0, then and current Zone is 0, then and current Zone is 0, then is 0.  and current Zone is 0.  and				currentWaterLevelData is			
criteriaForNotify() in main py High Verify that if the CCTV D is 3, previous cone is 1, and current zone and current zone is 2.  a message is sent to sent to updateDatabase().  criteriaForNotify() in main py High Verify that if the CCTV B is 1.  a message is sent to updateDatabase().  criteriaForNotify() in main py High Verify that if the CCTV B is 1.  a message is sent to an exercise is 1, then a message is sent to updateDatabase().  criteriaForNotify() in main py High Verify that if the CCTV B is 1.  a message is sent to an exercise is 2, and current zone is 1, then a message is sent to be an exercise is 2, and current zone is 1, then a message is sent to be an exercise is 2, and current zone is 1, and current zone is 2, and current zone is 2, and current zone is 1, and current zone is 2, and current zone is 2, and current zone is 3, previous zone is 1, and current zone is 0, then is 0.  a message is sent to updateDatabase().  a message is sent to be an exercise is sent to an exercise is sent to an exercise is sent to be an exercise				sent to updateDatabase().			
Dis 3, previous zone is 1, and current zone and current zone is 2, then and current zone sendLineNotify(), and and current zone sendLineNotify(), and current zone sendLineNotify(), and current zone is 2, then to updateDatabase().  Example or criteriaForNotify() in main.py  CriteriaForNotify() in main.py  High Verify that if the CCTV  CriteriaForNotify() in main.py  High Verify that if the CCTV  CriteriaForNotify() in main.py  High Verify that if the CCTV  CriteriaForNotify() in main.py  High Verify that if the CCTV  CriteriaForNotify() in main.py  High Verify that if the CCTV  CriteriaForNotify() in main.py  High Verify that if the CCTV  CriteriaForNotify() in main.py  High Verify that if the CCTV  CriteriaForNotify() in main.py  High Verify that if the CCTV  CriteriaForNotify() in main.py  High Verify that if the CCTV  CriteriaForNotify() in main.py  CriteriaForNotify() in main.py  High Verify that if the CCTV  CriteriaForNotify() in main.py  CriteriaForNotify() in main.py  High Verify that if the CCTV  CriteriaForNotify() in main.py  CriteriaForNotify() in main.py  A message is sent to and current zone is 0, then is 0, and current zone sendLineNotify(), and current zone is 0, then is 0, and current zone sendLineNotify(), and current zone sendLineNotify(). and zone se	59	criteriaForNotify() in main.py	High	Verify that if the CCTV	CCTV ID is 3, previous	A message is sent to	Pass [Jidapa
and current zone is 2, then is 2.  and current water LevelData is sent to send time with the content of the content water LevelData is sent to updateDatabase().  This had and current zone is 1, then is 1.  By the current water LevelData is sent to send time water LevelData is sent to the current water LevelData is sent to send to updateDatabase().  The current water LevelData is sent to send to updateDatabase().  This had if the CCTV is 1.  The current water LevelData is sent to send to updateDatabase().  The current water LevelData is sent to updateDatabase().  This had if the CCTV is 1.  This had if the CCTV is 2, previous and current zone is 0, then is 0.  The current water LevelData is a message is sent to an exage is sent to updateDatabase().  The current water LevelData is sent to an exage is sent to updateDatabase().  The current water LevelData is sent to send LineNotify() and current zone is 0, then is 0.  The current water LevelData is sent to updateDatabase().				ID is 3, previous zone is 1,	zone is 1, and current zone	sendLineNotify(), and	18/04/2024
a message is sent to criteriaForNotify() in main.py High Verify that if the CCTV ID is 3, previous and current zone is 1, then sent to updateDatabase().  ID is 3, previous zone is 2, and current zone and current zone is 1, then sent to updateDatabase().  Sent to updateDatabase().  ID is 3, previous zone is 2, and current waterLevelData is a message is sent to updateDatabase().  Sent to updateDatabase().  Sent to updateDatabase().  High Verify that if the CCTV SendLineNotify(), and current zone is 1, and current zone and current zone is 0, then sent to updateDatabase().				and current zone is 2, then	is 2.	currentWaterLevelData is	11:40]
criteriaForNotify() in main.py       High       Verify that if the CCTV       CCTV ID is 3, previous       A message is sent to updateDatabase().         criteriaForNotify() in main.py       High       Verify that if the CCTV       CCTV ID is 3, previous       A message is sent to and current zone is 1, then is 1.         a message is sent to send current zone is 1, then sent to updateDatabase().       is 1.       sent to updateDatabase().         criteriaForNotify() in main.py       High       Verify that if the CCTV       CCTV ID is 3, previous       A message is sent to updateDatabase().         l D is 3, previous zone is 1, and current zone and current zone is 0, then a message is sent to updateDatabase().       a message is sent to updateDatabase().       currentWaterLevelData is sent to updateDatabase().				a message is sent to		sent to updateDatabase().	
criteriaForNotify() in main.py High Verify that if the CCTV D is 3, previous zone is 2, and current zone and current zone is 2, and current zone and current zone is sent to updateDatabase().  sendLineNotify() in main.py High Verify that if the CCTV D is 3, previous and current zone is 1, then is 1.  sent to updateDatabase().  sent to updateDatabase().  High Verify that if the CCTV D is 3, previous and current zone is 1, then is 1.  sent to updateDatabase().  sendLineNotify() and current zone is 1, then is 0.  sendLineNotify(), and current zone is 0, then is 0.  sendLineNotify(), and current zone is 0, then is 0.  sendLineNotify(), and current zone is 0, then is 0.  sendLineNotify(), and current zone is 0, then is 0.  sendLineNotify(), and current zone is 0, then is 0.  sendLineNotify(), and current zone is 0, then is 0.  sendLineNotify(), and current zone is 0, then is 0.  sendLineNotify(), and current zone is 0, then is 0.  sendLineNotify(), and current zone is 0, then is 0.  sendLineNotify(), and current zone is 0, then is 0.  sendLineNotify(), and current zone is 0, then is 0.  sendLineNotify(), and current zone is 0, then is 0.  sendLineNotify(), and current zone is 0, then is 0.				sendLineNotify(), and			
criteriaForNotify() in main.py High Verify that if the CCTV ID is 3, previous ID is 3, previous zone is 2, and current zone and current zone is 1, then and current zone is 1, then sendLineNotify(), and currentWaterLevelData is sent to updateDatabase().  High Verify that if the CCTV ID is 3, previous sent to updateDatabase().  Righ Verify that if the CCTV ID is 3, previous sent to updateDatabase().  Righ Verify that if the CCTV ID is 3, previous and current zone is 1, and current zone sent to updateDatabase().				currentWaterLevelData is			
criteriaForNotify() in main.py High Verify that if the CCTV ID is 3, previous zone is 2, and current zone and current zone is 1, then and current zone is 1, then sendLineNotify(), and currentWaterLevelData is sent to updateDatabase().  High Verify that if the CCTV ID is 3, previous sent to updateDatabase().  High Verify that if the CCTV ID is 3, previous and current zone is 0, then and current zone is 0, then sendLineNotify(), and currentWaterLevelData is a message is sent to sendLineNotify(), and currentWaterLevelData is sent to updateDatabase().				sent to updateDatabase().			
ID is 3, previous zone is 2, and current zone and current zone is 1, then and current zone is 1, then an essage is sent to sendLineNotify(), and currentWaterLevelData is sent to updateDatabase().    ContentPart zone is 1, then is 1.	09	criteriaForNotify() in main.py	High	Verify that if the CCTV	CCTV ID is 3, previous	A message is sent to	Pass [Jidapa
and current zone is 1, then is 1.  and current zone is 1, then sent to send LineNotify(), and current Port Send LineNotify() in main.py  criteriaForNotify() in main.py  High Verify that if the CCTV  ID is 3, previous zone is 1, and current zone and current zone is 0, then is 0.  a message is sent to updateDatabase().  and current zone is 0, then is 0.  and current zone is 0, then is 0.  and current zone is 0, then is 0.  currentWaterLevelData is sent to updateDatabase().  sent to updateDatabase().  sent to updateDatabase().  sent to updateDatabase().				ID is 3, previous zone is 2,	zone is 2, and current zone	sendLineNotify(), and	18/04/2024
a message is sent to sendLineNotify(), and currentWaterLevelData is sent to updateDatabase().  CriteriaForNotify() in main.py High Verify that if the CCTV ID is 3, previous Dis 3, previous zone is 1, and current zone and current zone is 0, then is 0.  ReadLineNotify(), and currentWaterLevelData is sent to updateDatabase().  SendLineNotify(), and currentWaterLevelData is sent to updateDatabase().  Sent to updateDatabase().				and current zone is 1, then	is 1.	currentWaterLevelData is	11:50]
criteriaForNotify() in main.py  High Verify that if the CCTV ID is 3, previous ID is 3, previous zone is 1, and current zone and current zone is 0, then sendLineNotify(), and currentWaterLevelData is a message is sent to sendLineNotify(), and currentWaterLevelData is sent to updateDatabase().  sent to updateDatabase().				a message is sent to		sent to updateDatabase().	
criteriaForNotify() in main.py High Verify that if the CCTV ID is 3, previous ID is 3, previous zone is 1, and current zone and current zone is 0, then a message is sent to sendLineNotify(), and currentWaterLevelData is sent to updateDatabase().  sent to updateDatabase().				sendLineNotify(), and			
criteriaForNotify() in main.py High Verify that if the CCTV ID is 3, previous zone is 1, and current zone is 0, then and current zone is sent to sendLineNotify(), and currentWaterLevelData is sent to updateDatabase().  sent to updateDatabase().				currentWaterLevelData is			
criteriaForNotify() in main.py High Verify that if the CCTV ID is 3, previous zone is 1, and current zone and current zone is 0, then and current zone is 0, then send is 0.  a message is sent to sendLineNotify(), and currentWaterLevelData is sent to updateDatabase().  sendLineNotify(), and currentWaterLevelData is sent to updateDatabase().  sent to updateDatabase().				sent to updateDatabase().			
zone is 1, and current zone sendLineNotify(), and is 0. currentWaterLevelData is sent to updateDatabase().	61	criteriaForNotify() in main.py	High	Verify that if the CCTV	CCTV ID is 3, previous	A message is sent to	Pass [Jidapa
is 0. currentWaterLevelData is sent to updateDatabase().				ID is 3, previous zone is 1,	zone is 1, and current zone	sendLineNotify(), and	18/04/2024
				and current zone is 0, then	is 0.	currentWaterLevelData is	12:00]
sendLineNotify(), and currentWaterLevelData is sent to updateDatabase().				a message is sent to		sent to updateDatabase().	
currentWaterLevelData is sent to updateDatabase().				sendLineNotify(), and			
sent to updateDatabase().				currentWaterLevelData is			
				sent to updateDatabase().			

After conducting unit testing on the three modules—water level estimation algorithm (from tables 4.8, 4.9, 4.10, and 4.11), web application (including front-end testing from tables 4.12, 4.13, 4.14, 4.15, and 4.16, and API testing from tables 4.17 and 4.18), and the notification system (from tables 4.19, 4.20, 4.21, 4.22, 4.23, 4.24, and 4.26)—we found that each test case successfully returned the expected values and each module is ready for integration testing.

## 4.6.2 Integration Testing

We conduct integration testing with each module in three parts: water level estimation algorithm with the database, front-end with API connections, and notification system with the database. The details are shown in the table below.

#### 4.6.2.1 The water level estimation algorithm and database connection testing

Table 4.25 The water level estimation algorithm and database integration test cases from ID 62 to 63

	ID Function	Priority	Priority Description	Inputs	Expected output	Actual output	Test result
				Water level estimation algorithm - Database	- Database		
62	Insert water	High	Verify that new water	New water level data	All new water level data is	All new water level data is   All new water level data is   Pass [Jidapa	Pass [Jidapa
	level data to the		level data can be inserted		successfully inserted into	successfully inserted into	12/05/ 2024
	database		to the database.		the database.	the database.	10:30]
63	Update water	High	Verify that water level	New water level data	Water level data is	Water level data is	Pass [Jidapa
	level data in the		data can be updated with		successfully updated with	successfully updated with	12/05/ 2024
	database		new data in the database.		new data in the database.	new data in the database.	10:40]

4.6.2.2 The front-end and APIs connection testing

Table 4.26 The front-end and APIs integration test cases from ID 64 to 66

er 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4		Function	Priority	Description	Inputs	Expected output	Actual output	Test result
Fetch water High Verify that the front-end and http://27.254.145.207:8000/ Display the latest water level data from an API turn retrieves data from the web from an API, which in turn retrieves data from the web application.  Send selected High Verify that the front-end data on the web application.  Send selected High Verify that the front-end data download http://27.254.145.207:8000/ http://27.254.145.207: CCTV ID and can send selected CCTV download/selected CCTV download/selected CCTV download/selected CCTV Data data download http://27.254.145.207: Selected Year = 2024  API. API. and selected CCTV Data and selected Year = 2024  API. API. API. and successfully download from an API and successfully download from an API device. It should comprise five columns: CCTV ID should be device. It should comprise five columns: CCTV ID: CCTV ID: CCTV camera name, data contine.					2. Front-end - APIs			
level data from an API, which in turn retrieves data from the database, and then displays the water level data on the web application.  Send selected High Verify that the front-end data download the file to the device.	64	Fetch water	High	Verify that the front-end	http://27.254.145.207:8000/	Display the latest water	Display the latest water	Pass [Jidapa
an API from an API, which in turn retrieves data from the database, and then displays the water level data on the web application.  Send selected High Verify that the front-end dropdown options to an API dropdown options to an API High Verify that the front-end http://27.254.145.207:8000/ http://27.254.145.207:  Water level High Verify that the front-end http://27.254.145.207:8000/ http://27.254.145.207:  Water level High Verify that the front-end http://27.254.145.207:8000/ and selected/Year = 20.24  Water level High Verify that the front-end http://27.254.145.207:8000/ water level data within a selected data within a data download from an API and successfully downloaded to my device. It should be device.  API and successfully complex successfully downloaded to my device It should be device.  CCTV ID should be comprise five columns: CCTY ID. CCTY comprise five columns: CCTY ID. CCTY camera name, data and time, water level, and zone.		level data from		can fetch water level data	waterLevel/latest	level data on the web	level data on the web	12/05/2024
turn retrieves data from the database, and then displays the water level data on the web application.  Send selected High Verify that the front-end data ownload/selectedCCTVID/ sear to an API Water level High Verify that the front-end data download from an data download from an data download from an API download from an API and successfully download the file to the device.  In mane, and selected CCTV D should be device.  API.  API.  API.  API.  API.  API and successfully download from an API and successfully download the file to the device.  CCTV ID, Should be comprise five columns: CCTV ID, CCTV Camera  CCTV ID, CCTV Camera  CCTV ID, CCTV Camera  CCTV ID, Should be comprise five columns: CCTV ID, Stoke and time, water level, and zone.		an API		from an API, which in		application.	application.	10:50]
the database, and then displays the water level data on the web application.  Send selected High Verify that the front-end download/selected/CCTVID/ Send selected CCTV D and dopdown options to an API dopdown options to an API.  Water level High Verify that the front-end data download from an data download from an data download the file to the download the file to the device.  High API and successfully download the file to the device.  High API and successfully download the file to the device.  Send selected CCTV ID/27.254.145.207.8000/  Http://27.254.145.207.8000/  Http://27.254.145.207.8000/  API and successfully download the file to the download the file to the device.  CCTV ID should comprise five columns:  CCTV ID/CCTV camera name, date and time, water level, and zone.				turn retrieves data from				
Send selected High Verify that the front-end application.  Send selected High Verify that the front-end http://27.254.145.207:8000/ http://27.254.145.207:  CCTV ID and year from dropdown options to an API API.  Water level High Verify that the front-end http://27.254.145.207:8000/  Water level High Verify that the front-end http://27.254.145.207:8000/  Water level High Verify that the front-end http://27.254.145.207:8000/  API and successfully download/1/2024 successfully downloaded to my device. It should comprise five columns:  CCTV ID should be successfully device. It should comprise five columns:  CCTV ID, CCTV camera name, date and time, water level, and zone.				the database, and then				
Send selected High Verify that the front-end http://27.254.145.207:8000/ http://27.254.145.207:  CCTV ID and can send selected CCTV download/selectedCCTVID/ sono/download/1/2024  year to an API dropdown options to an delectedYear = 2024  Water level High Verify that the front-end http://27.254.145.207:8000/  Water level High Verify that the front-end http://27.254.145.207:8000/  Water level High Verify that the front-end download/1/2024 selected year range and can request water level download from an data download from an API and successfully downloaded device.  CCTV ID should be successfully comprise five columns:  CCTV ID, CCTV camera name, date and time, water level, and zone.				displays the water level				
Send selected High Verify that the front-end http://27.254.145.207:8000/ http://27.254.145.207:  CCTV ID and can send selected CCTV download/selectedCCTVID/ solf-oxdownload/1/2024  year to an API and year from dropdown options to an dropdown options to an and selected Year = 2024  Water level High Verify that the front-end http://27.254.145.207:8000/ The Excel file containing water level data download from an API and successfully download/1/2024 selected year range and device.  CCTV ID, should be successfully comprise five columns:  CCTV ID, CCTV CTV CTV Camera name, date and time, water level, and zone.				data on the web				
Send selected High Verify that the front-end http://27.254.145.207;  CCTV ID and can send selected CCTV download/selectedCCTVID/ selectedYear dropdown options to an API dropdown options to an date download High Verify that the front-end data download from an data download from an API and successfully download the file to the device.  Send selected CCTV ID and year from dropdown options to an elected Year and selected Year = 2024  API. API. API. Arther front-end http://27.254.145.207:8000/ The Excel file containing water level data within a selected year range and data download from an API and successfully download the file to the device.  CCTV ID should be successfully comprise five columns: CCTV ID, CCTV camera name, date and time, water level, and zone.				application.				
CCTV ID and       can send selected CCTV       download/selectedCCTVID/       8000/download/1/2024         year to an API       ID and year from dropdown options to an dropdown options to an an electedYear = 2024       API.       and selectedYear = 2024         Water level       High       Verify that the front-end data download from an data download from an data download from an download the file to the device.       API and successfully successfully downloaded to mane, date and time, comprise five columns:     CCTV ID should be successfully companied to mane, date and time, water level, and zone.	9	Send selected	High	Verify that the front-end	http://27.254.145.207:8000/	http://27.254.145.207:	http://27.254.145.207:	Pass [Jidapa
year to an API ID and year from selected Year dropdown options to an deceded Year and selected Year = 2024  Water level High Verify that the front-end data download from an data download from an data download the file to the device.  API and successfully download to my device. It should comprise five columns:  CCTV ID, CCTV CATOR CATO		CCTV ID and		can send selected CCTV	download/selectedCCTVID/	8000/download/1/2024	8000/download/1/2024	12/05/2024
Water level       High       Verify that the front-end data download       i, Given selected CCTVID = 1         Mater level       High       Verify that the front-end data download from an data download from an data download from an device.       Inhtp://27.254.145.207.8000/       The Excel file containing water level data within a selected year range and CCTV ID should be successfully downloaded device.     API and successfully  download the file to the device.  CCTV ID, CCTV camera name, date and time, water level, and zone.		year to an API		ID and year from	selectedYear			11:00]
Water level       High       Verify that the front-end data download       http://27.254.145.207:8000/       The Excel file containing         data download       can request water level data within a data download from an API and successfully       download from an selected year range and correspond to the file to the download the file to the device.         device.       device.       comprise five columns: CCTV ID, CCTV camera name, date and time, water level, and zone.				dropdown options to an	, Given selectedCCTVID = 1			
Water level       High       Verify that the front-end data download       http://27.254.145.207:8000/       The Excel file containing water level data within a selected year range and data download from an API and successfully download the file to the device.				API.	and selected Year = $2024$			
data download from an  API and successfully download the file to the device.  CCTV ID should be successfully downloaded to my device. It should comprise five columns: CCTV ID, CCTV camera name, date and time, water level, and zone.	99	Water level	High	Verify that the front-end	http://27.254.145.207:8000/	The Excel file containing	The Excel file containing	Pass [Jidapa
wnload from an  d successfully  ad the file to the  comprise five columns:  CCTV ID should be  successfully downloaded  to my device. It should  comprise five columns:  CCTV ID, CCTV camera  name, date and time,  water level, and zone.		data download		can request water level	download/1/2024	water level data within a	water level data within a	12/05/2024
d successfully  ad the file to the successfully downloaded to my device. It should comprise five columns:  CCTV ID, CCTV camera name, date and time, water level, and zone.				data download from an		selected year range and	selected year range and	11:10]
and the file to the to the to my device. It should comprise five columns:  CCTV ID, CCTV camera name, date and time, water level, and zone.				API and successfully		CCTV ID should be	CCTV ID is successfully	
to my device. It should comprise five columns:  CCTV ID, CCTV camera name, date and time, water level, and zone.				download the file to the		successfully downloaded	downloaded to my device.	
nera				device.		to my device. It should	It comprises five columns:	
nera						comprise five columns:	CCTV ID, CCTV camera	
<u> </u>						CCTV ID, CCTV camera	name, date and time,	
water level, and zone.						name, date and time,	water level, and zone.	
						water level, and zone.		

4.6.2.3 The notification system and database connection testing

Table 4.27 The notification system and database integration test case for ID 67

Transport   Tran	1			<u></u>	T			E
Second WHERE cevil   High   Get water level data from   SHEECT's FROM   [""cetvIDD" "1"],   ""dateTime"; "2024-05-12   ""dateTime"; "2024-05-12   """   ""		Function	Friority	Description	Inputs	Expected output	Actual output	lest result
Retrieve water   High   Get water level data from   SELECT * FROM   ["cctvID"; "I";   I" database   Hailand waterlevel—1148-01.000000 UTC";   II-48.01.000000 UTC";   II-48.01.00000 UTC";   II-48.01.000000 UTC";   II-48.01.00000 UTC";   II-48.01.0000 UTC";   II-48.01.0000 UTC";   II-48.01.0000 UTC";   II-48.01.00000 UTC";   II-48.01.0000 UTC";   II-48.01.000					3. Notification system - Datab	ase		
the database   depa-smartcity-  1148:01 000000 UTC",   RaterLevel' 1178:01 000000 UTC",   RaterLevel' 1178:0100000 UTC",   RaterLevel' 1178:01 000000 UTC"	29	Retrieve water	High	Get water level data from	SELECT * FROM	[ "cctvID": "1",	[ "cctvID": "1",	Pass [Jidapa
thailand,waterLevel- 11:48:01.000000 UTC", Record WHERE cctvID = 1 ORDER BY dateTime DESC "zone"; "0", "cetvID"; "1", "dateTime"; "1", "dateTime"; "2024-05-12 11:46:01.000000 UTC", "waterLevel"; "1", "dateTime"; "2024-05-12 11:44:01.000000 UTC", "waterLevel"; "1", "waterLevel"; "1", "waterLevel"; "1", "waterLevel"; "1", "waterTime"; "2024-05-12 11:44:01.000000 UTC", "waterTime"; "2024-05-12 11:42:01.000000 UTC", "waterLevel"; "1", "waterTime"; "2024-05-12 11:40:01.000000 UTC", "waterLevel"; "1", "waterTime"; "2024-05-12 11:40:01.000000 UTC", "waterLevel"; "1", "waterTime"; "2024-05-12 11:40:01.000000 UTC", "waterLevel"; "1", "waterTevel"; "1", "", "", "", "", "", "", "", "", ""		level data from		the database	depa-smartcity-	"dateTime": "2024-05-12	"dateTime": "2024-05-12	12/05/2024
"waterLevel": "1",  "200e": "0", "cctvID":  "2024-05-12  11:46:01.000000 UTC",  "waterLevel": "1",  "zone": "0", "cctvID":  "1", "dateTime":  "2024-05-12  11:44:01.000000 UTC",  "waterLevel": "1",  "zone": "0", "cctvID":  "1", "dateTime":  "2024-05-12  11:42:01.000000 UTC",  "waterLevel": "1",  "zone": "0", "cctvID":  "1", "dateTime":  "2024-05-12  11:40:01.000000 UTC",  "waterLevel": "1",  "zone": "0", "cctvID":  "xone": "0", "cctvID":  "xone": "0", "cctvID":  "zone": "0", "cotvID":  "zone": "0", "cotvID": "1:40:01.0000000 UTC", "cotvID": "1:40:01.000000 UTC", "cotvID": "1:40:01.000000 UTC", "cotvID": "1:40:01.000000 UTC", "cotvID": "2024-05-10", "cotvID": "2024-05-10", "cotvID": "2025-10", "cotvID		the database			thailand.waterlevel.waterLevel-	11:48:01.000000 UTC",	11:48:01.000000 UTC",	11:49]
3Y dateTime DESC  "1", "dateTime":  "2024-05-12  11:46:01.000000 UTC",  "waterLevel": "1",  "zone": "0", "cetvID":  "2024-05-12  11:44:01.000000 UTC",  "waterLevel": "1",  "zone": "0", "cetvID":  "1", "dateTime":  "2024-05-12  11:42:01.00000 UTC",  "waterLevel": "1",  "zone": "0", "cetvID":  "1", "dateTime":  "2024-05-12  11:40:01.000000 UTC",  "waterLevel": "1",  "zone": "0", "cetvID":  "", "dateTime":  "zone": "1",  "zone": "0", "cetvID":  "", "dateTime":  "zone": "0", "cetvID":  "zone": "0", "cetvID": "literial "output ID": "					Record WHERE $cctvID = 1$	"waterLevel": "1",	"waterLevel": "1",	
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