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Design of Sewerage Network by using SewerGems

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Abstract: Sewerage (or sewage system) is the infrastructure that conveys sewage or surface runoff (stormwater, meltwater, rainwater) using sewers. It encompasses components such as receiving drains, manholes, pumping stations, storm overflows, and screening chambers of the combined sewer or sanitary sewer. Sewerage ends at the entry to a sewage treatment plant or at the point of discharge into the environment. It is the system of pipes, chambers, manholes, etc. that conveys the sewage or storm water.

In many cities, sewage (or municipal wastewater) is carried together with stormwater, in a combined sewer system, to a sewage treatment plant. In some urban areas, sewage is carried separately in sanitary sewers and runoff from streets is carried in storm drains. Access to these systems, for maintenance purposes, is typically through a manhole. During high precipitation periods a sewer system may experience a combined sewer overflow event or a sanitary sewer overflow event, which forces untreated sewage to flow directly to receiving waters. This can pose a serious threat to public health and the surrounding environment.

Key Words: SewerGems, Sewer Network, Rural Areas.

CHAPTER - I

1.1 INTRODUCTION

Sewage (or domestic sewage, domestic wastewater, municipal wastewater) is a type of wastewater that is produced by a community of people. It is typically transported through a sewer system. Sewage consists of wastewater discharged from residences and from commercial, institutional and public facilities that exist in the locality. Sub-types of sewage are greywater (from sinks, bathtubs, showers, dishwashers, and clothes washers) and blackwater (the water used to flush toilets, combined with the human waste that it flushes away). Sewage also contains soaps and detergents. Food waste may be present from dishwashing, and food quantities may be increased where garbage disposal units are used. In regions where toilet paper is used rather than bidets, that paper is also added to the sewage. Sewage contains macro-pollutants and micro-pollutants, and may also incorporate some municipal solid waste and pollutants from industrial wastewater.

Sewage usually travels from a building's plumbing either into a sewer, which will carry it elsewhere, or into an onsite sewage facility. Collection of sewage of several households together usually takes places in either sanitary sewers or combined sewers. The former is designed to exclude stormwater flows whereas the latter is designed to also take stormwater. The production of sewage generally corresponds to the water consumption. A range of factors influence water consumption and hence the sewage flowrates per person. These include: Water availability (the opposite of water scarcity), water supply options, climate (warmer climates may lead to greater water consumption), community size, economic level of the community, level of industrialization, metering of household consumption, water cost and water pressure.

The main parameters in sewage that are measured to assess the sewage strength or quality as well as treatment options include: solids, indicators of organic matter, nitrogen, phosphorus, and indicators of fecal contamination. These can be considered to be the main macro-pollutants in sewage. Sewage contains pathogens which stem from fecal matter. The following four types of pathogens are found in sewage: pathogenic bacteria, viruses, protozoa (in the form of cysts or oocysts) and helminths (in the form of eggs). In order to quantify the organic matter, indirect methods are commonly used: mainly the Biochemical Oxygen Demand (BOD) and the Chemical Oxygen Demand (COD).

Management of sewage includes collection and transport for release into the environment, after a treatment level that is compatible with the local requirements for discharge into water bodies, onto soil or for reuse applications. Disposal options include dilution (self-purification of water bodies, making use of their assimilative capacity if possible), marine outfalls, land disposal and sewage farms. All disposal options may run risks of causing water pollution.

Drainage networks are an important part of the infrastructure of any society.

The main purpose of providing the drainage network is to carry away sanitary waste and storm water to sewage treatment plant. A drainage network is just a reverse action of water supply network. Drainage system has become an issue in urban & rural planning and management.

1.2 NEED

- To save water by making water eligible to reuse.
- To stops the damage caused by the wastewater to the environment.
- To enhance public health & environmental protection.
- To make the sewerage system cost effective.

1.3 AIM

Design sewerage network for rural areas.

1.4 OBJECTIVE

- To analyze the designed network
- To study the existing problems
- Use of SewerGems software for designing a sewerage network

1.5 TYPES OF SEWER SYSTEM

- Partial separate
- Combined system
- Separate system
- Full flow system
- Partial flow system

1.6 SCOPE OF WORK

• Steady hydraulics

• Model building

• Unsteady hydraulics

• Hydrology

• Pumps and force mains

• Pressure sewers

• Transient analysis

• Dry weather loading

• Sanitary sewers

• Combined Sewers

• Designing new systems

• Monitoring/rehab

• Geospatial data

• Load building

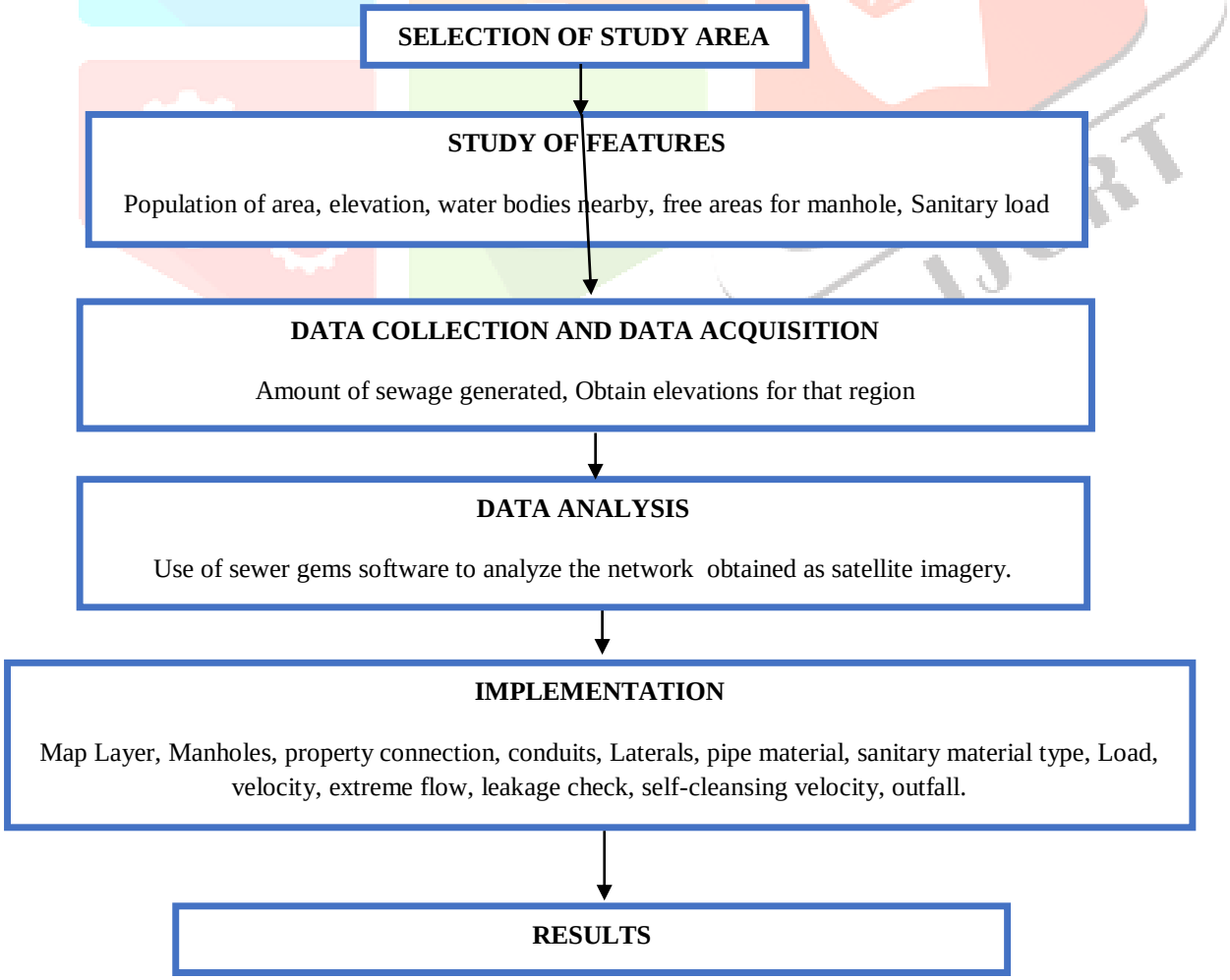
• Water quality

1.7 LIMITATIONS

- Data Collection and Data Acquisition is a tedious process.
- Data processing requires knowledge of software.
- Software installation and learning software consumes time.
- Results obtained at one location cannot be directly used to establish a direct relation at other location.

CHAPTER-II

METHODOLOGY



2.1 SELECTION OF STUDY AREA.

The region of Maharashtra is sub divided into 4 major regions. Pune district comes in Western Maharashtra region. In Pune district Nira village lies in Purandar Taluka. And ward number 1 & 2 of Nira is selected study area. In this area there is mismanagement of sewage water. So, Nira is selected as study area.

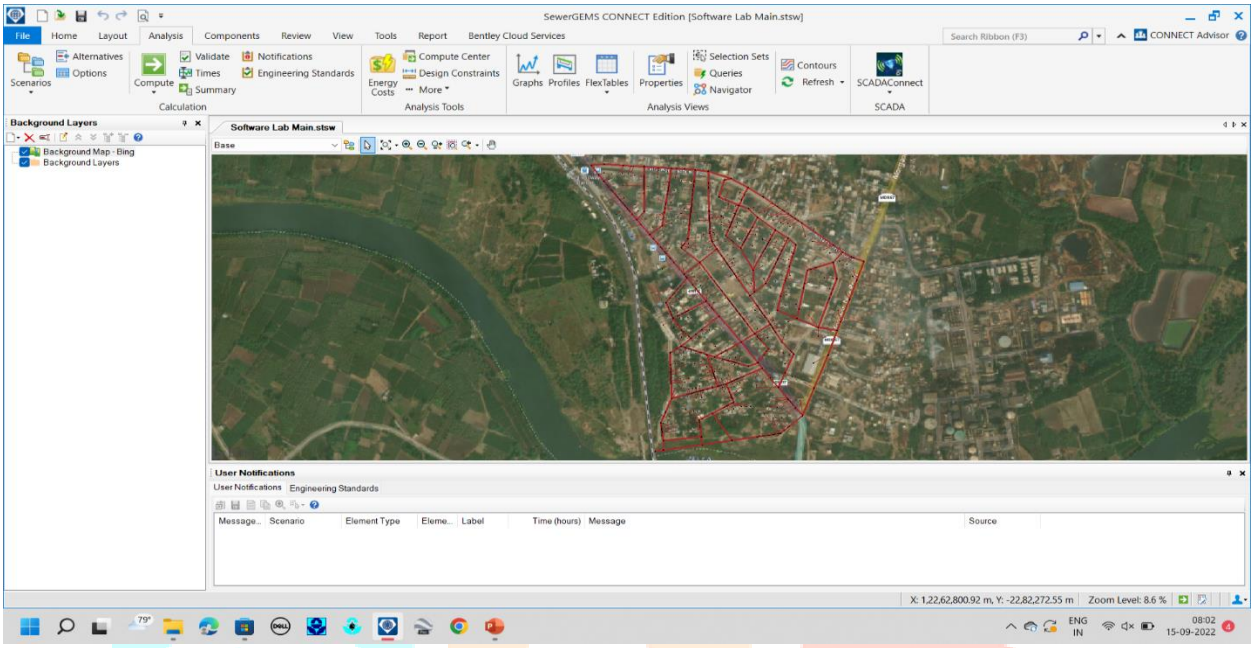


Figure 1: SewerGems - Nira Network

2.2 STUDY OF AREA SELECTED.

This study basically includes –

- **Topographical and Geographical features –** Study of natural water bodies in the region, type of soil present in the region, physiographic and climatic conditions of the region.
- **Rainfall pattern and climate study** – It includes the study of rainfall pattern of the region, the wind direction and temperature variation of the region, arrival, and departure of monsoon etc.
- **Social and political aspects** – This involve the study of economic status of people, Their life styles and interference of political parties if any, implementation of various schemes related to sewerage network.

2.3 DATA COLLECTION AND ACQUISITION.

- Elevations from Google Earth
- Lengths of network from Google Earth

2.4 DATA ANALYSIS

Use of SewerGems software

- The software mainly uses spatial images obtained from the satellite (bing Map).

About Software

SewerGems is an easy-to-use advanced engineering software for you to analyze, design, and operate sanitary and combined sewer systems.

You can decrease decision risks by ensuring that the model uses the best available data, built-in hydraulic and hydrology capabilities, and a variety of wet-weather calibration methods

Software Application

1. Allocate and estimate stormwater loads
2. Analyze hydraulics and combined sewer overflows
3. Analyze hydrogen sulfide formation
4. Analyze inlet capacities
5. Build and manage hydraulic models
6. Design and analyze culverts
7. Design and analyze low impact development controls
8. Design and analyze pond and outlets
9. Design sanitary sewers
10. Design stormwater systems
11. Simulate water quality

2.5 Implementation

Bringing Background Layers in, first background Layer is Bing map for more convenient design.

(Bing Map site>Create Profile>Create activation key Id>Copy that activation id>Create hydraulic model in SewerGems > go to view tool> Background option>select new file> background layer>New bing file>dialog box appears> Paste the key here)

Select the study area from bing map check areal views and areal and contour maps for elevation and nearest water body for outfall.

Plan accordingly for design and start plotting manholes.

Check the water sanitary load as per water supply demand and consider population forecasting method. In this mini project, only residential area is included no commercial area is included.

Mark property connections, and check whether the manholes are convenient over there. Manhole to manhole connection by conduits and manholes to property by laterals. And give elevation for manhole for deriving gravity flow.

Plot outfall and release the effluent in nearest STP and STP to water body.

Home>Option>Base calculation> Engineering standards> formula for gravity friction = (manning const 0.013) and Horton formula used for infiltration, for pressure friction method Hazen williams is used.

We use the tools in layout section.

Component> Load fixing> unit sanitary load > new profile selection > population based> population demand (135 LPCD)> 135*.8 will be our gradual flow> Component> extreme flow> new file > population per capita factor> Extreme Flow Factor EFF= $C_1 + (C_2 + (m_1P)^{e1})/(C_3 + (m_2P)^{e2})$
we can also import values from sewer gems library.

Analysis> design constraints> Gravity pipe> Velocity>minimum 0.6m/s and maximum 3 m/s.> constrains type is simple> partial flow or full flow selection> after this design constraints > cover> pipe crown > min cover 1 m and max 5m

Design constraints>manholes manually elevation(slope is given automatically by sewer gems) and min 0.006N/m is maximum is N/M Design >Inlets> we keep maximum spread 2.4 m, maximum gutter depth 0.15m and efficiency of 50% for surface flow. design constraints > node > no match line offset and minimum drop depth not given and pipe matching is given by crowning option.

Extreme flow setup> multiplying Factor 1 > patrial or full> 1 for residential area

Conduits catlog > new file> conduits shape> circular> manning (0.013) and Darcy (0.0001) Hazen Williams (110) and we do for every pipe diameter meter> material selection Concrete. (sewer gems library each and every type material available)

Every type of loss ca be calculated. Can make graph on every aspect.

Analysis> Validate > Errors if any

2.6 Error analysis and reimplantation

Error types

1. Mismatching of connection types same matching connection to be used for conduits and manholes

2. elevation errors

3. reverse flow occurrence

4. 2-3 node at one point it exceeds extreme capacity and overflow may occur.

5. Outfall error, there must be a manhole just before releasing.

6. As per decided type of material if not used then error occurs, recheck with catalog.

7. No manholes, property connection or taps should be left alone without connectivity.

2.7 Re Implementation

1. After validating we come know about errors in the given dialog box below and we can know location of the errors by double clicking them doing the necessary.
2. We can resolve the errors by above given points. By solving all we bring the errors to zero. No validation issues found is displayed.

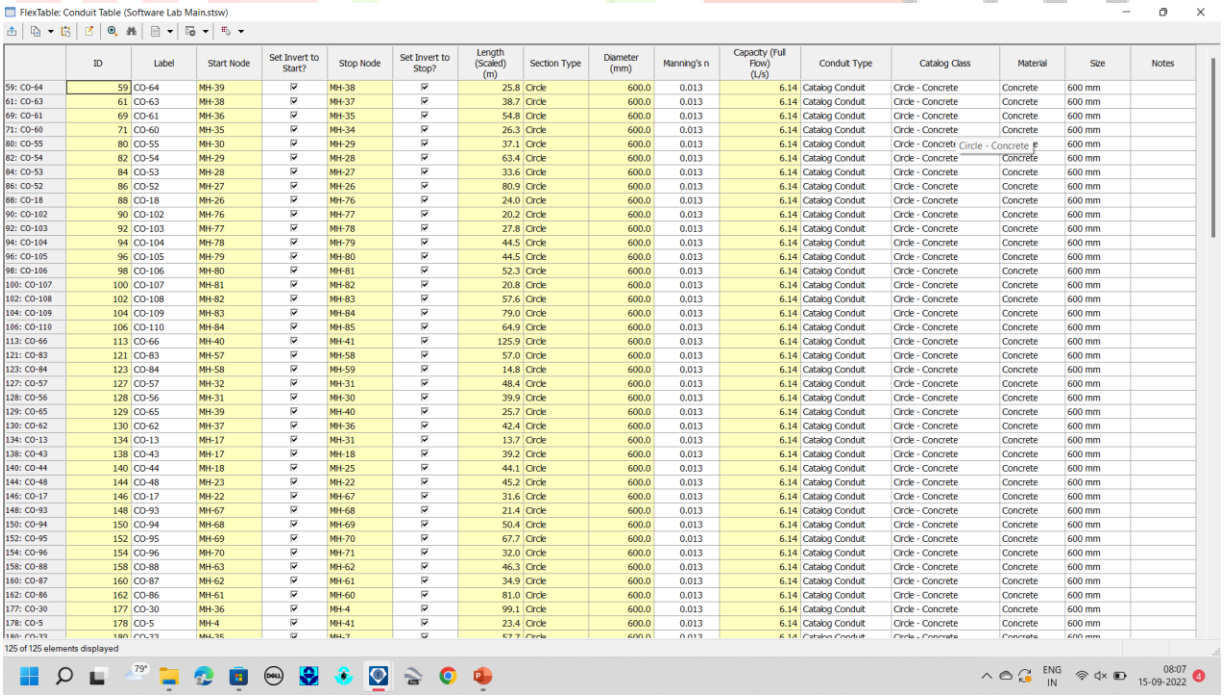
CHAPTER III

RESULT

Flex tables

1. Conduits
   (Start node end nodes, labels, Id, section types , diameter, capacity full flow, conduits type, conduit class, material)

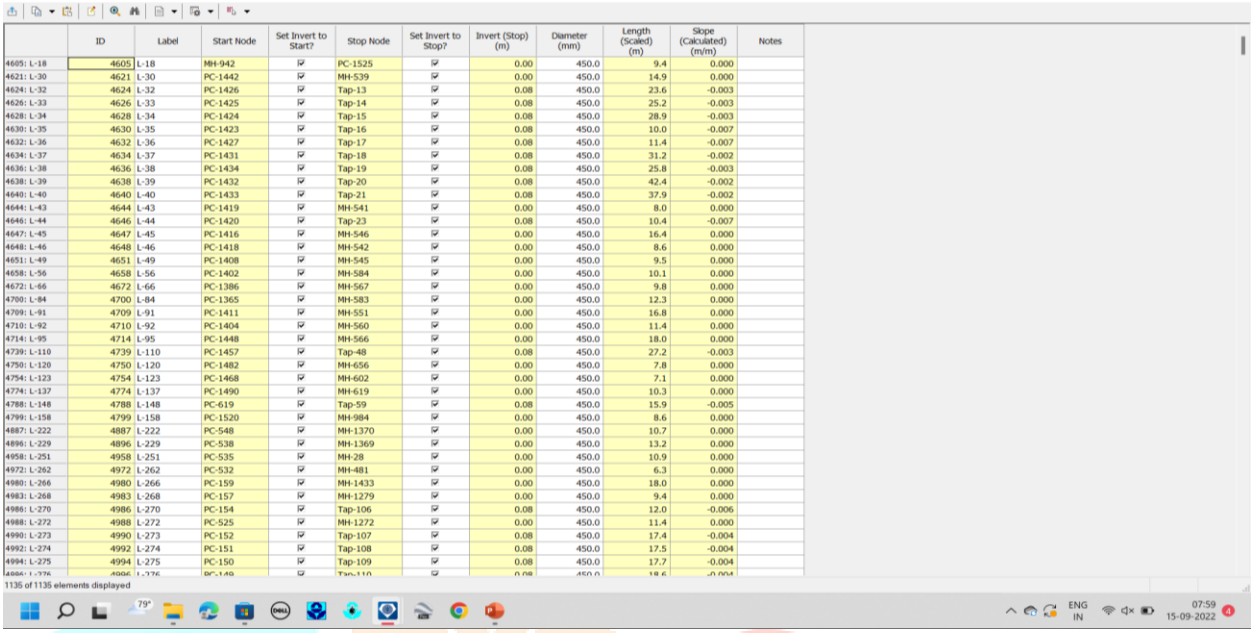
Table 1: Properties of Conduits



	ID	Label	Start Node	Set Invert to Start?	Stop Node	Set Invert to Stop?	Length (Scaled) (m)	Section Type	Diameter (mm)	Manning's n	Capacity (Full Flow) (L/s)	Conduit Type	Catalog Class	Material	Size	Notes
59: CO-64	59	CO-64	MH-39	☑	MH-38	☑	25.8	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
61: CO-63	61	CO-63	MH-38	☑	MH-37	☑	38.7	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
69: CO-61	69	CO-61	MH-36	☑	MH-35	☑	54.8	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
71: CO-60	71	CO-60	MH-35	☑	MH-34	☑	26.3	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
80: CO-55	80	CO-55	MH-30	☑	MH-29	☑	37.1	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
82: CO-54	82	CO-54	MH-29	☑	MH-28	☑	63.4	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
84: CO-53	84	CO-53	MH-28	☑	MH-27	☑	33.6	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
86: CO-52	86	CO-52	MH-27	☑	MH-26	☑	80.9	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
88: CO-18	88	CO-18	MH-26	☑	MH-76	☑	24.0	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
90: CO-102	90	CO-102	MH-76	☑	MH-77	☑	20.2	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
92: CO-103	92	CO-103	MH-77	☑	MH-78	☑	27.8	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
94: CO-104	94	CO-104	MH-78	☑	MH-79	☑	44.5	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
96: CO-105	96	CO-105	MH-79	☑	MH-80	☑	44.5	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
98: CO-106	98	CO-106	MH-80	☑	MH-81	☑	52.3	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
100: CO-107	100	CO-107	MH-81	☑	MH-82	☑	20.8	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
102: CO-108	102	CO-108	MH-82	☑	MH-83	☑	57.6	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
104: CO-109	104	CO-109	MH-83	☑	MH-84	☑	79.0	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
106: CO-110	106	CO-110	MH-84	☑	MH-85	☑	64.9	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
113: CO-66	113	CO-66	MH-40	☑	MH-41	☑	125.9	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
121: CO-83	121	CO-83	MH-57	☑	MH-58	☑	57.0	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
123: CO-84	123	CO-84	MH-58	☑	MH-59	☑	14.8	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
127: CO-57	127	CO-57	MH-32	☑	MH-31	☑	48.4	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
128: CO-56	128	CO-56	MH-31	☑	MH-30	☑	39.9	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
129: CO-65	129	CO-65	MH-39	☑	MH-40	☑	25.7	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
130: CO-62	130	CO-62	MH-37	☑	MH-36	☑	42.4	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
134: CO-13	134	CO-13	MH-17	☑	MH-31	☑	13.7	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
138: CO-43	138	CO-43	MH-17	☑	MH-18	☑	39.2	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
140: CO-44	140	CO-44	MH-18	☑	MH-25	☑	44.1	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
144: CO-48	144	CO-48	MH-23	☑	MH-22	☑	45.2	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
146: CO-17	146	CO-17	MH-22	☑	MH-67	☑	31.6	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
148: CO-93	148	CO-93	MH-67	☑	MH-68	☑	21.4	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
150: CO-94	150	CO-94	MH-68	☑	MH-69	☑	50.4	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
152: CO-95	152	CO-95	MH-69	☑	MH-70	☑	67.7	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
154: CO-96	154	CO-96	MH-70	☑	MH-71	☑	32.0	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
158: CO-88	158	CO-88	MH-63	☑	MH-62	☑	46.3	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
160: CO-87	160	CO-87	MH-62	☑	MH-61	☑	34.9	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
162: CO-86	162	CO-86	MH-61	☑	MH-60	☑	81.0	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
177: CO-30	177	CO-30	MH-36	☑	MH-4	☑	99.1	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	
178: CO-5	178	CO-5	MH-4	☑	MH-41	☑	23.4	Circle	600.0	0.013	6.14	Catalog Conduit	Circle - Concrete	Concrete	600 mm	

2. **Laterals**
(ID, start nodes, end nodes, length, dia, and slope)

Table 1: Properties of laterals

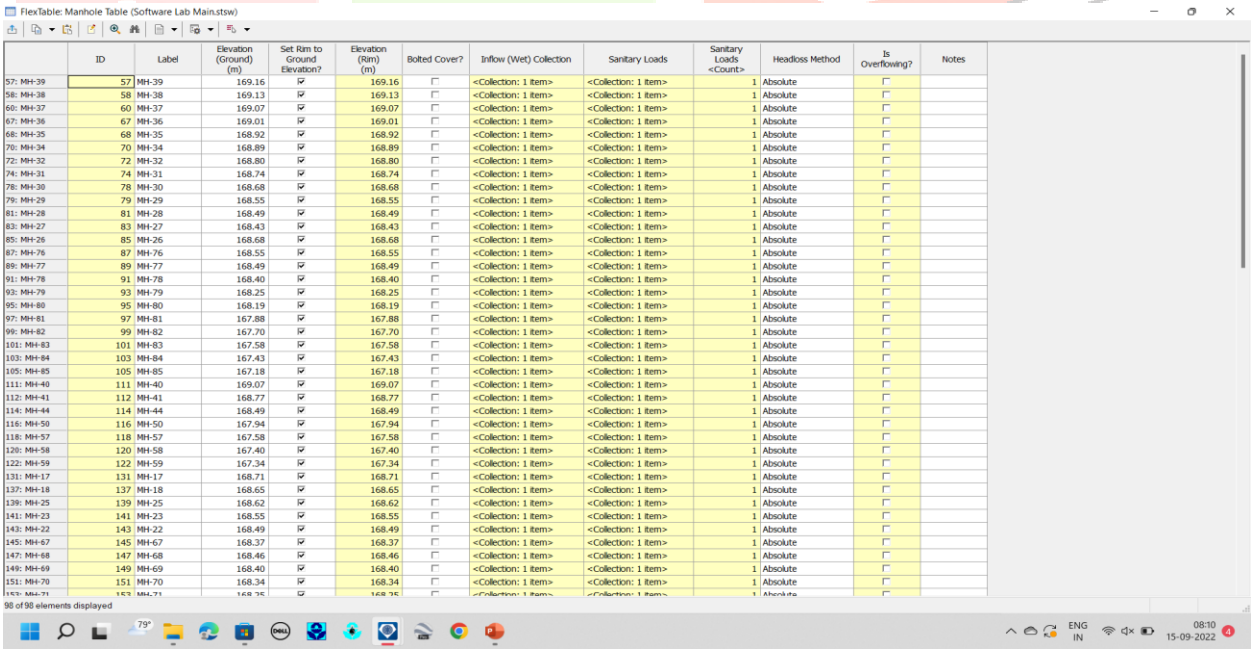


	ID	Label	Start Node	Set Invert to Start?	Stop Node	Set Invert to Stop?	Invert (Stop) (m)	Diameter (mm)	Length (Scaled) (m)	Slope (Calculated) (m/m)	Notes
4605: L-18	4605	L-18	MH-942	☑	PC-1525	☑	0.00	450.0	9.4	0.000	
4621: L-30	4621	L-30	PC-1442	☑	MH-539	☑	0.00	450.0	14.9	0.000	
4624: L-32	4624	L-32	PC-1426	☑	Tap-13	☑	0.08	450.0	23.6	-0.003	
4626: L-33	4626	L-33	PC-1425	☑	Tap-14	☑	0.08	450.0	25.2	-0.003	
4628: L-34	4628	L-34	PC-1424	☑	Tap-15	☑	0.08	450.0	28.9	-0.003	
4630: L-35	4630	L-35	PC-1423	☑	Tap-16	☑	0.08	450.0	10.0	-0.007	
4632: L-36	4632	L-36	PC-1427	☑	Tap-17	☑	0.08	450.0	11.4	-0.007	
4634: L-37	4634	L-37	PC-1431	☑	Tap-18	☑	0.08	450.0	31.2	-0.002	
4636: L-38	4636	L-38	PC-1434	☑	Tap-19	☑	0.08	450.0	25.8	-0.003	
4638: L-39	4638	L-39	PC-1432	☑	Tap-20	☑	0.08	450.0	42.4	-0.002	
4640: L-40	4640	L-40	PC-1433	☑	Tap-21	☑	0.08	450.0	37.9	-0.002	
4644: L-43	4644	L-43	PC-1419	☑	MH-541	☑	0.00	450.0	8.0	0.000	
4646: L-44	4646	L-44	PC-1420	☑	Tap-23	☑	0.08	450.0	10.4	-0.007	
4647: L-45	4647	L-45	PC-1416	☑	MH-546	☑	0.00	450.0	16.4	0.000	
4648: L-46	4648	L-46	PC-1418	☑	MH-542	☑	0.00	450.0	8.6	0.000	
4651: L-49	4651	L-49	PC-1408	☑	MH-545	☑	0.00	450.0	9.5	0.000	
4658: L-56	4658	L-56	PC-1402	☑	MH-584	☑	0.00	450.0	10.1	0.000	
4672: L-66	4672	L-66	PC-1386	☑	MH-567	☑	0.00	450.0	9.8	0.000	
4700: L-84	4700	L-84	PC-1365	☑	MH-583	☑	0.00	450.0	12.3	0.000	
4709: L-91	4709	L-91	PC-1411	☑	MH-551	☑	0.00	450.0	16.8	0.000	
4710: L-92	4710	L-92	PC-1404	☑	MH-560	☑	0.00	450.0	11.4	0.000	
4714: L-95	4714	L-95	PC-1448	☑	MH-566	☑	0.00	450.0	18.0	0.000	
4739: L-110	4739	L-110	PC-1457	☑	Tap-48	☑	0.08	450.0	27.2	-0.003	
4750: L-120	4750	L-120	PC-1482	☑	MH-656	☑	0.00	450.0	7.8	0.000	
4754: L-123	4754	L-123	PC-1468	☑	MH-602	☑	0.00	450.0	7.1	0.000	
4774: L-137	4774	L-137	PC-1490	☑	MH-619	☑	0.00	450.0	10.3	0.000	
4788: L-148	4788	L-148	PC-619	☑	Tap-59	☑	0.08	450.0	15.9	-0.005	
4799: L-158	4799	L-158	PC-1520	☑	MH-984	☑	0.00	450.0	8.6	0.000	
4887: L-222	4887	L-222	PC-548	☑	MH-1370	☑	0.00	450.0	10.7	0.000	
4896: L-229	4896	L-229	PC-538	☑	MH-1369	☑	0.00	450.0	13.2	0.000	
4958: L-251	4958	L-251	PC-535	☑	MH-28	☑	0.00	450.0	10.9	0.000	
4972: L-262	4972	L-262	PC-532	☑	MH-481	☑	0.00	450.0	6.3	0.000	
4980: L-266	4980	L-266	PC-159	☑	MH-1433	☑	0.00	450.0	18.0	0.000	
4983: L-268	4983	L-268	PC-157	☑	MH-1279	☑	0.00	450.0	9.4	0.000	
4986: L-270	4986	L-270	PC-154	☑	Tap-106	☑	0.08	450.0	12.0	-0.006	
4988: L-272	4988	L-272	PC-525	☑	MH-1272	☑	0.00	450.0	11.4	0.000	
4990: L-273	4990	L-273	PC-152	☑	Tap-107	☑	0.08	450.0	17.4	-0.004	
4992: L-274	4992	L-274	PC-151	☑	Tap-108	☑	0.08	450.0	17.5	-0.004	
4994: L-275	4994	L-275	PC-150	☑	Tap-109	☑	0.08	450.0	17.7	-0.004	

1135 of 1135 elements displayed

3. **Manholes**
(Id, Label, 499round Elevation, rim elevation, conut of sanitary load, type sanitary load and inflow connection, head loss method, chances of overflow)

Table 2: Properties of Manholes



FlexTable: Manhole Table (Software Lab Main.stsw)

	ID	Label	Elevation (Ground) (m)	Set Rim to Ground Elevation?	Elevation (Rim) (m)	Bolted Cover?	Inflow (Wet) Collection	Sanitary Loads	Sanitary Loads <Count>	Headloss Method	Is Overflowing?	Notes
57: MH-39	57	MH-39	169.16	☑	169.16	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
58: MH-38	58	MH-38	169.13	☑	169.13	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
60: MH-37	60	MH-37	169.07	☑	169.07	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
67: MH-36	67	MH-36	169.01	☑	169.01	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
68: MH-35	68	MH-35	168.92	☑	168.92	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
70: MH-34	70	MH-34	168.89	☑	168.89	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
72: MH-32	72	MH-32	168.80	☑	168.80	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
74: MH-31	74	MH-31	168.74	☑	168.74	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
78: MH-30	78	MH-30	168.68	☑	168.68	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
79: MH-29	79	MH-29	168.55	☑	168.55	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
81: MH-28	81	MH-28	168.49	☑	168.49	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
83: MH-27	83	MH-27	168.43	☑	168.43	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
85: MH-26	85	MH-26	168.68	☑	168.68	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
87: MH-76	87	MH-76	168.55	☑	168.55	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
89: MH-77	89	MH-77	168.49	☑	168.49	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
91: MH-78	91	MH-78	168.40	☑	168.40	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
93: MH-79	93	MH-79	168.25	☑	168.25	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
95: MH-80	95	MH-80	168.19	☑	168.19	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
97: MH-81	97	MH-81	167.88	☑	167.88	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
99: MH-82	99	MH-82	167.70	☑	167.70	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
101: MH-83	101	MH-83	167.58	☑	167.58	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
103: MH-84	103	MH-84	167.43	☑	167.43	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
105: MH-85	105	MH-85	167.18	☑	167.18	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
111: MH-40	111	MH-40	169.07	☑	169.07	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
112: MH-41	112	MH-41	168.77	☑	168.77	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
114: MH-44	114	MH-44	168.49	☑	168.49	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
116: MH-50	116	MH-50	167.94	☑	167.94	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
118: MH-57	118	MH-57	167.58	☑	167.58	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
120: MH-58	120	MH-58	167.40	☑	167.40	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
122: MH-59	122	MH-59	167.34	☑	167.34	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
131: MH-17	131	MH-17	168.71	☑	168.71	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
137: MH-18	137	MH-18	168.65	☑	168.65	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
139: MH-25	139	MH-25	168.62	☑	168.62	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
141: MH-23	141	MH-23	168.55	☑	168.55	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
143: MH-22	143	MH-22	168.49	☑	168.49	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
145: MH-67	145	MH-67	168.37	☑	168.37	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
147: MH-68	147	MH-68	168.46	☑	168.46	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
149: MH-69	149	MH-69	168.40	☑	168.40	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	
151: MH-70	151	MH-70	168.34	☑	168.34	☐	<Collection: 1 item>	<Collection: 1 item>	1	Absolute	☐	

98 of 98 elements displayed

4. **Taps** **connection**
(Id, Label, Elevation, loading count, type of unit, sanitary load, sanitary pattern, base flow,)

Table 3:Properties of Tap Connections

FlexTable: Tap Table (Software Lab Main.stsw)

	ID	Label	Referenced Link	Distance from End Point (Scaled) (m)	Notes
728: Tap-1	728	Tap-1	CO-66	16.9	
730: Tap-2	730	Tap-2	CO-66	19.8	
732: Tap-3	732	Tap-3	CO-66	33.1	
734: Tap-4	734	Tap-4	CO-66	51.8	
736: Tap-5	736	Tap-5	CO-66	71.7	
738: Tap-6	738	Tap-6	CO-66	97.5	
740: Tap-7	740	Tap-7	CO-66	103.4	
742: Tap-8	742	Tap-8	CO-66	112.6	
746: Tap-9	746	Tap-9	CO-62	15.3	
748: Tap-10	748	Tap-10	CO-62	20.4	
752: Tap-12	752	Tap-12	CO-30	18.6	
754: Tap-13	754	Tap-13	CO-30	21.8	
756: Tap-14	756	Tap-14	CO-30	24.3	
758: Tap-15	758	Tap-15	CO-30	43.5	
760: Tap-16	760	Tap-16	CO-33	29.5	
762: Tap-17	762	Tap-17	CO-33	38.1	
764: Tap-18	764	Tap-18	CO-61	28.5	
766: Tap-19	766	Tap-19	CO-60	10.2	
768: Tap-20	768	Tap-20	CO-8	25.4	
770: Tap-21	770	Tap-21	CO-8	23.6	
772: Tap-22	772	Tap-22	CO-8	44.1	
774: Tap-23	774	Tap-23	CO-33	51.5	
776: Tap-24	776	Tap-24	CO-33	48.2	
779: Tap-25	779	Tap-25	CO-32	18.8	
783: Tap-27	783	Tap-27	CO-32	31.6	
785: Tap-28	785	Tap-28	CO-31	10.4	
787: Tap-29	787	Tap-29	CO-8	86.6	
789: Tap-30	789	Tap-30	CO-8	94.7	
791: Tap-31	791	Tap-31	CO-8	98.5	
793: Tap-32	793	Tap-32	CO-8	110.9	
795: Tap-33	795	Tap-33	CO-8	105.4	
797: Tap-34	797	Tap-34	CO-41	19.6	
799: Tap-35	799	Tap-35	CO-41	21.8	
801: Tap-36	801	Tap-36	CO-41	16.2	
803: Tap-37	803	Tap-37	CO-41	8.6	
805: Tap-38	805	Tap-38	CO-41	1.8	
807: Tap-39	807	Tap-39	CO-42	25.6	
809: Tap-40	809	Tap-40	CO-44	14.2	
811: Tap-41	811	Tap-41	CO-51	16.8	

251 of 251 elements displayed

Scenario Summary

Preview

File View Background

Scenario Summary Report
Scenario: Base

Scenario Summary

ID	1
Label	Base
Notes	
Active Topology	Base Active Topology
User Data Extensions	Base User Data Extensions
Physical	Physical Alternative - 2
Boundary Condition	Base Boundary Condition
Initial Settings	Base Initial Settings
Hydrology	Base Hydrology
Output	Base Output
Infiltration and Inflow	Base Infiltration and Inflow
Rainfall Runoff	Base Rainfall Runoff
Water Quality	Base Water Quality
Sanitary Loading	Base Sanitary Loading
Headloss	Base Headloss
Operational	Base Operational
Design	Base Design
System Flows	Base System Flows
SCADA	Base SCADA
Energy Cost	Base Energy Cost
Solver Calculation Options	Base Calculation Options

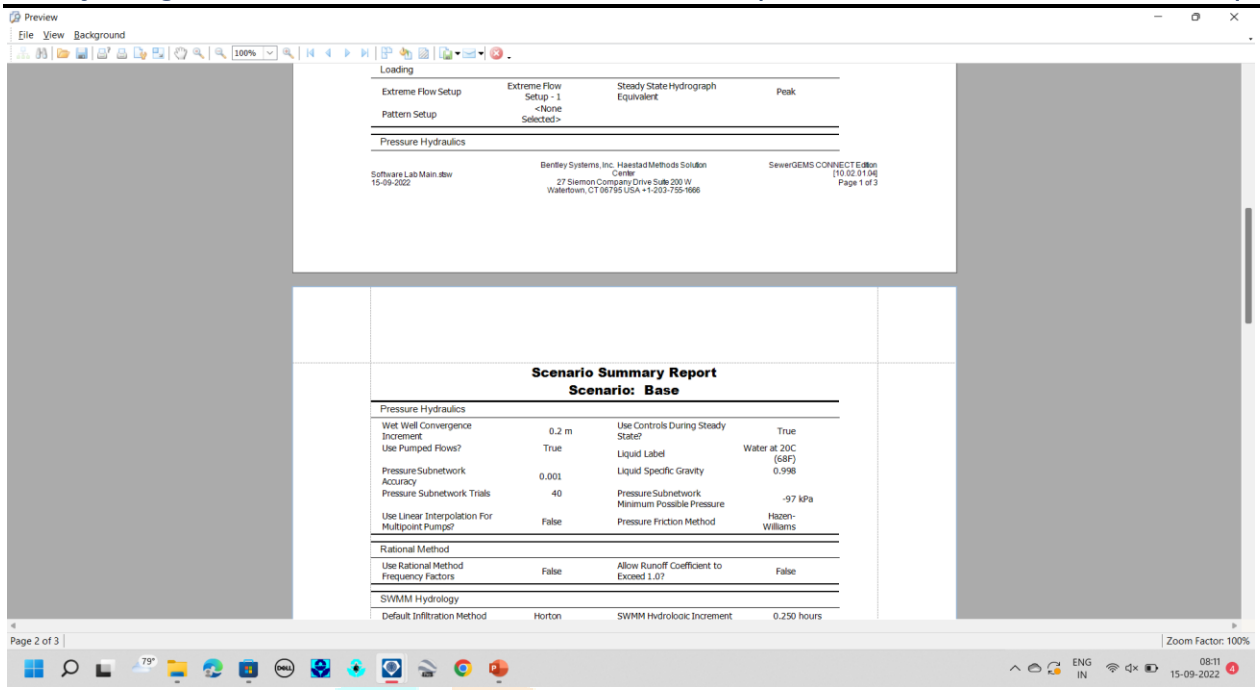
Convex Routing

Peak Flow Ratio	75.0 %

Gravity Hydraulics

Tractive Stress (Global Minimum)	0.000 Pascals	Minimum Structure Headloss	0.00 m
Maximum Network Traversals	5	Governing Upstream Pipe Selection Method	Pipe with Maximum QV
Flow Convergence Test	0.001	Structure Loss Mode	Hydraulic Grade
Flow Profile Method	Backwater Analysis	Save Detailed Headloss Data?	False
Number of Flow Profile Steps	5	Gravity Friction Method	Manning's
Hydraulic Grade Convergence Test	0.00 m	Use Explicit Depth and Slope Equations?	False
Average Velocity Method	Actual Uniform Flow Velocity		

Page 1 of 3 Zoom Factor: 100%



Preview
File View Background

Loading			
Extreme Flow Setup	Extreme Flow Setup - 1	Steady State Hydrograph Equivalent	Peak
Pattern Setup	<None Selected>		

Pressure Hydraulics			

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[10.02.01.04]
Page 1 of 3

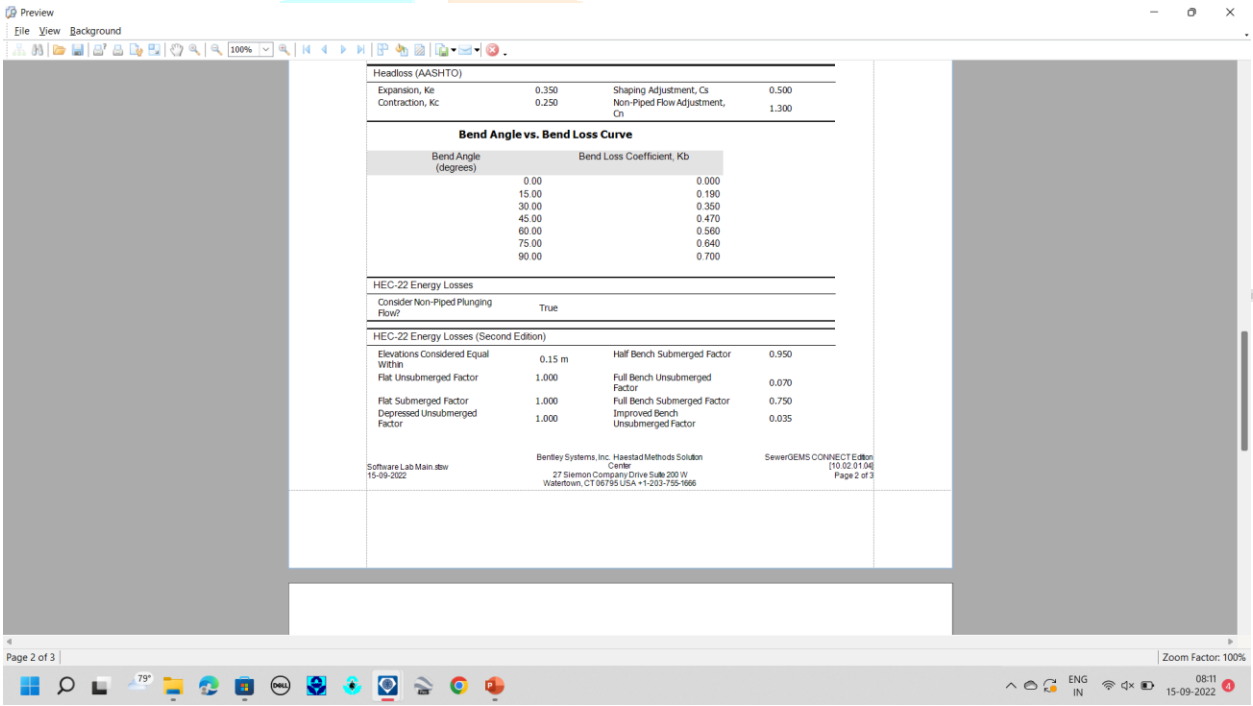
Scenario Summary Report
Scenario: Base

Pressure Hydraulics			
Wet Well Convergence Increment	0.2 m	Use Controls During Steady State?	True
Use Pumped Flows?	True	Liquid Label	Water at 20C (68F)
Pressure Subnetwork Accuracy	0.001	Liquid Specific Gravity	0.998
Pressure Subnetwork Trials	40	Pressure Subnetwork Minimum Possible Pressure	-97 kPa
Use Linear Interpolation For Multipoint Pumps?	False	Pressure Friction Method	Hazen-Williams

Rational Method			
Use Rational Method Frequency Factors	False	Allow Runoff Coefficient to Exceed 1.0?	False

SWMM Hydrology			
Default Infiltration Method	Horton	SWMM Hydrologic Increment	0.250 hours

Page 2 of 3
Zoom Factor: 100%



Preview
File View Background

Headloss (AASHTO)			
Expansion, Ke	0.350	Shaping Adjustment, Cs	0.500
Contraction, Kc	0.250	Non-Piped Flow Adjustment, Cn	1.300

Bend Angle vs. Bend Loss Curve

Bend Angle (degrees)	Bend Loss Coefficient, Kb
0.00	0.000
15.00	0.190
30.00	0.350
45.00	0.470
60.00	0.560
75.00	0.640
90.00	0.700

HEC-22 Energy Losses			
Consider Non-Piped Plunging Flow?	True		

HEC-22 Energy Losses (Second Edition)			
Elevations Considered Equal Within	0.15 m	Half Bench Submerged Factor	0.950
Flat Unsubmerged Factor	1.000	Full Bench Unsubmerged Factor	0.070
Flat Submerged Factor	1.000	Full Bench Submerged Factor	0.750
Depressed Unsubmerged Factor	1.000	Improved Bench Unsubmerged Factor	0.035

Bentley Systems, Inc. Haestad Methods Solution Center
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Watertown, CT 06795 USA +1-203-755-1666

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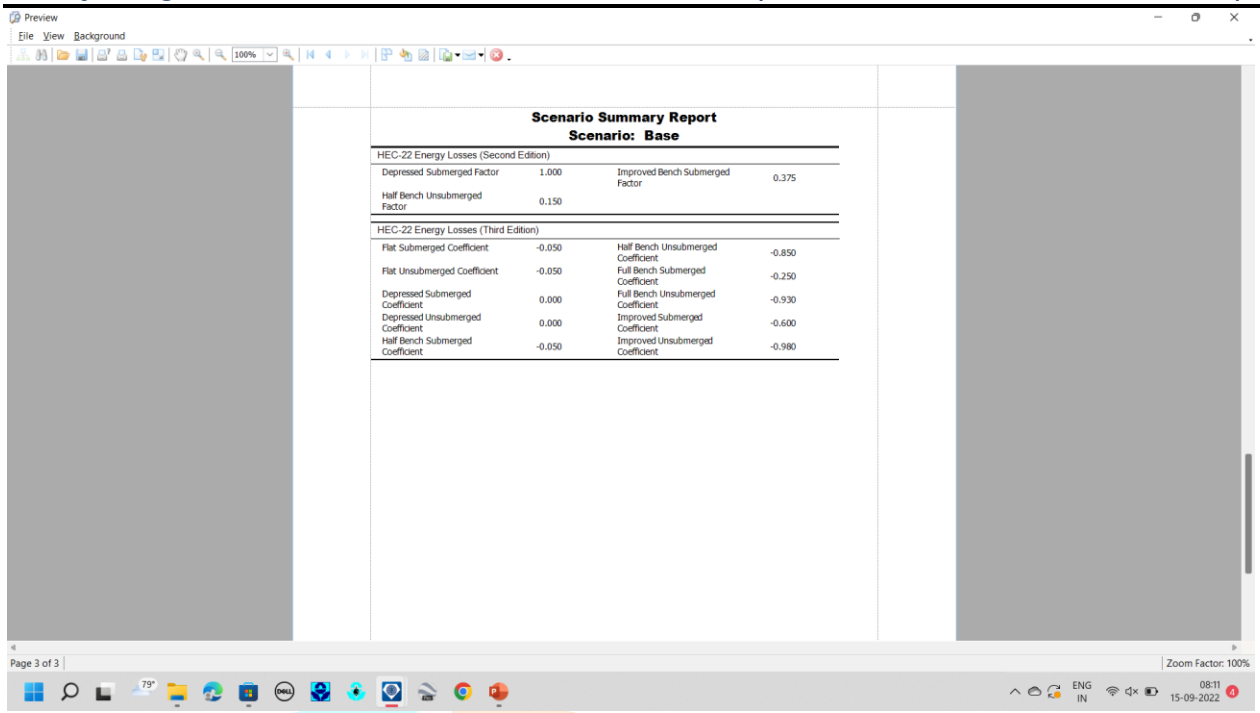
[10.02.01.04]
Page 2 of 3

Page 2 of 3
Zoom Factor: 100%

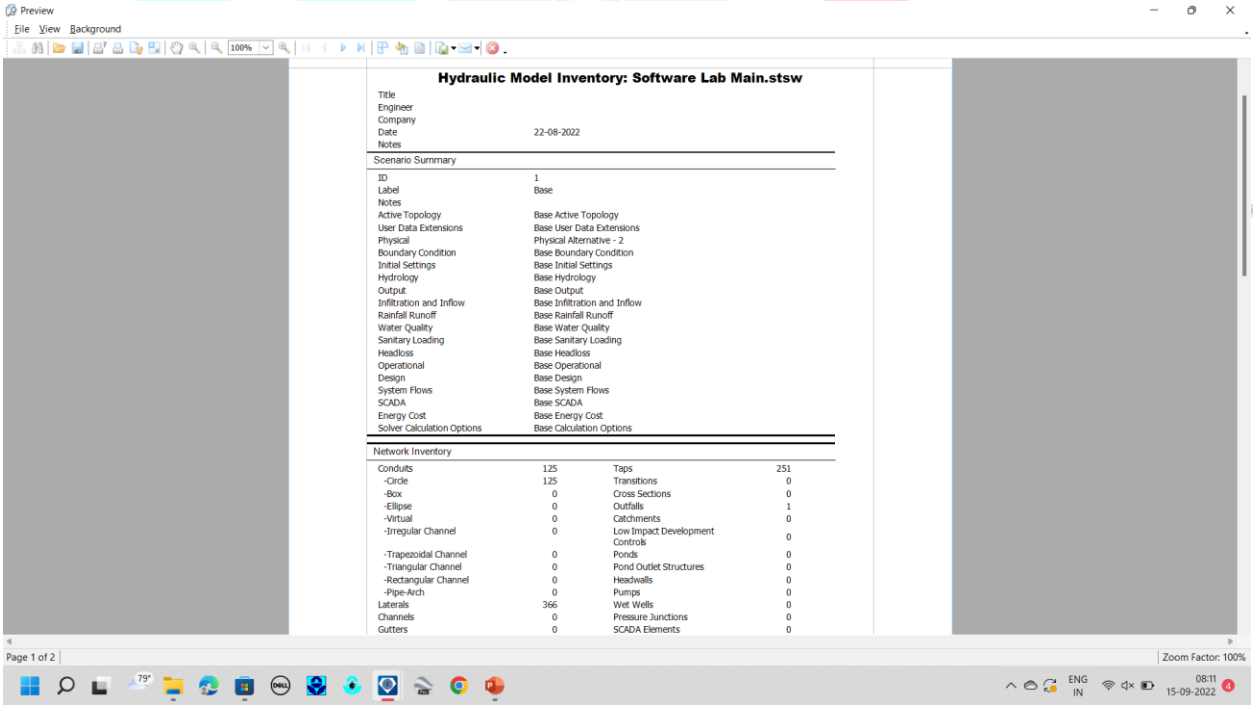


Scenario Summary Report
Scenario: Base

HEC-22 Energy Losses (Second Edition)			
Depressed Submerged Factor	1.000	Improved Bench Submerged Factor	0.375
Half Bench Unsubmerged Factor	0.150		

HEC-22 Energy Losses (Third Edition)			
Flat Submerged Coefficient	-0.050	Half Bench Unsubmerged Coefficient	-0.850
Flat Unsubmerged Coefficient	-0.050	Full Bench Submerged Coefficient	-0.250
Depressed Submerged Coefficient	0.000	Full Bench Unsubmerged Coefficient	-0.930
Depressed Unsubmerged Coefficient	0.000	Improved Submerged Coefficient	-0.600
Half Bench Submerged Coefficient	-0.050	Improved Unsubmerged Coefficient	-0.980

Hydraulic model summary

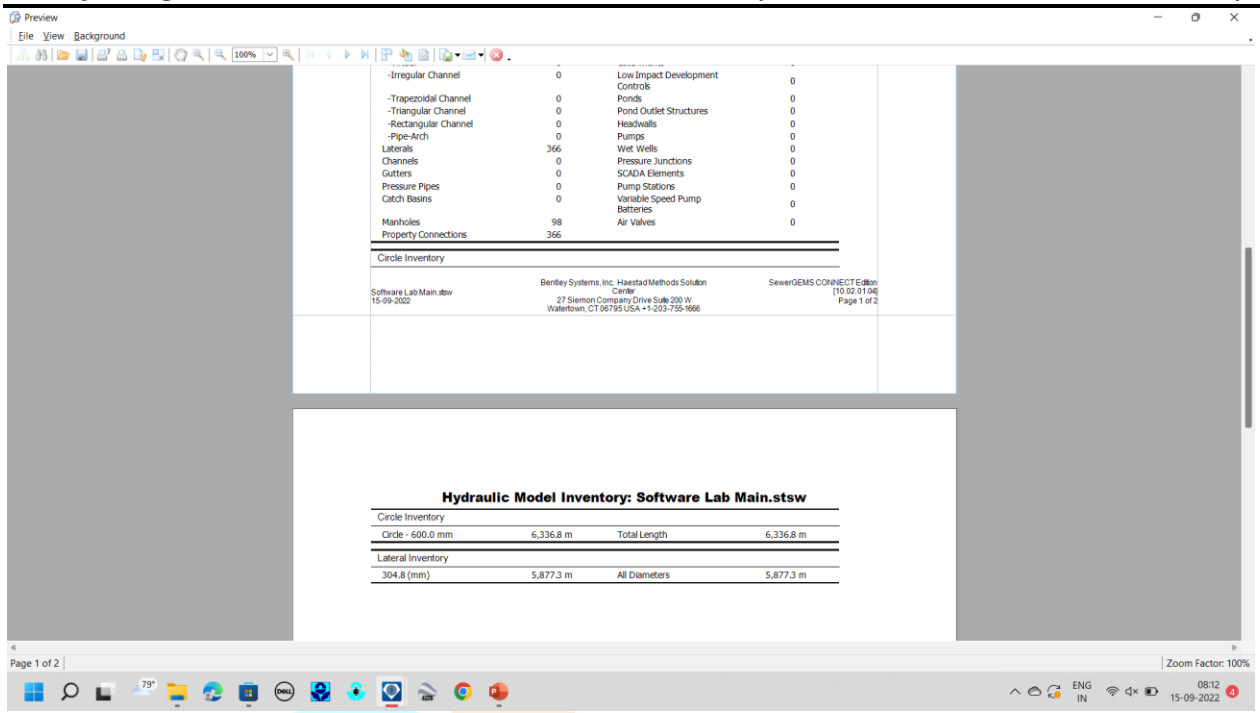


Hydraulic Model Inventory: Software Lab Main.stsw

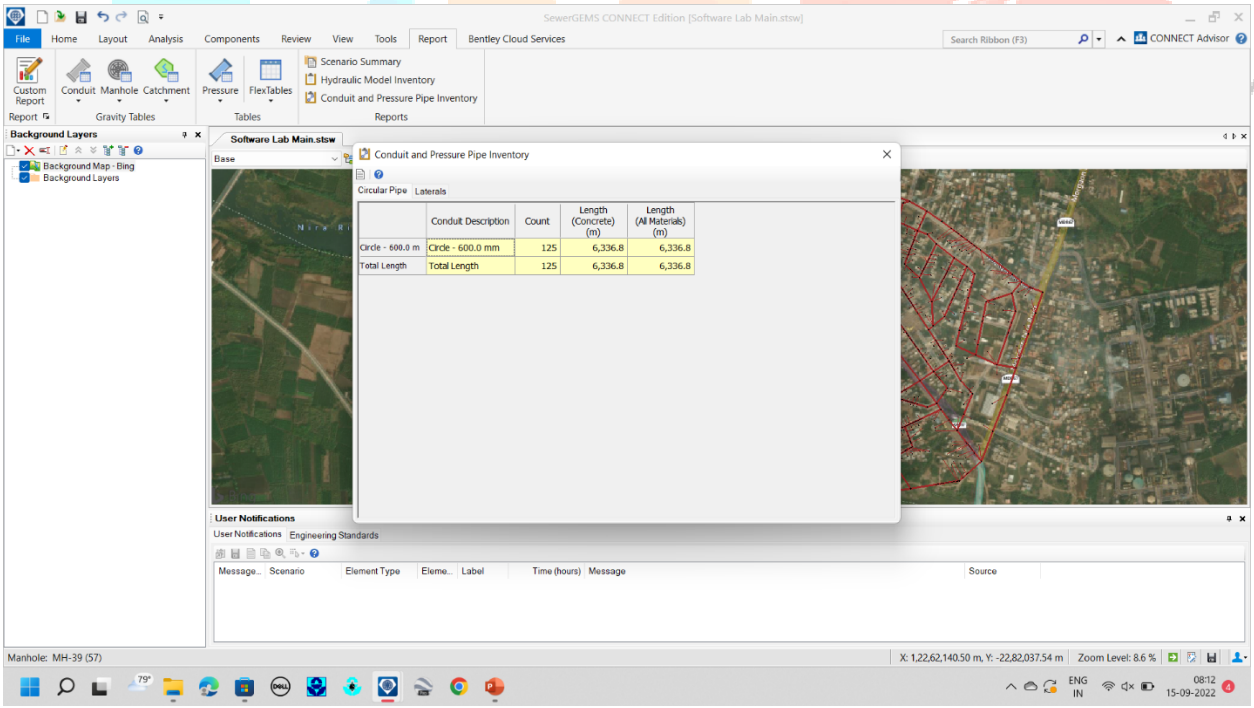
Title	
Engineer	
Company	
Date	22-08-2022
Notes	

Scenario Summary	
ID	1
Label	Base
Notes	
Active Topology	Base Active Topology
User Data Extensions	Base User Data Extensions
Physical	Physical Alternative - 2
Boundary Condition	Base Boundary Condition
Initial Settings	Base Initial Settings
Hydrology	Base Hydrology
Output	Base Output
Infiltration and Inflow	Base Infiltration and Inflow
Rainfall Runoff	Base Rainfall Runoff
Water Quality	Base Water Quality
Sanitary Loading	Base Sanitary Loading
Headloss	Base Headloss
Operational	Base Operational
Design	Base Design
System Flows	Base System Flows
SCADA	Base SCADA
Energy Cost	Base Energy Cost
Solver Calculation Options	Base Calculation Options

Network Inventory			
Conduits	125	Taps	251
-Circle	125	Transitions	0
-Box	0	Cross Sections	0
-Ellipse	0	Outfalls	1
-Virtual	0	Catchments	0
-Irregular Channel	0	Low Impact Development Controls	0
-Trapezoidal Channel	0	Ponds	0
-Triangular Channel	0	Pond Outlet Structures	0
-Rectangular Channel	0	Headwalls	0
-Pipe-Arch	0	Pumps	0
Laterals	366	Wet Wells	0
Channels	0	Pressure Junctions	0
Gutters	0	SCADA Elements	0



Conduits and Lateral Inventory



Graph:

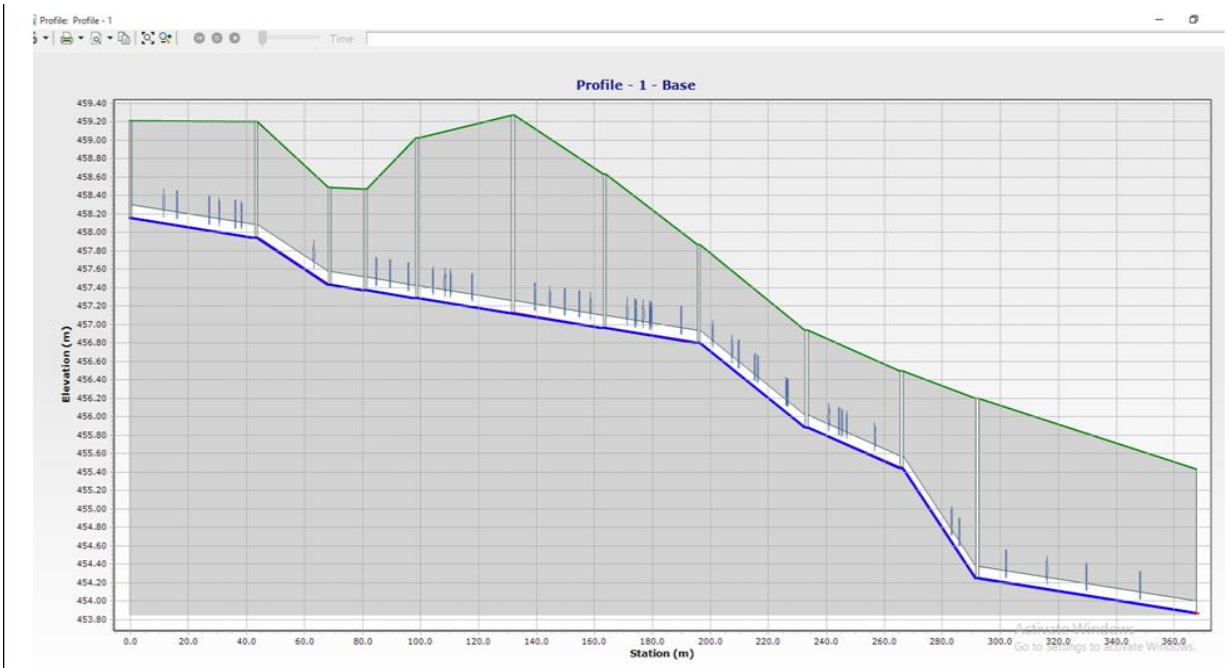


Figure: Profile Diagram

Figure 2: Profile Graph of sewer water flow

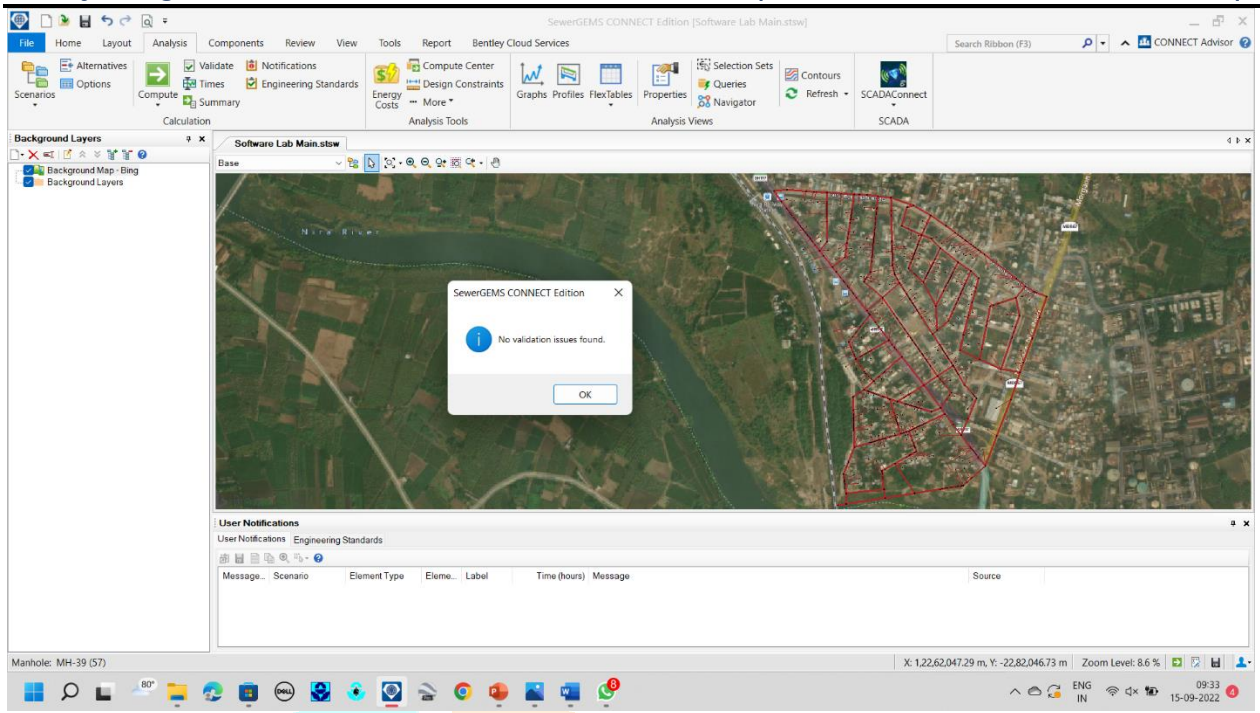
CHAPTER IV

CONCLUSION

Network is successfully designed and analysis is done without any issues. The results are represented in tabular format including details like length, slope, section type, material , diameter , conduit class, etc

Overflow and extreme flow is recognized automatically and hence is best suitable method to design. Observed data is as per the standards, the observed velocity is between 0.6 m/s to 1m/s. (0.93m/s) Actual elevation were taken and model is generated on gravity flow basis.

Visual and less time consuming software for sewerage network till date.



CHAPTER V

SUMMARY

To summarize the work till now,

- **Research papers, articles related to and based on network of sewer design are studied.**
- **Basic terminologies are studied.**
- **Knowledge and basics of Sewergems software and geo spatial imagery is obtained.**
- **Limitations associated with network are identified.**
- **To identify the best suitable network of the area can be studied; preventive measures along with preparedness can be suggested.**

CHAPTER VI

REFERENCES

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2. Naveen Kumar Rai; Sewerage System Assessment Using Sewer Gems V8i and Autocad Civil 3d; International Journal of Engineering Science Invention, May 2020; PP 24-29 Volume 9 Issue 5 Series II ISSN: 2319-6734
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6. Punam Rajpurohit, J.D. Raol, Ajay Patel, Indra Prakash, (2016), Design of sewer network and strom water using sewergems, ISSN: 2366-1157
7. Pankaj K. Roy, S. Mallick, S.Pal, G.Banerjee, A.Mazumdar and R. Chakraborti, (2015), Use of Sewergems V8i for sewer network ISSN:2321-1489