添付資料 4.18

2017 年秋期研修「Asset Management」の教材

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ACADEMY

LECTURE NOTES

Asset Management

Introduction to Asset Management
Module No: 1

2017

Introduction to the Asset Management Course:

This course introduces key concepts related to asset management specifically for water utilities. The examples are generic enough that they can be applied to other manufacturing environments, but the governance concerns are obviously linked to public service asset management. As such, the course focuses on identifying and measuring assets, asset attributes, condition based assessments, risk profiles, asset life cycles, monitoring programs (i.e. reliability and preventative maintenance based), accounting practices, asset valuation and preparing asset replacement plans. This course is especially beneficial for officers of grade 17 and 18 who are directly or indirectly involved in planning and the routine management of assets.

In order to effectively supervise asset maintenance practices to frontline staff, while communicating and reporting asset management to senior management, course participants will be versed in a few key areas of asset knowledge. Course Participants (CPs) will develop knowledge and skills about asset identification, inventory creation, maintenance documentation life cycle assessment and asset condition based measurement. They will be taught to develop, maintain and report out on an asset data base for asset replacement planning. This course will also help the CPs in understanding application of the concepts related to Asset Replacement Plans, Asset Operational Plans (Standard Operating Procedures) and Condition Based Monitoring. The CPs will also be introduced through OJT, to the Asset Management Information System, GIS and other tools.

Why do Asset Management?

Early developments in Computerized Maintenance Management Systems (CMMS) led to the adoption of work management systems for service request generation, work order completion and activity based management and costing. Advances in automation have arguably led to reductions in risk and cost overruns as pertaining to labour allocations and resource management. In other words, the more automation, the less people requiring management. Let us leave contract management of third parties out of the picture for a moment, as their productivity is mixed across utilities. Nevertheless, attention related to CMMS has increasingly turned to asset management. We in the utility sector are faced with costs (energy, consumables and maintenance/replacement services) which are directly linked to assets. Upon the completion of this course the CPs will be in a better position to apply their learning in their routine jobs and prepare an Integrated Development & Asset Management Plan (IDAMP) to provide better water supply and sewerage services to their consumers.

Introduction of Asset Management Module 1:

This module contains four lectures and twelve hours of totaling to three (3) days of class room teaching. Major topics in this module are;

I. Assets and Asset Attributes
II. Condition Based Assessment of different asset types and asset classes
III. Risk assessment of different assets
IV. Application of asset attributes
V. Asset lifecycle
VI. and Asset Management Plan

Lecture 1

1. Lecture Information

Topics: 1) Assets 2) Asset Attributes	
Lecture Duration: 4 Hours	

2. Introduction of Topic

2.1 Brainstorming ~~(10 Minutes)~~

Knowledge testing: What is an Asset?

Current knowledge of course participants related broadly to "Asset and Asset Management" will be assessed through a brainstorming period. The following question will be posed to the class: 'What is an asset?' Probing questions may be asked which speak to 'What can asset information used for?', 'How do we know when to replace equipment/assets?' The expected responses are presented below:

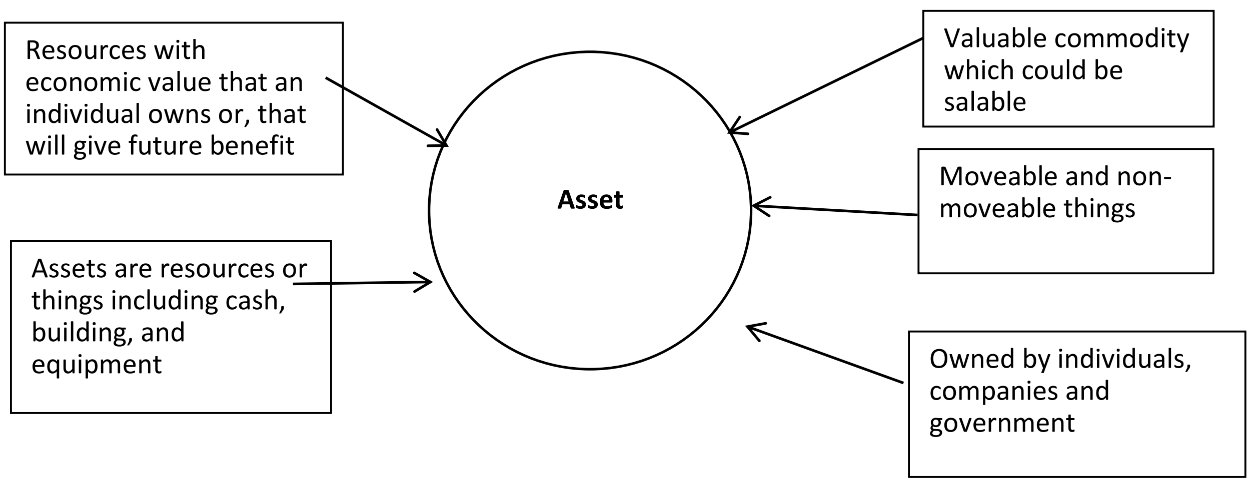


Figure 1: Expected responses to the question "what is an asset?"

2.2. Definition of Asset (10 Minutes)

An asset is anything with value. Assets can be categorized into physical assets, financial assets, human resource asset etc. Rest of the reading will focus on physical assets. There are two types of physical assets which is Current Asset and Fixed Asset.

The authentic definition of an asset is as:

"Anything of value such as an area of land, or a building, or an item of plant or equipment or infrastructure that provides service potential or future economic benefits over a period longer than one year and has a cost which is not "immaterial" (typically

defined as more than, say, Rs. 100,000). Assets are typically classified as either "financial" (cash, stocks, debt instruments), "intangible" (intellectual property, goodwill) or "physical". Unless otherwise specified, the term "asset" as used in is assumed to be a physical asset or more specifically fixed assets."

Asset(s) are the physical resources of a business, such as plants, facilities, fleets or their parts and components (Campbell and Reyes-Picknell, 2006)

Asset List is a register of items usually with information on manufacturer, vendor, specifications, classification, costs, warranty and tax status (Campbell and Reyes-Picknell, 2006)

Asset Management is the systematic planning and control of a physical resource throughout its economic life (Campbell and Reyes-Picknell, 2006)

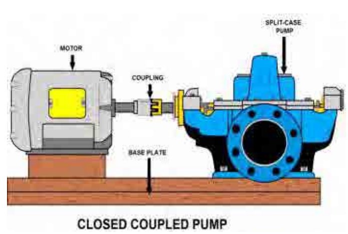
The introductory activity must end by summarizing course participants' responses, appreciating and encouraging them and clarifying their misconceptions if any. If the lecturer is organized, they should tabulate the definitions on the board (or on white paper) by utility (what assets are used for) and by discipline (an engineering definition, operator definition, management definition, financial definition). This can then be used later to show the CPs what their original thoughts on an asset were and how they have changed after taking the course.

Exercise # 1: **(20 minutes)**

Please list and present a number of critical aboveground and belowground assets of WASAs. Divide them into the following services;

1. Water supply services
2. Sewerage (wastewater) services
3. Drainage (storm water) services

Examples and Pictures of 'Assets in WASAs'

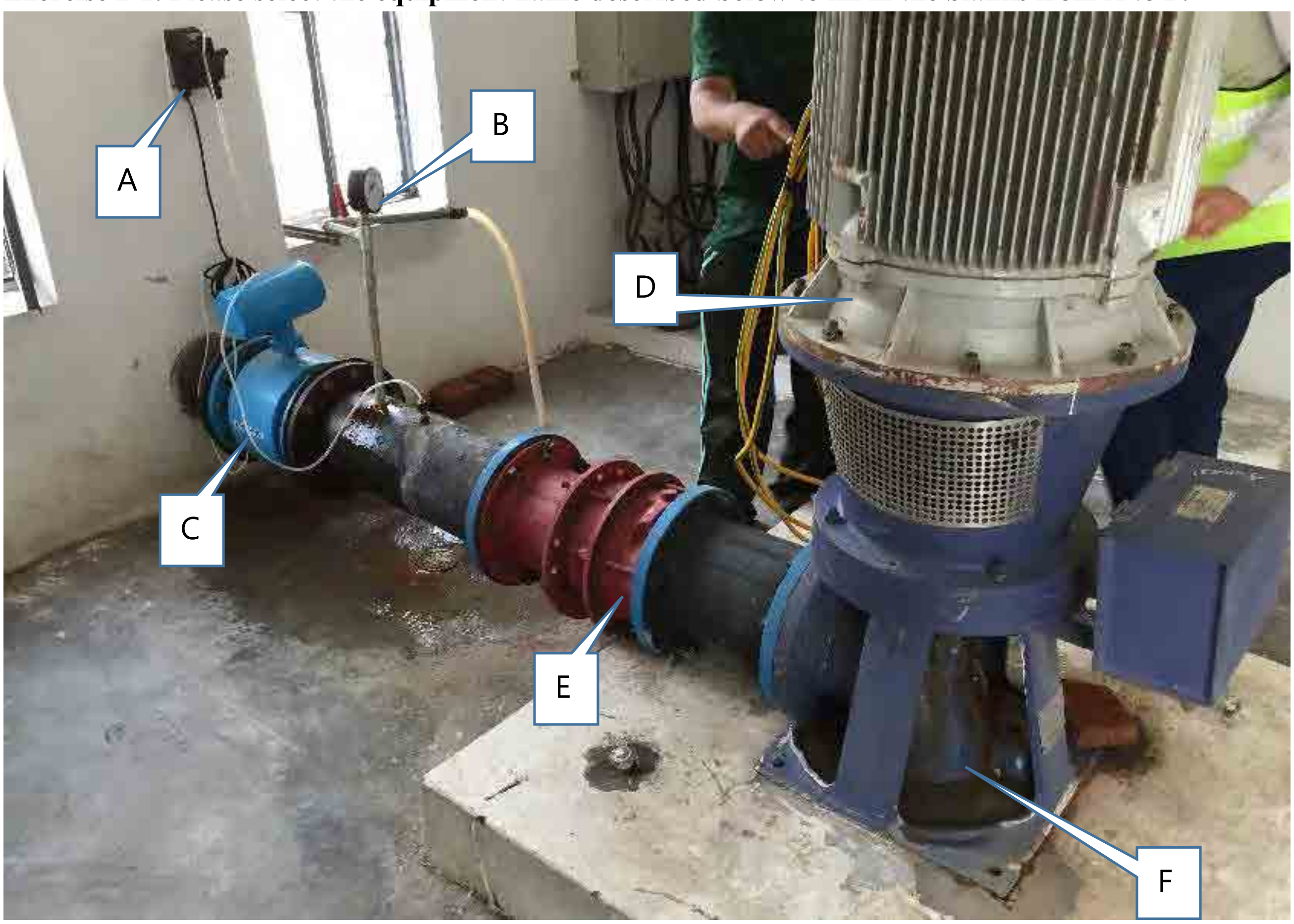


The list of assets includes;

1) Water Supply pipelines
2) Sewerage Pipelines
3) Tube wells
4) Disposal Stations
5) Vehicles
6) Transformers
7) Electrical & Mechanical Works
8) Buildings

Exercise # 2: (20 minutes)

Exercise 2-1. Please select the equipment name described below to fill in the blanks from A to F.



Pump, Motor, Flow meter, Non return valve, Pressure gauge, Chlorine dosing pump

Also indicate how you label the asset as part of your standard operating procedures, maintenance manuals, daily logs, inspections and reports to senior management

Answers may include: Process area, by equipment type, by numerical tag, by year of commissioning, etc. Lecturer should ask the CP if the label and asset tagging standard is consistent across the organization.

As a reference, Toronto Water uses the following asset tagging method:

A. Coding System:

- The code consists of up to eighteen (18) characters and each section may be of an alpha-numeric combination.
- Dashes are included, as shown in the examples below, for GE RPUs' and are replaced by underscore "_".
- The basic code shall be:

AAA-	**CCC-**	**AAAA-**	**NNNN**	**A**
(1)	**(2)**	**(3)**	**(4)**	**(5)**

Where:	A	Denotes Alphabetic character (letter)
	N	Denotes Numeric character (number)
	C	Denotes generic Character (either alphabetic or numeric)

The different groups of characters are split into various fragments which have specific functions meanings. These fragments or groups of characters are denoted by the numbers 1 to 5 and have the following functions:

Fragment 1 is a three-digit character representing the facility or location (site). (See section 3.01)

Fragment 2 is a two or three character code representing a process/sub-process performed within the facility or site. Water mains, reservoirs and pumping stations are classified as processes in the tag name. (See section 3.02)

Fragment 3 is a one to four-character code representing the type of equipment (section 3.03), instrument (section 3.04) or signal (section 4.07) codes.

Fragment 4 is a four-character alpha / numeric code (alpha is only to be used for electrical equipment to represent existing numbering conversions that are difficult to change due to both health and safety and operational reasons) that identifies the equipment number **(this may contain loop number intelligence for process equipment that is associated to other equipment – see section 3.05).** Where loop numbers are not used (for stand alone equipment), leading zeroes are used to fill the code for numbers with less than four characters. For water mains, the Equipment number is the chamber number.

Fragment 5 is a one character alpha code to differentiate between otherwise duplicate equipment items (see the example in section B below. FCL-FLT-LIT-0012A Fragment 5 is an extension of fragment 4 used only when needed for duplicate equipment)

B. Example Equipment and Loop Coding

The following is an example of an equipment and loop names.

THR-PRM-V-0551

(1)	(2)	(3)	(4)	(5)
THR-	**PRM-**	**V-**	**0551**	
Humber Treatment Plant	Primary Treatment Process	Valve	No. 551	No Duplicate

FHA-TRW-P-0100 (including associated equipment in the loop)

(1)	(2)	(3)	(4)	(5)
FHA-	**TRW-**	**P-**	**0100**	
Harris Filtration Plant	Treated Water Process	Pump	No. 1	No Duplicate
FHA-	**TRW-**	**V-**	**0101**	
Harris Filtration Plant	Treated Water Process	Valve (Suction)	1st Valve in loop	No Duplicate
FHA-	**TRW-**	**V-**	**0102**	
Harris Filtration	Treated Water	Valve	2nd Valve	No

Plant	Process	(Check)	in loop	Duplicate
FHA-	**TRW-**	**SWG-**	**0101**	
Harris Filtration Plant	Treated Water Process	**Switch Gear**	**Switch Gear** for Pump No. 1	No Duplicate

TAB-STR-PAL-2332

(1)	**(2)**	**(3)**	**(4)**	**(5)**
TAB-	**STR-**	**PSL-**	**2332**	
Ashbridges Bay Treatment Plant	Secondary Treatment	Pressure Switch Low	No. 2332	No Duplicate

FCL-FLT-LIT-0012A

(1)	**(2)**	**(3)**	**(4)**	**(5)**
FCL-	**FLT-**	**LIT-**	**0012**	**A**
Clark Filtration Plant	Filtration Process	Level Indicating Transmitter	No. 12	First Duplicate

WTR-PEG-FIT-0324

(1)	**(2)**	**(3)**	**(4)**	**(5)**
WTR-	**PEG-**	**FIT-**	**0324**	
Water Transmission	Eglinton Pumping Station	Flow Indicating Transmitter	Loop 3 FIT 24	No Duplicate

WTR-103-FIT-0012

(1)	(2)	(3)	(4)	(5)
WTR-	**103-**	**FIT-**	**0012**	
Water Transmission	Water Main 103	Flow Indicating Transmitter	Chamber 12	No Duplicate

A:__________________________

B:__________________________

C:__________________________

D:__________________________

E:__________________________

F:__________________________

Exercise 2-2: Please write each function as well as the relationship to the assets upstream and downstream of this particular process area (in other words, if this asset does not work well, how does it impact the rest of the system? This will get CPs thinking about a larger system perspective.

A (function: ____)

B (function: ____)

C (function:____)

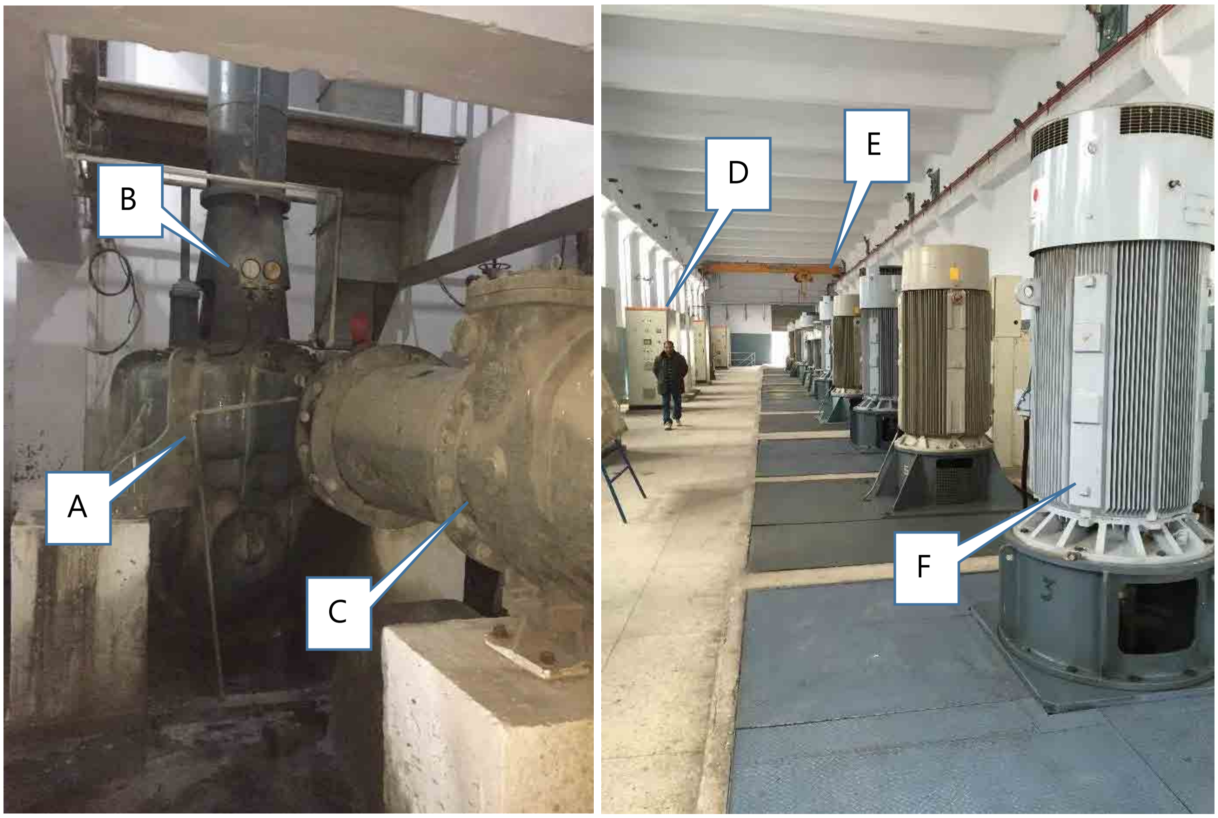
D (function:____)

E (function:____)

F (function:____)

Exercise # 3: **(20 minutes)**

Exercise 3-1: Please select the equipment name described below to fill in the blanks from A to F.



Control panel, Motor, Non return valve, Pump, Crane, Pressure gauge

A: ______________________________

B: ______________________________

C: ______________________________

D: ______________________________

E: ______________________________

F: ______________________________

Exercise 3-2: Please write each function.

A (function: ____)

B (function: ____)

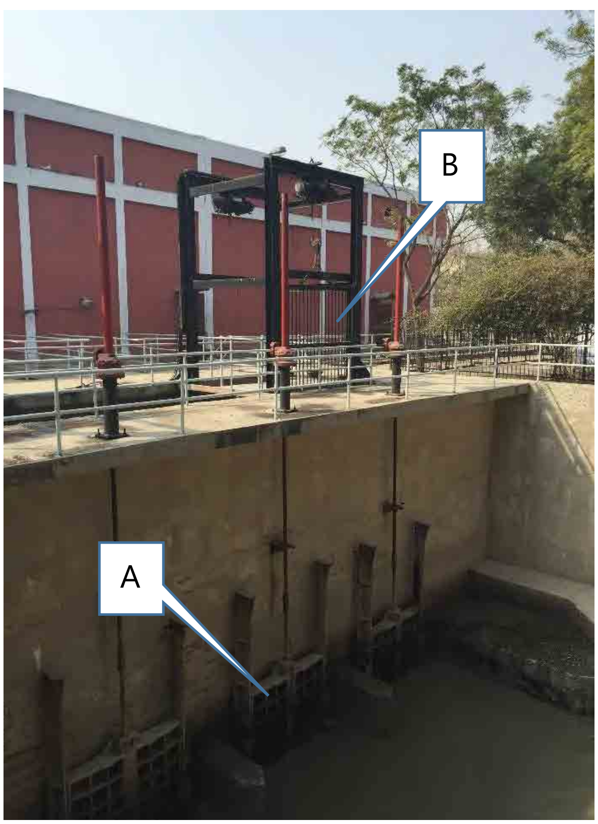
C (function: ____)

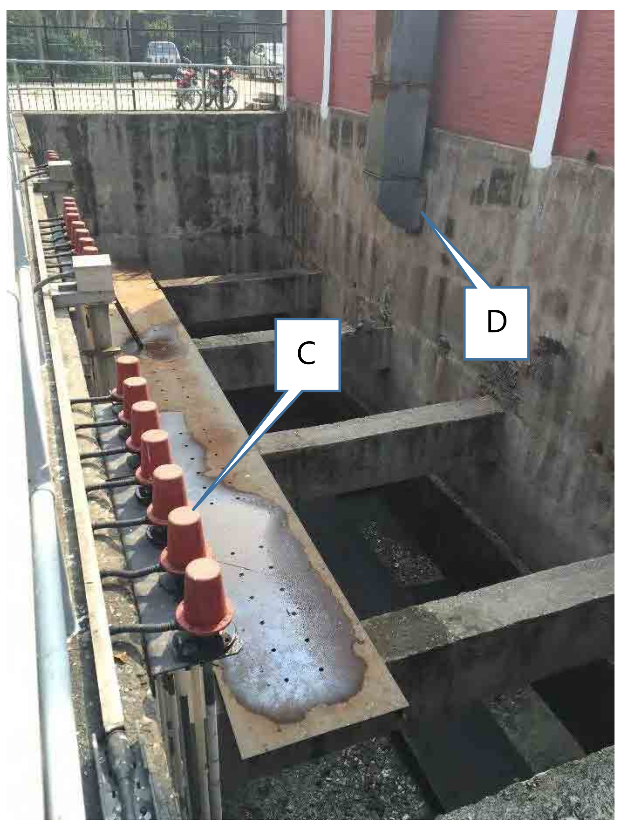
D (function: ____)

E (function: ____)

F (function: ____)

Exercise 3-3: Please select the equipment name described below to fill in the blanks from A to D.





A:______ B:______ C:______ D:

Water level censer, Penstock valve, Exhaust duct, Screen facility

Exercise 3-4: Please write each function.

A (function: ____)

B (function: ____)

C (function: ____)

D (function: ____)

2.3. Asset Attributes: (40 Minutes)

Asset attributes

Every asset has a certain set of attributes like historical cost, book value, condition, risk, capacity, residual life, efficiency etc. Other attributes include:

- Physical attributes including size, material, installation date, manufacturer, model, date deployed, spare parts and numbers, etc.
- Asset condition, performance and probability of failure data.
- Procedures to secure AM related data security and archive records required for legal or knowledge preservation purposes

Scale to determine conditions of different assets - handouts

The condition scales of different assets are as under:

Water & Wastewater Networks Condition Rating			
Rank	**Rating**	**Condition**	**Description**
A	Excellent	Very Good Condition	Only normal maintenance required. No failures. Complies with engineering standards.
B	Good	Minor Defects Only	Minor maintenance required (5%). Few failures.

			Few areas not complying with engineering standards.
C	Fair	Maintenance Required to Return to Accepted Level of Service	Significant maintenance required (10-20%). Failures beginning to occur. Significant areas not complying with engineering standards.
D	Poor	Requires Renewal	Significant renewal / upgrade required (20-40%). Regular failures occurring and significant corrosion. Increased operating costs as a result. Many parts must be replaced.
E	Critical	Asset Unserviceable	Over 50% of asset requires replacement. Significant failures and should be substantially reconstructed.

Water Supply and Wastewater Condition Grading Standards: Civil Structures		
Grade	**Condition**	**Description**
0	Non-existent	Asset abandoned or no longer exists.
1	Excellent	Sound physical condition: Asset likely to perform adequately without major work for 25 years or more.
2	Good	Acceptable physical condition: Minimal short-term failure risk but potential for deterioration in long-term (10 years plus). Only minor work required (if any).
3	Fair	Significant deterioration evident: Failure unlikely within next 2 years but further deterioration likely and major replacement likely within next 10 years. Minor components or isolated sections of the asset need replacement or repair now but asset still functions safely at adequate level of service. Work required but asset is still serviceable.
4	Poor	Failure likely in short-term. Likely need to replace most or all of asset within 2 years. No immediate risk to health or safety but works required within 2 years to ensure asset remains safe. Substantial work is required in short-term, asset barely serviceable.
5	Critical	Failed or failure imminent. Immediate need to replace most or all of asset. Health and safety hazards exist which present a possible risk to public safety or asset cannot be serviced / operated without risk to personnel. Major work or replacement required urgently.

Condition Grading System for Building Assets	
Element	**CONDITION GRADE**

<table>
<tr><th rowspan="2"></th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th></tr>
<tr><th>Excellent</th><th>Good Condition</th><th>Moderate Condition</th><th>Poor Condition</th><th>Critical</th></tr>
<tr><td>Estimated Proportion of Life Consumed</td><td>Up to 45%</td><td colspan="3">Between 45% to 90%</td><td>90% to 100%</td></tr>
<tr><td>Structure</td><td>Sound structure.</td><td>Functionally sound structure.</td><td>Adequate structure, some evidence of foundation movement, minor cracking</td><td>Structure functioning but with problems due to foundation movement. Some significant cracking.</td><td>Structure has serious problems and concern is held for the integrity of the structure.</td></tr>
<tr><td>External</td><td rowspan="2">Fabric constructed with sound materials, true to line and level. No evidence of deterioration or discolouration.</td><td rowspan="2">Showing minor wear and tear and minor deterioration of surfaces.</td><td>Appearance affected by minor cracking, staining, or minor leakage. Indications of breaches of weatherproofing. Minor damage to coatings.</td><td>Fabric damaged, weakened or displaced. Appearance affected by cracking, staining, overflows, or breakages. Breaches of weatherproofing evident. Coatings in need of heavy maintenance or renewal.</td><td>Fabric is badly damaged or weakened. Appearance affected by cracking, staining, overflows, leakage, or damage. Breaches of waterproofing. Coatings badly damaged or non-existent.</td></tr>
<tr><td>Internal</td><td>Appearance affected by minor cracking, staining, or minor leakage, some dampness or mildew. Minor damage to wall / ceiling finishes.</td><td>Fabric damaged, weakened or displaced. Appearance affected by cracking, staining, dampness, leakage, or breakages. Breaches of waterproofing evident. Finishes of poor</td><td>Fabric is badly damaged or weakened. Appearance affected by cracking, staining, leakage, or wilful damage. Breaches of waterproofing. Finishes badly</td></tr>
</table>

				quality and in need of replacement.	damaged, marked and in need of replacement.

Water Supply and Wastewater Condition Grading Standards: Mechanical and Electrical Assets		
Grade	**Condition**	**Description**
0	Non-existent	Asset abandoned or no longer exists.
1	Excellent	Plant in sound physical condition designed to meet the current standards. Operable and well-maintained. Asset likely to perform adequately within routine maintenance for 10 years or more. **No work**.
2	Good	Acceptable physical condition but not designed to current standards, or showing minor wear. Deterioration has minimal impact on asset performance. Minimal short-term failure risk but potential for deterioration or reduced performance in medium term (5-10 years). **Only minor work required (if any).**
3	Fair	Functionally sound plant and components, but showing some wear with minor failures and some diminished efficiency. Minor components or isolated sections of the asset need replacement or repair but asset still functions safely at adequate level of service. For example, bearing and gland wear becoming evident and some corrosion present. Deterioration beginning to be reflected in performance and higher attendance for maintenance. Failure unlikely within 2 years but further deterioration likely and major replacement required within next 5 years. **Work required but asset still serviceable**.
4	Poor	Plant and components function but require a high level of maintenance to remain operational. Likely to cause a marked deterioration in performance in short-term. Likely need to replace most or all of assets within 2 years. No immediate risk to health or safety but work required within 2 years to ensure asset remains safe. **Substantial work required in short-term, asset barely serviceable**.
5	Critical	Failed or failure imminent. Plant and component effective life exceeded and excessive maintenance costs incurred. A high risk of breakdown with a serious impact on performance. No life expectancy. Health and safety hazards exist which present a possible risk to public safety, or the asset cannot be serviced / operated without risk to personnel. **Major work or replacement required urgently.**

Case Study Calgary Rating Scale by Condition Category

CONDITION CATEGORY DESCRIPTION RATING SCALE

Physical refers to the physical deterioration of the asset.

- Very good – Sound or “as new” condition
- Good – Acceptable physical condition. Asset shows only minor deterioration.
- Fair – Tolerable physical condition. Moderate deterioration evident.
- Poor – Major deterioration evident.
- Critical – Asset deteriorated to such an extent that it is generally inoperable or unsafe.

Demand refers to the asset’s capacity to deal with long-term demand or usage.

- Excellent – The asset has capacity to comfortably deal with long-term demand, loading or usage requirements.
- Good – The asset has capacity to comfortably deal with medium-term demand, loading or usage requirements, but may have minor long-term shortcomings.
- Moderate – The asset’s design and function are generally aligned with its current purpose although there may be some minor shortcomings.
- Borderline – The asset is operating near the limits of its design parameters and only has capacity to deal with short-term demands, loading or usage requirements.
- Fail – The asset is already operating at the limits of/or in excess of its design parameters and/or is incapable of meeting any short-term demands, loading or usage requirements.

Functional The level of alignment with the asset’s current purpose.

- Excellent - The asset’s design and function are fully aligned with its current purpose.
- Good – The asset’s design and function are well aligned with its current purpose.
- Moderate – The asset’s design and function are generally aligned with its current purpose although there may be some minor shortcomings.
- Borderline – The asset’s design and function are only partially aligned with its current purpose and there are significant shortcomings.
- Fail – The asset’s design and function are substantially misaligned with its current purpose.

2.4. Asset Conditions Assessment: (40 minutes)

How to determine the condition of assets using asset attributes like physical appearance, performance efficiency, and failure history?

Asset physical condition reflects the physical state of the asset which may or may not affect its performance. It is imperative for an organization to have a clear picture of the physical condition of their assets and their current level of service. All management decisions regarding maintenance, rehabilitation and renewal revolve around these two aspects. Oblivion to the current asset condition may lead to the premature failure. Asset physical condition analysis is used to determine the need and timing of some preventative or remedial maintenance to ensure desired Level of Service and prevent service breakdown.

Following factors contribute to the overall condition of an asset:

- Its age
- Its operating environment (what weather etc. it is exposed to)

- Its apparent wear and tear
- How well it is treated by the community
- How much use it gets

According to USEPA GHD; Asset condition can be analyzed by using the following methodology. A score from 5-1 shall be awarded by the O&M department for each factor. Asset condition can be specified using the following scales:

1. Physical Condition

Physical Condition	New/ Excellent Condition	Minor Defects Only	Moderate Deterioration	Significant Deterioration	Unserviceable
Score	*1*	*2*	*3*	*4*	*5*

2. Asset Performance ()

Performance ()	Meets Performance Targets	Minor Performance Deficiencies	Considerable Performance Deficiencies	Major Performance Deficiencies	Doesn't Meet Performance Targets
Score	*1*	*2*	*3*	*4*	*5*

3. Asset reliability

Reliability	As Specified by Manufacturer	Random Breakdown	Occasional Breakdown	Periodic Breakdown	Continuous Breakdown
Score	*1*	*2*	*3*	*4*	*5*

Asset Condition Rating

An average score shall then be calculated by the O&M department and final score shall be awarded on the basis of average score of all the factors.

Average Score	*1*	*2*	*3*	*4*	*5*
Asset Condition	Excellent	Good	Fair	Poor	Failing
Category	*A*	*B*	*C*	*D*	*F*

Average figures may be rounded off to the nearest whole number for convenience

Action on the basis of Condition Assessment

Category	Asset Condition	Actions Required
A	Excellent	Only Normal Maintenance Required
B	Good	Minor Maintenance And Rehabilitation Required
C	Fair	Significant Maintenance And Minor Rehabilitation Required
D	Poor	Significant Renewal/ Upgrade Required
F	Critical	Major Renewal/Replacement Required

Exercise # 4:

Please determine the condition of Tubewell using following information and justify your answer in light of the preceding parameters and criteria:

(An actual case study of WASA will be used.)

Group work

1. **Asset management system in each wasa and strength and weakness – Lab work**
2. **Asset condition exercise – class work**

Asset Code

Coding of Asset

WASA Lahore example of Asset Register by JICA


Table 10.4 Information to Be Input in Ledger (Example)

Level	Description	Description	AMIS
I	District	Lahore	180
		Faisalabad	090
		Rawalpindi	020
		Gujranwala	120
		Multan	260
II	City	Lahore	1850
		Faisalabad	1490
		Rawalpindi	1100
		Gujranwala	1630
		Multan	2120
III	Town (WASA Lahore)	Allama Iqbal	106
		Gunj Buksh	109
		Ravi	101
IV	Union Council	Gulberg	097
		Mozang	079

Lecture 2

1. Lecture Information

Topic:	1) Measuring Risk as pertaining to Assets 2) Application of Asset Attributes for decision making
Lecture Duration:	4 Hours

2. Introduction to Topic

2.1. Setting the Basics: (10 Minutes)

Knowledge Testing: what is a Risk?

"Risk can be defined as a situation involving exposure to danger or possibility of loss. The risk related to physical assets is called Asset Failure risk. Simply put, it means that assets have inherent risks or the potential for failure."

Risk is often defined as a measure of the probability and severity of adverse effects [Lowrance 1976]. In an era of austerity and increasing pressure on operating and capital costs, asset managers are spending more resources in building their understanding of risks as related to assets and decision making regarding asset management.

In assessing risk to assets, managers often consider a few questions: What can go wrong with an asset? What is the likelihood that it would go wrong? And, what are the consequences of this asset failing? Answers to these questions help asset managers identify, measure, quantify, and evaluate risks and their consequences and impacts to assets.

(Adapted from University of Virginia, Centre for Risk Management of Engineering Systems http://bart.sys.virginia.edu/risk/riskdefined.html)

The following scale is used worldwide to determine risk of an asset;

a) Significant
b) High
c) Medium
d) Low

2.2. Asset Risk Assessment (90 minutes)

The risks must be clearly understood and managed to assure cost-effective service delivery.

ISO 55002 states that "*the organization should determine the actions that are necessary for addressing risks when planning for its asset management system. The overall purpose is to understand the cause, effect and likelihood of adverse events occurring, to manage such risks to an acceptable level, and to provide an audit trail for the management of risks. The intent is for the organization to ensure that the asset management system achieves its objectives, prevents or reduces undesired effects, identifies opportunities, and achieves continual improvement.*

Addressing risks in the asset management system, the organization should determine the risk assessment criteria (e.g. likelihood and consequence, and risk attitude). A risk matrix may be used as part of this process."

For every risk there are some conditions or vulnerabilities that give rise to such risk. These vulnerabilities are called the risk factors/ contributing factors. The greatest risk associated with Asset Management is "*Asset Failure Risk*". There are two basic factors that determine the **magnitude** of Asset Failure Risk.

- Probability (likelihood) of Asset Failure
- Impact of Asset Failure

a) Probability of Asset Failure

The Probability of asset breakdown can be defined as the likelihood that the asset will fail. Asset breakdown does not necessarily means that an asset is faulty and has stopped working; it can also mean that the asset is not contributing to the service delivery as it should.

Following factors can be analyzed to predict the probability of Asset Failure:

- Asset Condition
- Asset Effective Age
- Past Failure history

Asset probability of failure can be calculated according to the following scales:

Condition	A	B	C	D	F
Probability of Failure Rating	*1*	*2*	*3*	*4*	*5*

b) Impact of Asset Failure

Impact of the asset failure means the gravity of damage failure of said asset would do to service delivery. The larger service delivery is, the more impact it has. Thus, assets can be categorized into two broader categories in respect of the impact, namely:

- Critical Assets
- Non critical assets

Critical assets are those assets which are essential for the service delivery and their failure may have severe impact on the business. Failure of a critical asset will adversely affect delivery of service if not bring it to a halt. It should be kept in mind that critical assets are those that have adverse consequences of failure but not necessarily a high probability of failure. It is important to identify critical assets, to target and refine maintenance plans, capital expenditure plans, and investigative activities at the critical areas.

Potential consequences of asset failure are assessed against 4 key strategy elements:

- Environment - damage to the environment
- Customer - disruption of the customer/community
- Efficiency- costs associated with the failure
- Culture – potential for injury or damage when repairing a failed asset

Based on the aforementioned potential impacts/ consequences associated with the failure of asset, Impact of an asset to the service delivery can be assigned using the following scale.

Impact	Total System Failure	Facility/ Sub-Division Failure	Asset Failure	Major Component Failure	Minor Component Failure
Scale Value	*5*	*4*	*3*	*2*	*1*

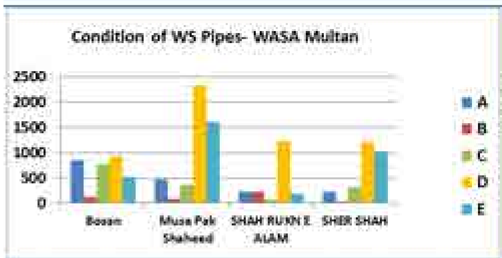
Risk Rating

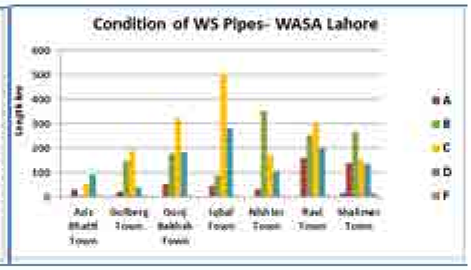
The overall risk depends on both the probability and consequence of the event. As mentioned above, the overall asset failure risk depends upon the Probability of asset failure and Impact of Asset Failure (Asset Criticality)

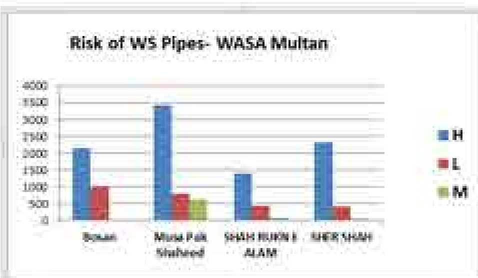
Thus asset failure risk is the product of Probability rating and the impact rating. Calculation steps are shown in the following table:

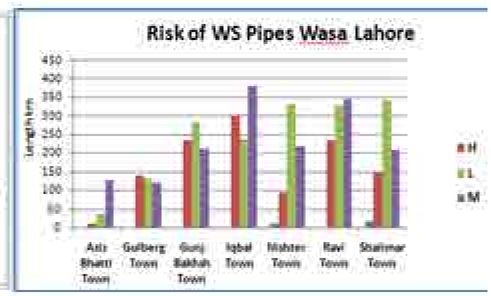
Probability	**Impact (criticality assessment)**				
	1	***2***	***3***	***4***	***5***
A	Low Risk	Low Risk	Low Risk	Moderate Risk	High Risk
B	Low Risk	Low Risk	Moderate Risk	High Risk	High Risk
C	Low Risk	Moderate Risk	High Risk	High Risk	Significant Risk
D	Moderate Risk	High Risk	High Risk	Significant Risk	Significant Risk
F	High Risk	High Risk	Significant	Significant	Significant

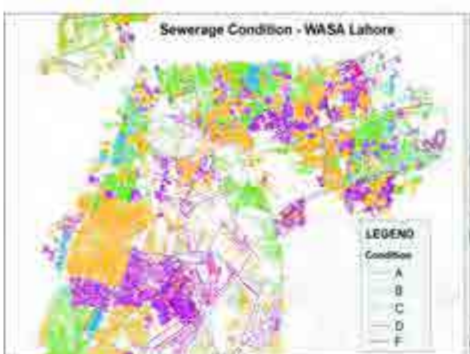
			Risk	Risk	Risk

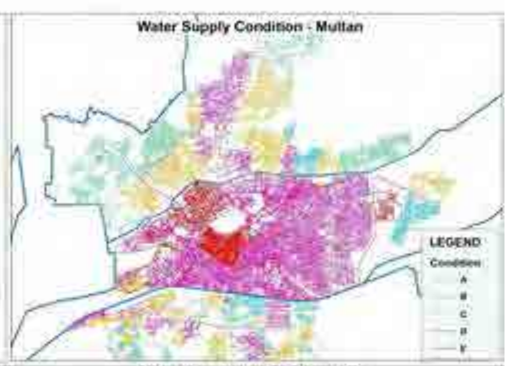


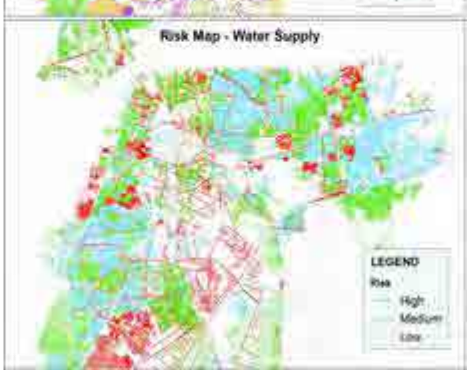












The following industry best practices are employed when developing a risk management framework (RMF)

B.1 Establish a Risk Context

Effective risk management programs are characterized by clear objectives that an organization is trying to meet. Setting the context of a risk assessment serves to scope the risk assessment process. Industry leading practice suggests this is done best by aligning strategic objectives and goals to asset-specific customer and technical levels of service. Risks to assets against these service levels and metrics are then used to form the basis for identification of critical assets with a particular service area (e.g. water, wastewater, storm water).

B.2 Identification of Risk

This step focuses on the identification of applicable risk scenarios for assets. Risk scenarios should consider threats related to natural disasters, third party damage, proximity to dangerous sites, operational process / methods, physical breaks and design and construction.

B.3 Risk Evaluation

Risk is typically expressed as the product of Probability of Failure x Consequence of Failure. More sophisticated measures of risk evaluation include vulnerability analysis. Each is discussed further below.

- **Probability of Failure Analysis:** Probability of failure (PoF) measures the “probability” or “likelihood” that an asset will fail to meet is desired level of service objectives. Many industry leaders have developed 5 point rating scales to evaluate PoF that reflect the percent (%) chance of failure occurring or a temporal measure (e.g. number of years) for estimated failure. PoF is best measured through formal condition assessment of an asset. In the absence of condition data, deterioration modelling, asset age relative to maximum potential life (MPL), historical records, staff knowledge, industry trends, fundamental risk, site experience and data, expert judgement and applicable regulatory requirements.
- **Consequence of Failure Analysis:** Consequence of Failure (CoF) provides a measure for the consequence of an asset failure. From an organizational perspective, consequence of failure encompasses failure to meet established customer and technical levels of service related to capacity, health and safety, financial and asset integrity considerations. The impacts of CoF in these areas should be measured against triple bottom line impacts - Social, Environmental and Financial.
- **Vulnerability Analysis:** Vulnerability analysis recognizes the extent to which an asset can withstand a risk event. Vulnerability criteria are typically associated with asset attributes, design parameters, operating conditions and site data. This criterion is used to supplement the PoF evaluation of a watermain segment being able to withstand a risk event.

Risk = │Probability (PoF) x Vulnerability (V) │ x │ Consequence (CoF) │

B.4 Mitigation Plans

Industry leaders in risk management have adopted an approach to mitigation planning that is based on a cost–benefit–risk analysis to identify mitigation strategies that provide the greatest overall risk reduction for the lowest cost. This is typically done through cost benefit analysis

(CBA) or net present value (NPV) economic analysis of potential mitigating options. The outcome of the phase in the risk management process consists of program-level mitigation strategies based on like strategies and organized around short, medium and long term delivery times and geographic areas (e.g. pressure zones).

B.5 Implementation

Implementation of risk assessment and evaluation processes are primarily undertaken by geographic or pressure zone boundaries. Mitigation planning is done similarly but further organized into program level initiatives (e.g. Program to replace metallic pipe to reduce the risk of physical pipe failure from corrosion).

B.6 Monitoring and Review

Monitoring and review programs are characterized by updating risk profiles on an annual basis and updating residual risk scores following implementation of mitigation strategies.

Exercise # 4: Please determine the Risk of Tubewell and disposal station (extending the previous case):

(The case will be developed based on actual information)

Group Exercise – all wasa / KSB/NSUSC

Data on tube well with its condition

Exercise

Data on tube well with its condition

Exercise

Your managing director has asked you to prepare a risk report of tube wells data based on the consultant report as attached.

You will use the risk table to determine the risk and its impacts

Use condition table

Impact table

Write a report to MD - 3 paragraph recommendation what to do with asset along with table of condition and impact marks

2.3. Combining Condition, Risk and Residual life to plan (20 minutes)

The course participants will be asked to list down the possible uses of condition, risk and residual life in future planning of assets. The possible answers are;

a) Replace the assets with poor condition.
b) Rehabilitate the assets which have high risk
c) Replace the assets which have completed the useful life.

In order to plan asset management in light of the ***Physical Condition*** and assessed ***Asset Failure Risks*** the following matrix may be used to identify action plan for asset management.

Condition	**Failure Risk State**			
	Low	***Moderate***	***High***	***Significant***
A	Regular Maintenance	Regular Maintenance	Preventive Maintenance	Priority Maintenance
B	Regular Maintenance	Preventive Maintenance	Priority Maintenance	Priority Rehabilitation
C	Preventive Maintenance	Priority Maintenance	Priority Rehabilitation	Immediate Rehabilitation
D	Priority Maintenance	Priority Rehabilitation	Immediate Rehabilitation	Immediate Replacement
F	Priority Maintenance	Immediate Rehabilitation	Immediate Replacement	Immediate Replacement

Use the table …..for group work

- Assets that require "immediate Replacement/ Rehabilitation" should be top priority
- Assets that require " Priority Rehabilitation" should be accommodated if resources allow
- Assets that require "Preventive/ Priority maintenance" should be carefully monitored to prevent the need for their replacement

Assets that require regular maintenance does not pose a risk and can be operated with regular maintenance schedule.

Exercise # 5: Application of Risk, Condition and other attributes to make decision:

Lecture 3

1. **Lecture Information**

Topics: 1) Asset Life Cycle 2) Preventive Maintenance of Assets 3) Asset Management Plan	
Lecture Duration: 5 Hours	

2. **Introduction of Topic**

2.1. Definition of Asset Life Cycle (15 Minutes)

The asset life cycle includes following four stages;

1) Planning
2) Acquisition
3) Operation &Maintenance
4) Disposal

Asset Life Cycle Management is a process designed based on best practices from multiple industries on how to best manage the performance/activities of an asset over its entire life span. This is of course, challenging without adequate information and records (think of how you would service your car proactively in order of frequency – wiper fluid, tire pressure, oil, coolant, brakes, transmission, etc.). If we adopt this approach, the asset has the following phases during its life span:

0) Planning
    A Identified need to provide a product / service
1) Acquisition
    A Concept and specification
    B Design development
    C Fabrication / Build
    D Install / Commissioning
2) Utilization
    A Operations and Maintenance (requires the most cost)
3) Disposal

Please comment on life cycle costing and identify which phase require maximum cost?

2.2. Asset Management: (105 Minutes)

Asset Management is organizing, planning and controlling the acquisition, use, care, refurbishment and/or disposal of physical assets to:

- Optimize their service delivery potential
- Minimize related risks and costs over their entire life through development and application of intangible assets such as business processes and decision supporting systems

In order to avoid failures in the operations and maintenance phase, where most of the costs are incurred, a reliability approach needs to be taken which considers the following:

Are designs reviewed before asset(s) are built from the perspective of maintainability – reliability, sustainability and safety?

• Did M&R professionals &/or designer review design to ensure:
– Easy access to repair
– Easy to lift, provision for lifting
– Easy to align
– No or minimum special tools required
– Use of Standardized components, modular design, etc.
– Built in health monitoring (Predictive maintenance technologies) including diagnostics
– Use of energy efficient components
– Performed preliminary FMEA, SSHA, Reliability modeling etc.

• Were O&M or designers involved during build phase to ensure
– Was everything done with high quality - welds, testing done as required etc..

• Did O&M or designers perform reliability check during commissioning process to:
– Ensure cables / hoses have right size loops to avoid rubbing or tightness
– Proper labeling of cables, piping, etc...
– Components such as motors, bearings, oils have been properly sized and right for the environment to be used

Then the Lecturer will bring the attention of course participants toward the preventive maintenance during the cycle of the assets. The lecturer will give a brief concept of international best practices regarding frequencies of preventive maintenance for different assets of WASA. A few of the frequencies are;

Mechanical & Electrical parts of tube wells, disposal stations

A full set of maintenance routines should be provided to cover all work on all equipment.

Table 1: Instrumentation Maintenance Frequencies

Asset type	Monthly	3 monthly	6monthly	Annual
Control panel meters			•	
Level sensors/transmitters	•			
SCADA control panels				•
Soft starters		•		
Bearing sensors			•	
Chemical dosing	•			
Bulk Flow meters				•
pH Calibration (RO) Plants	• weekly			

The monitoring of pump efficiency as an annual check should be carried out. The intention should be to evaluate whether there is a cost savings or operational improvements as a result of overhauling pumps with poor performance.

Table 2: M&E Maintenance Frequencies

Asset Type	Monthly	3 Monthly	6 Monthly	Annual	Two yearly	Overhaul Period (yrs)
Pumps (dw/ww)	•			•		•5
Motors		•	•		•	•5
Sub pumps			•			•5
Gear boxes	•		•			•5
Transformers		•	•	•		
Control panels	•					
Control valves	•					
Bulk meters	•					
Compressors	•		•			•3
Generators	•	•		•		•5
Chlorinators	•			•		•3
A/sc blowers	•	•				•3
Bk/w pumps	•		•			•5
Lime handling	•	•				•2-3
Chemical handling	•	•				•3
Tank stirrers			•			•5
Cooling fans	•	•		•		•3
RO plants	•	•				
Lifting equip				•		
Site security	•					
Safety inspections				•		

The on-line pumping stations should be incorporated into the Maintenance Management System. Guideline frequencies for mechanical and electrical maintenance are given below:

Table 3: Pumping Station M&E Maintenance Frequencies

Asset Type	Monthly	3 Monthly	6 Monthly	Annual	Two Yearly	Overhaul Period (years)
Pumps (dw/ww)	•			•		•5
Motors		•	•		•	•5
Sub pumps			•			•5
Gear boxes	•		•			•5
Transformers		•	•	•		
Control panels	•					
Control valves	•					
Generators	•	•		•		•5
Lifting equip				•		
Security	•					
Safety inspections				•		

Typical target instrumentation fréquences are also given below:

Table 4: Pumping Station Instrumentation Maintenance Frequencies

Asset type	Monthly	3 Monthly	6 Monthly	Annual
Control panel meters			•	
Level sensors/transmitters	•			
SCADA control panels				•
Soft starters		•		
Bearing sensors			•	
Chemical dosing	•			
pH Meters (RO) Plants	• weekly			

3 Asset Management Plan (100 minutes)

Exercise # 6: Please prepare daily, monthly, quarterly and annually checklist of asset management plan and also workout asset lifecycle costing.

3. Conclusion: (20 minutes)

Questions?

Evaluation of Instructor?

Asset Management Plan- template For Tube well 180 1850 10 40 20110

Name of Asset	Asset code	Condition	Maintenance Frequency /Checking	Remaining Life	Improvement required to extend life of asset	budget
Pump	1					
Motor	2					
Electrical	3					
Chlorinator	4					
Meter	5					
Transformer	6					

ALJAZARI
ACADEMY

Asset Management

Course Code: M4131

Asset Management Information System
Module 2

Lecture Notes

2017

Introduction of the Asset Management Course:

This course introduces key concepts related to asset management specifically for water utilities. The examples are generic enough that they can be applied to other manufacturing environments, but the governance concerns are obviously linked to public service asset management. As such, the course focuses on identifying and measuring assets, asset attributes, condition based assessments, risk profiles, asset life cycles, monitoring programs (i.e. reliability and preventative maintenance based), accounting practices, asset valuation and preparing asset replacement plans. This course is especially beneficial for officers of grade 17 and 18 who are directly or indirectly involved in planning and the routine management of assets.

In order to effectively supervise asset maintenance practices to frontline staff, while communicating and reporting asset management to senior management, course participants will be versed in a few key areas of asset knowledge. Course Participants (CPs) will develop knowledge and skills about asset identification, inventory creation, maintenance documentation life cycle assessment and asset condition based measurement. They will be taught to develop, maintain and report out on an asset data base for asset replacement planning. This course will also help the CPs in understanding application of the concepts related to Asset Replacement Plans, Asset Operational Plans (Standard Operating Procedures) and Condition Based Monitoring. The CPs will also be introduced through OJT, to the Asset Management Information System, GIS and other tools.

Why do Asset Management?

Early developments in Computerized Maintenance Management Systems (CMMS) led to the adoption of work management systems for service request generation, work order completion and activity based management and costing. Advances in automation have arguably led to reductions in risk and cost overruns as pertaining to labour allocations and resource management. In other words, the more automation, the less people requiring management. Let us leave contract management of third parties out of the picture for a moment, as their productivity is mixed across utilities. Nevertheless, attention related to CMMS has increasingly turned to asset management. We in the utility sector are faced with costs (energy, consumables and maintenance/replacement services) which are directly linked to assets. Upon the completion of this course the CPs will be in a better position to apply their learning in their routine jobs and prepare an Integrated Development & Asset Management Plan (IDAMP) to provide better water supply and sewerage services to their consumers.

Introduction of AMIS Module:

An Asset Management Information System take the inventory based view envisioned by financial management of assets, and frames assets geo spatially. This module provides an overview of how GIS systems can enable and enhance asset management functionality. This course uses proprietary software and introduces CPs to the solution. CPs are encouraged to see their login and account creation as a progression of their public service to WASAs and the Punjab Water Operators

Network. As with the homework provided, the more engaged and the more CPs leverage their own WASA asset inventories, the more networked they will be to the analysis offered by the AJA team.

Lecture 1

1. **Lecture Information**

Topics: 1) Recording & Reporting of Assets in books of accounts. 2) Asset Depreciation & Application of depreciation information. 3) Fixed Asset Register.	
Lecture Duration: 2 Hours	

2. **Introduction of Topic**

2.1 Introduction of Accounting Regimes **(20 minutes)**

The following two accounting manners are applied all over the world;

Cash Basis of Accounting

Accrual Basis of Accounting

Cash Basis of Accounting

The modified basis of accounting records transactions on a cash basis but also takes into account:

Accounting for certain assets and liabilities. At period end, disclosure of all material assets and Liabilities shall be made in the Annual Financial Statements.

Physical assets are recorded into asset Fixed Asset Register and memorandum/ supplementary record.

Thus, an additional step in this process is the memorandum recording of certain assets and liabilities.

Accrual Basis of Accounting

Accrual basis means a basis of accounting under which transactions and other events are recognized when they occur (and not only when cash or its equivalent is received or paid).

Therefore, the transactions and events are recorded in the accounting records and recognized in the financial statements of the periods to which they relate. The elements recognized under accrual accounting are assets, liabilities, net assets/equity, revenue, and expenses.

2.2 Reporting of asset under different accounting methods

1. IPSAS for Cash Basis of Accounting
2. IFRS & IAS for Accrual Basis of Accounting

Discussion Question on what method is being followed in Government of the Punjab & WASAs?

2.3. Treatment of Assets in WASAs (20 minutes)

Please explain the Accounting system in your respective WASA?

The following Matrix will be filled

WASA Lahore	
WASA Faisalabad	
WASA Gujranwala	
WASA Rawalpindi	
WASA Multan	

2.4. Treatment of assets in Financial Management Manual-Cash Basis

I. Introduction

Asset management function deals with the optimal management of Fixed assets and their life cycles. Fixed Assets Management process aims to ensure that:

i. Fixed Assets are appropriately disclosed in financial statements in accordance with WASA's policies and the applicable financial reporting standards;
ii. Only authorized employees have access to the asset records;
iii. Fixed assets acquisitions, receipt, recording and disposal duties are segregated;
iv. Fixed asset acquisition, transfers, disposals are approved and recorded in accordance with WASA's policies and in light of the IPSASs;
v. Fixed assets are properly safeguarded in accordance with WASA's policy.

II. Policies

A. Accounting for Fixed Assets:

1. All the items of property, plant and equipment (physical assets), freehold land and capital work in progress shall be expensed out on cash basis at the time of payment made to the vendor/ contractor.
2. In addition to expensing out all the physical assets in the relevant accounts as per prescribed in Chart of Account, Finance Directorate shall maintain a supplementary record for the Fixed assets management as per following provision:

CWIP Ledger

i. Fixed Assets through construction shall be recorded in the supplementary 'capital work in progress (CWIP) Ledger'.

ii. Capital Work in Progress shall be recorded at costs including overhead cost and related expenses incurred thereon.

iii. The assets in CWIP shall be transferred from capital work in progress (CWIP) Ledger to the 'Fixed Assets Register' upon completion of work and completion certificate obtained by relevant directorate

Fixed Assets Register

i. Finance Directorate shall maintain a "Fixed Assets Register" to record the all the categories of assets whether acquired through construction or purchase. The categories of assets shall include the following:

- Land & building
- Machinery and Equipment
- Pipelines
- Tube wells
- Vehicles
- Computer equipment
- Furniture & fitting
- Office equipment

ii. Each Fixed asset purchased or improvement/extension made above Rs 100,000 shall be recorded in the Fixed Assets Register. This threshold should be subsequently adjusted in the light of experience and better defined management information requirements.

iii. The record of each item shall also include references to the relevant files, plans and deeds, source of acquisition, and give other relevant details such as rents payable or receivable, and restrictive covenants.

iv. Every change affecting the ownership, occupation or change in location of the asset shall be the subject of an entry in the register

v. The Finance directorate shall ensure that the Fixed Assets Register kept is properly maintained and is up-to-date.

vi. The Fixed Assets Register will be maintained by the Senior Account Book keeping section who should take appropriate precautions to safeguard the accuracy and integrity of the record.

vii. No item will be removed from the register except under proper authority. When an item is removed the record should be noted to show the date and reasons for removal and the reference of the relevant written authority.

B. Disposal of Fixed Assets

1. Assets shall be disposed by the relevant directorate as per disposal policies/ guidelines/rules framed by the WASA.
2. Receipts from the sale of Fixed assets shall be credited to the capital receipts as per chart of Account.
3. Sale receipts shall be accounted for as an income in the on a gross basis. Sale expenses will not be netted off the sale proceeds but shall be separately accounted for as an expenditure item.

C. Insurance of Fixed Assets

1. WASAs shall OPTIONALLY opt to insure the Fixed assets.
2. All the assets of WASA pertaining to the following categories having cost above 1,000,000 may be insured:
    - Plant and Machinery
    - Building
    - Pipelines
    - Tube wells
    - Vehicles
    - Computer equipment
3. Insurance premium shall be recognized as expense on cash basis

Amount recovered from insurance claim shall be recognized as other income on cash basis.

2.5. Treatment of assets in Financial Management Manual- Accrual Basis

FIXED ASSET ACCOUNTING POLICIES

- All the items of property, plant and equipment (fixed assets) except freehold land and capital work-in- progress shall be stated at cost less accumulated depreciation. Freehold land and capital work-in-progress shall be stated at cost.
- Major renewals and improvements resulting in increase of useful life of fixed assets shall be capitalized whereas minor renewals, replacements, maintenance and repair shall be charged to surplus or deficit as and when incurred

- Gain or loss on disposal of fixed assets, if any, shall be charged to income and expenditure account in the year of disposal

- <u>Items of property, plant and equipment (fixed assets) which cost below 10,000 shall not be capitalized and booked as expense in the relevant period</u>

- The residual value and the useful life of an asset shall be reviewed at least at each financial year-end and, if expectations differ from previous estimates, the change(s) shall be accounted for prospectively
- Depreciation of an asset shall begin when it is available for use
- Depreciation for an asset shall not be charged when the asset is derecognized.
- Each part of an item of property, plant and equipment with a cost that is significant in relation to the total cost of the item shall be depreciated separately.
- Depreciation on additions to fixed assets is charged when the asset is available for use until the asset is held for use and up till the asset is disposed-off.
- The depreciation charge for each period shall be recognized in income and expenditure account unless it is included in the carrying amount of another asset
- Capital Work in Progress shall be shown at costs incurred thereon up to the date of balance sheet including overhead cost and related expenses
- The assets shall be transferred from capital work in progress (CWIP) account to the Fixed Assets account upon completion of work and completion certificate obtained by relevant directorate
- Capital Work in Progress shall be classified as non-current asset and no depreciation shall be charged on CWIP
- The carrying amount of assets shall be reviewed at each balance sheet date to determine whether there is any indication of impairment. If any such indication exists then the assets recoverable amount shall be estimated. The recoverable amount is the greater of its value in use and fair value less cost to sell.
- Impairment loss shall be recognized if the carrying amount exceeds its estimated recoverable amount.
- The impairment loss shall be charged to the income and expenditure account for the period. The depreciation of an impaired asset shall be adjusted in future periods and shall be charged on the impaired value of asset.
- When conditions which led to the recognition of impairment loss cease to exist, the impairment loss may be reversed only if the recoverable amount of asset exceeds its carrying amount. However, the increased carrying amount due to reversal should not be more than the depreciated historical cost had the impairment not been recognized.
- Reversal of an impairment loss shall be recognized as income in the income and expenditure account

- All the assets of WASA pertaining to the following categories having cost above 50,000 shall be insured:
    - Plant and Machinery
    - Building
    - Vehicles
    - Computer equipment
    - Finished goods inventory
    - Cash in hand
- Insurance policy shall be reviewed and signed by DMD-Finance and Managing Director
- Insurance premium shall be recognized as expense on accrual basis

Amount recovered from insurance claim shall be recognized as other income

The recording of assets into the books of accounts has huge implications in terms of presentation in financial accounts of an organization. The assets are reported on the balance sheet of accounting statements and create smoothing effect. Companies usually have a policy to record assets with a view that assets must have life of more than one (1) year and material value. The recording of assets is called Capitalization.

Activity **(10 Minutes)**

Assume a utility has a policy to record assets if its acquisition cost is more than 100,000/- and expected life of more than one (1) year. Please identify the following transactions may or may not be recorded into assets:

Purchase of a table in Rs. 120,000/- (Yes / No)

Purchase of UPS in Rs. 80,000/- (Yes / No)

Purchase of stationery of Rs. 110,000/- (Yes / No)

2.6 Different methods of Depreciation **(20 minutes)**

- Straight Line Method
- Declining Balance Method
- Average Balance Method

Depreciation Policy of WASAs:

- Depreciation on fixed assets shall be provided on the straight line method so as to write off the historical cost of the assets over its estimated useful life.

- Fixed assets will be depreciated using the following rates:

Description	Depreciation %age	Tax Depreciation (@ WDV)
Freehold land	0%	0
Building	2%	10
Plant and Machinery		
• Tube-wells and water supply	7%	10
• Sewerage and disposal station	7%	10
Pipelines		
• Water supply	3%	10
• Sewerage	3%	10
Office equipment	10%	30
Furniture and fixture	10%	10
Vehicles	20%	20
Computer equipment	20%	30

2.7 Application of Depreciation in Planning

Average Age = Accumulated depreciation/annual depreciation expense

Average depreciable Life = ending gross investment/ annual depreciation expense

Remaining useful life = ending net investment/annual depreciation expense.

2.8 Fixed Asset Register (30 Minutes)

Fixed asset register is a compulsory accounting record. Accounting Policies and Procedural Manual (APPM) requires to record following attributes into the Fixed Asset Register at minimum (Section 13.4)

a) Description
b) Classification of asset
c) Year of Purchase or completion
d) Original Cost in PKR
e) Cost in foreign currency (if applicable)
f) Asset Identification Number
g) Current Location
h) Ownership / Responsibility of Asset

International Accounting standard requires following additional information into the Fixed Asset Register (TS 6):

a) Addition / Deletion of assets
b) Depreciation
c) Accumulated Depreciation
d) Revaluation
e) Date of Revaluation

Assignment: Prepare a Fixed Asset Register.

Suppose you are an Asset Manager of XYZ Subdivision of WASA-A. The fixed asset register for Financial Year 2014-15 is attached at annexure-A. In July 2015, you extended services in liberty area and installed water supply pipelines in 50 million and a Tubewell in Rs. 13 million. Please do the following;

1. Prepare Fixed Asset Register for FY 2015-16.

Conclusion (20 Minutes)

Questions?

Lecture 2

1. Lecture Information

Topics: 1) Introduction of AMIS 2) Registration Users into AMIS 3) Addition of Assets into AMIS
Lecture Duration: 2 Hours

2. Introduction of Topic

2.1 Introduction and Basic Functions of AMIS: (20 minutes)

The trainer will provide an overview of the GIS based asset management system along with basic functions of the system. Given the number of assets (including subcomponents), asset attributes and decision making processes which fall under the umbrella of utility responsibilities; an overarching information system is required for effective asset management. As such, it is critical to have as much of the needed information captured within one comprehensive system to serve the needs for a range of users. The Geographic Information System (GIS) based Asset Management System (AMS) is an integrated web based system developed for CDGs and WASAs of five (5) large districts of the Punjab. The scope of the system's use by AJA, UU and other Punjab Government offices will be outlined. Some of the best practices of such systems, in terms of functionality will also be provided, based on leading practices from utilities around the world.

2.2 Objectives

- To enter an inventory of major assets of CDGs and WASAs into the AMIS.
- To educate CPs on how to automate the asset management processes using the AMIS
- To educate CPs on how to use the AMIS to make appropriate decisions and create and effective support systems.

2.3 Basic Functions of Asset Management Information System (AMIS)

2.3.1 Create Asset

Users can create/add an asset by filling a form designed for each type of asset. Each form has a form number and basic attributes of the assets. The form is filled and sent for approval of the authorized personnel. Upon the approval the asset becomes a part of the GIS based asset inventory. A unique asset identifier should also be assigned to this particular asset once it has been created. See the previous course outline for more details on possible information and identifier fields for the development of a unique tag.

2.3.2 Asset revaluation

AMIS enables the users in asset revaluation and planning for decommissioning and replacement. Asset revaluation removes any anomalies in the valuation of the assets in the public infrastructure, it is particularly important in times of high inflation where realizable values have risen sharply over the years and a revaluation would bring the asset valuation in line with the market values. It is also critical for long term asset planning as capital investment comes under increasing pressure. This is critical in developing countries

2.3.3 Asset depreciation

This module also allows the users in calculation and inclusion of asset depreciation through gradual dilapidation and ageing. The depreciation shall be charged against the cost of the asset reflected in the GIS based Asset Inventory. This module allows for assets to be gradually depreciated so that managers and project planners can take measures to extend critical asset lifecycles in order to avoid the convergence of too many assets in need of replacement. Multiple assets, back-up systems and process redundancy are typically justified in order to guard against critical assets and their depreciation.

2.3.4 Asset disposal

Asset Disposal covers the disposals of assets to remove a particular asset from the GIS based Asset Inventory. This can be particularly useful in case an asset has completed its useful life, is dilapidated beyond maintenance and the decision makers have decided to replace the asset entirely.

2.3.5 Asset maintenance

The maintenance function allows the users to record the repair on a particular asset. This information could be useful to develop reporting mechanisms to aid in the budgeting and forecasting in the medium to long term. It can also be used to manage assets which will be extended in their life cycles and will experience substantial maintenance, vs. those which are simply being driven to failure. A continuum of critical assets (experiencing more maintenance) and non-critical assets (and processes, ostensibly) should be created and understood by process area in order to clearly delineate between assets of different financial and engineering value. Labour resource utilization should in turn, be aligned with such a system, using a work management system (also computerized) or some similar system.

2.3.6 GIS based Asset Inventory

The GIS based asset inventory covers the asset listing of all the assets and integrates the above mentioned modules to provide the asset name, ownership, department, location, cost and the satellite imagery of the particular asset. The inventory integrates the essential attribute data put in the system through the above mentioned modules, and feed the data into the reporting module. The GIS asset base is typically used for measuring the health of the linear system, which is linked to customer service connections, residential and ICI. This system should be linked as closely as possible to customer service efforts as well as field support.

2.3.7 Decision Support System

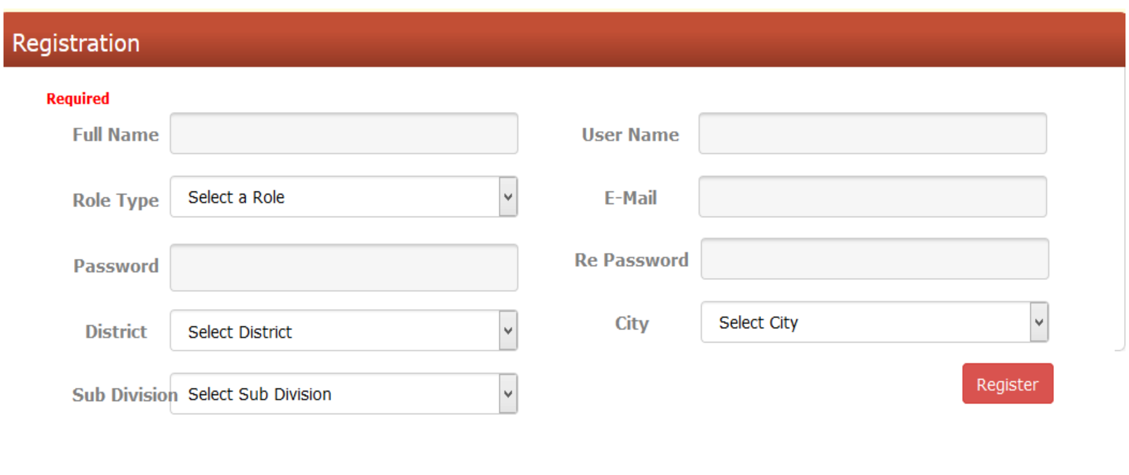
The system also produces consolidated reports based on the attribute data put into the GIS based asset inventory. The reports will help to make decisions regarding replacement of assets, their timely repair and maintenance and will provide a better control and monitoring mechanism. This support system should link engineers, planners and field support staff to middle management. Once aligned, then data and reports can be fed up to senior management to prioritize asset replacement programs and investments to balance customer service standards with capital project plans.

3. User Registration in AMIS (20 minutes)

Then the trainer will teach the CPs how to get register in the software.

To get register with the AMS follow the following steps

- Open web browser
- Type the following URL address
  http://202.166.168.184:99/Home/login
- Click on the registration link
- Fill the following form



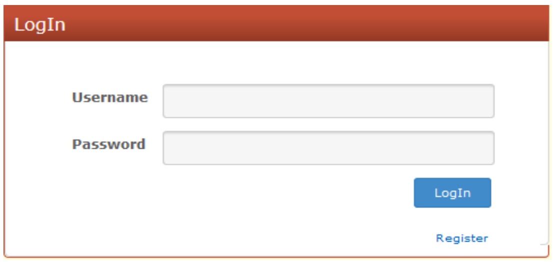
- Username will be used for login into the AMS software

4. **Addition of Information related to Assets into AMIS (80 minutes)**

4.1 User Login

The trainer will teach how to login into the system.

- Open web browser
- Go to the login page by typing the following URL address
  http://202.166.168.184:99/Home/login
  It will take you to the following screen

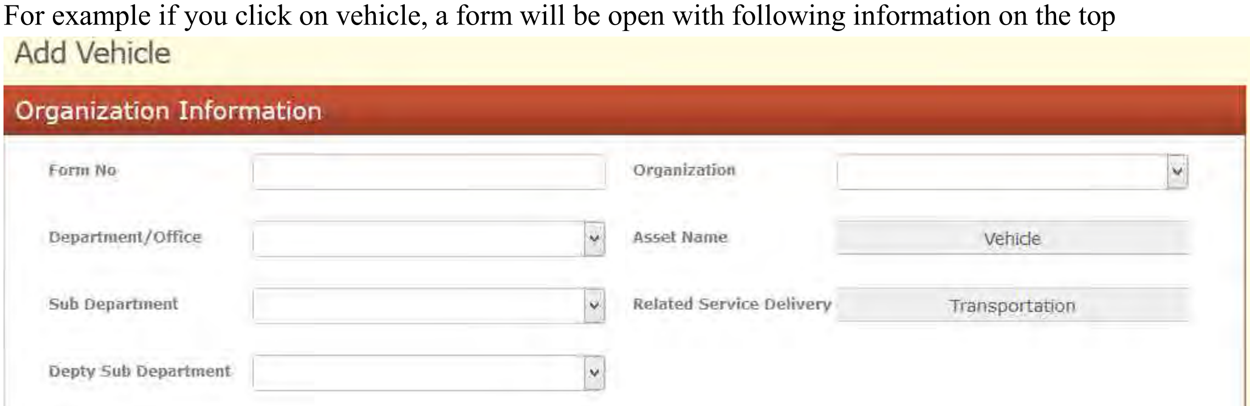


- Enter your username and password
- Click Login button
- After authentication you will be redirected to your dashboard

The trainer will tell how to add information into the system;

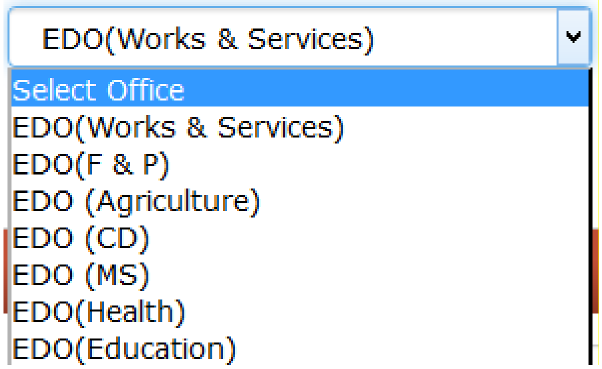
- To add an asset go to the Asset Acquisition Menu

- Click on the asset name
- For example if you click on vehicle, a form will be open with following information on the top

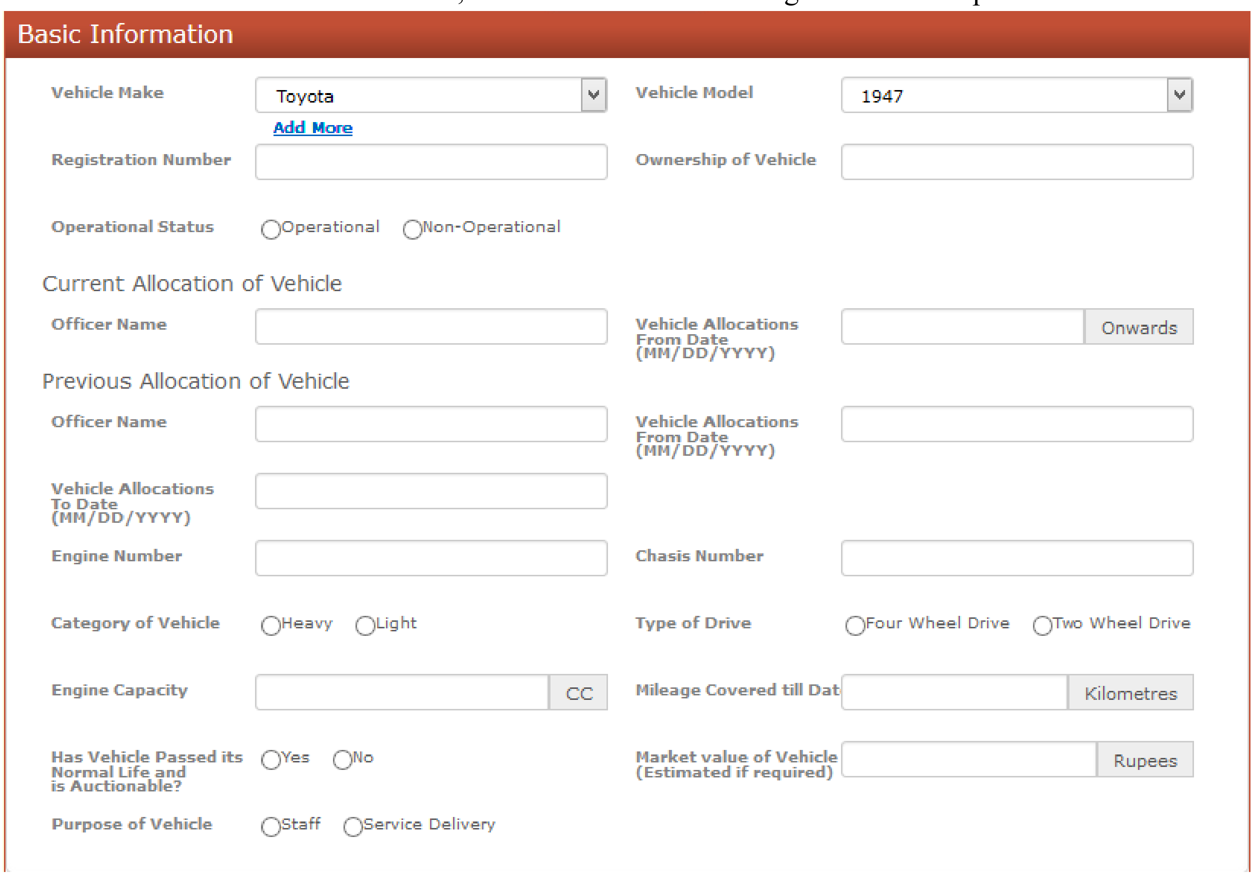


- Fill the form number
- Select the Organization as CDG or WASA
- Select the Department/Office pertaining to selected organization

For instance, In case of organization as in CDG-LHR the following options are available



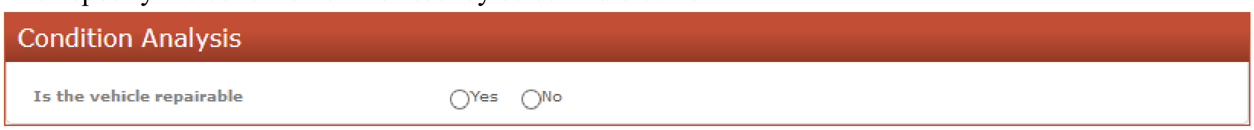
- Then select the sub office/department up to the 3rd level, but 2nd and 3rd levels are optional
- Then fill the basic information of asset, In case of vehicle following form will be opened



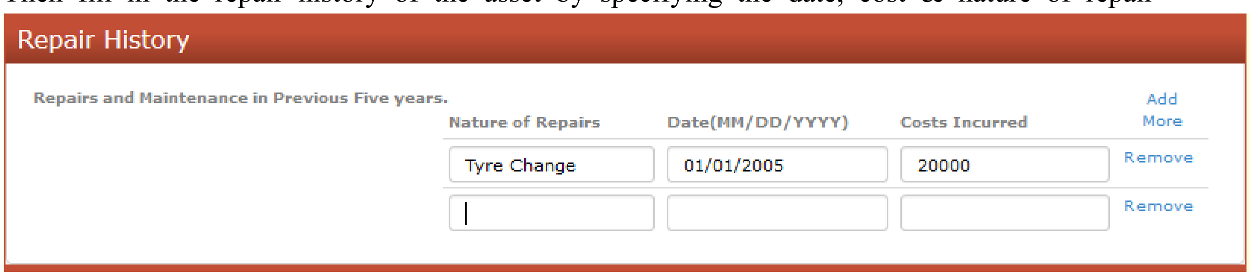
- Select the Manufacturer of vehicle from "Vehicle Make" drop down option

- If targeted manufacturer is not in the list, you may add it by clicking the "Add More" option
- By doing so, you will be presented with the following form for entry

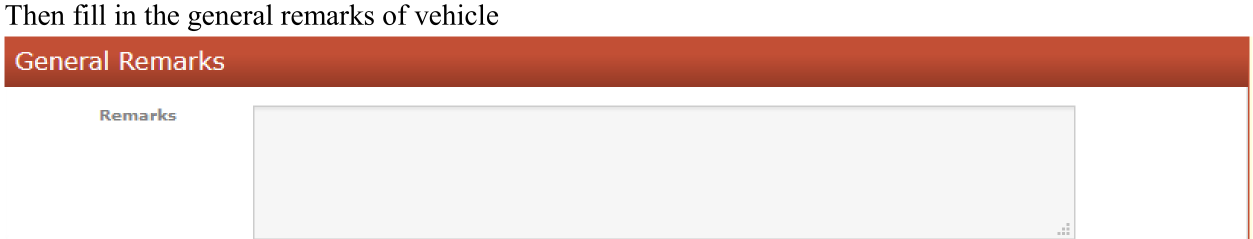
- Enter a targeted manufacturer name in the textbox under the "Value" label
- It becomes a part of the asset entry form & you can select this new manufacturer from Add Vehicle form
- Then select the vehicle model year from drop down list
- Fill all the basic information of vehicle as given in the form which is mostly self-explanatory
- Then specify the condition of the asset by select radio button



- Then fill in the repair history of the asset by specifying the date, cost & nature of repair

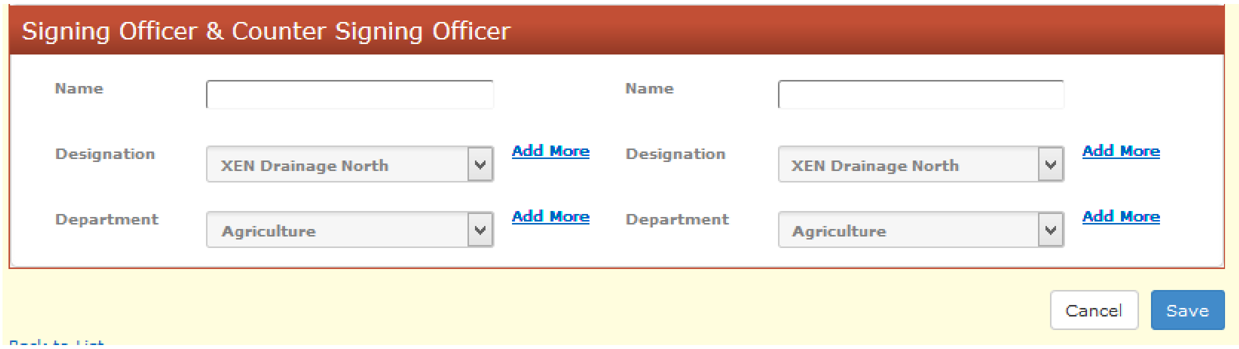


- You can add multiple repairs by clicking "Add More"
- Then fill in the general remarks of vehicle



It can be hundreds of characters

- In the end, specify the verifiers of this asset information with their designation & departments



- After it you can save all the provided information by clicking "Save"
- If you wish to discard all the information entered on this Add Asset Page, you can do so by clicking the "Cancel" button

Exercise 2: Login to the AMIS and add a tube well having all the information mentioned in the form.

Lecture 3

1. Lecture Information

Topics: 1) Searching and Editing of Assets into AMIS	
Lecture Duration: 2 Hours	

2. Introduction of Topic

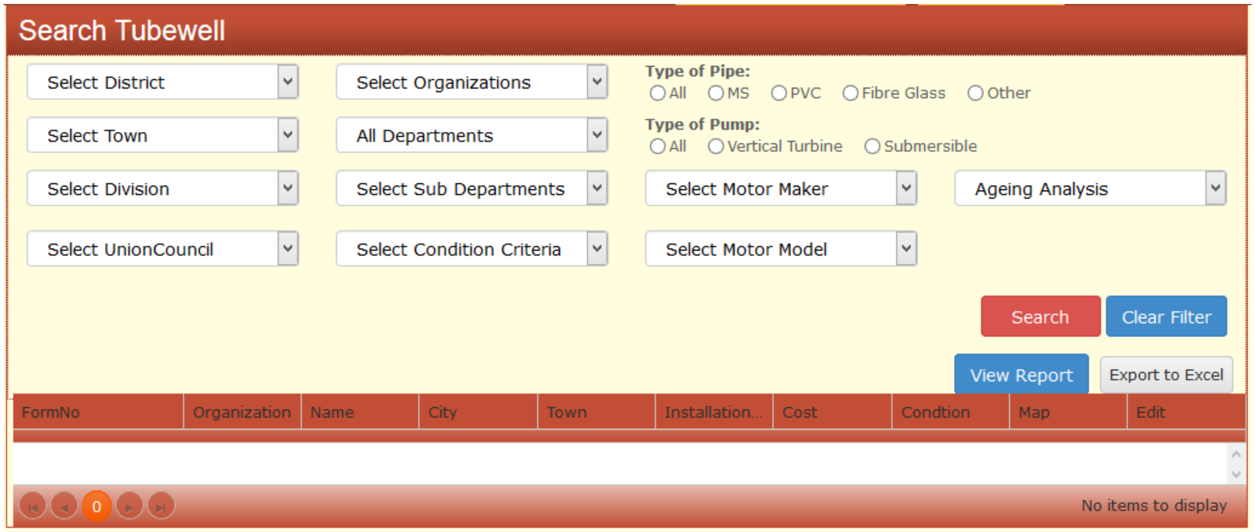
Searching and Editing **(90 minutes)**

2.1. Asset Searching:

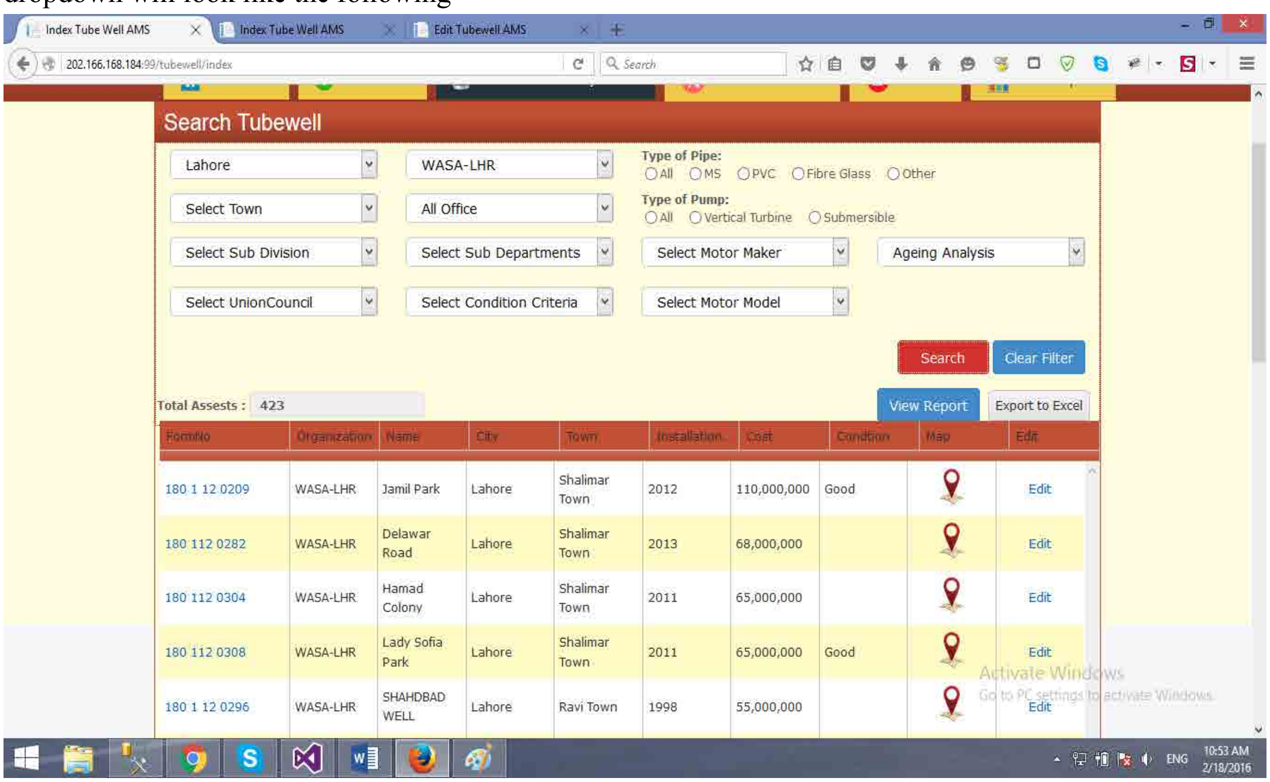
The instructor will guide the course participants regarding searching and editing of assets in AMIS. To search and view information of any asset in your scope, follow these steps

- Click on the 3rd Menu Option "GIS Based Inventory Assets" and click the type of asset you are wondering for, as in the following screenshot

- In case of **Tubewell** you will be redirected to the following search page



- Here you can search any **Tubewell** by selecting relevant dropdowns and clicking search button
- For instance if you wish to search for all of the Tube Wells in Lahore your criteria specification in dropdown will look like the following



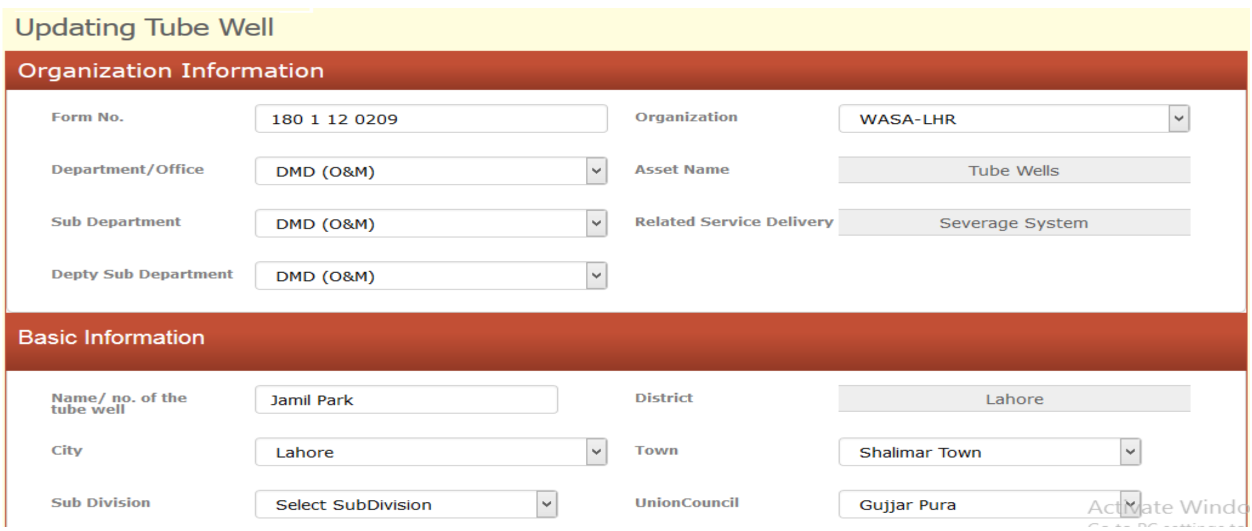
- You can export the results of table in excel sheet by clicking "Export to Excel" button
- "Total Assets" label shows the number of assets meeting this search criteria

- You can clear the filter and search for all the assets (In this case TubeWell) by clicking clear filter and then search button
- From the list you can edit the already entered information of assets by clicking the "Edit Button"
- By clicking on map icon, it will take you to the GIS site of the asset where you can view all TubeWells geographically on map

- For detailed list of asset, click on "View Report" button

2.2. Edit Asset

- To edit information of any asset, search the required asset by following the above steps
- Click on the Edit button in the grid which will take you to the following form



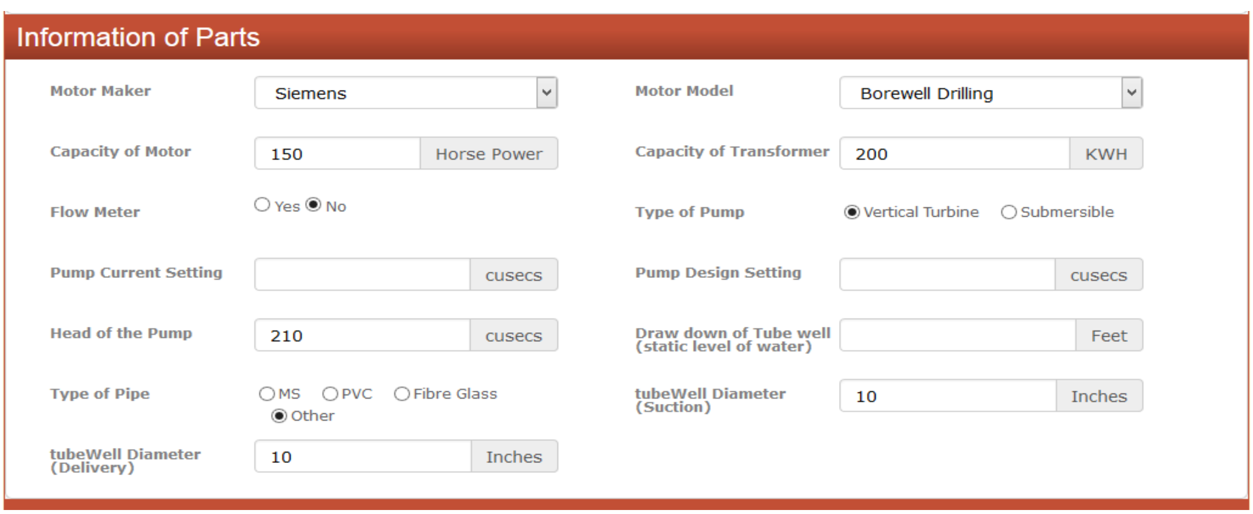
Updating Tube Well

Organization Information

Form No.	180 1 12 0209	Organization	WASA-LHR
Department/Office	DMD (O&M)	Asset Name	Tube Wells
Sub Department	DMD (O&M)	Related Service Delivery	Severage System
Depty Sub Department	DMD (O&M)		

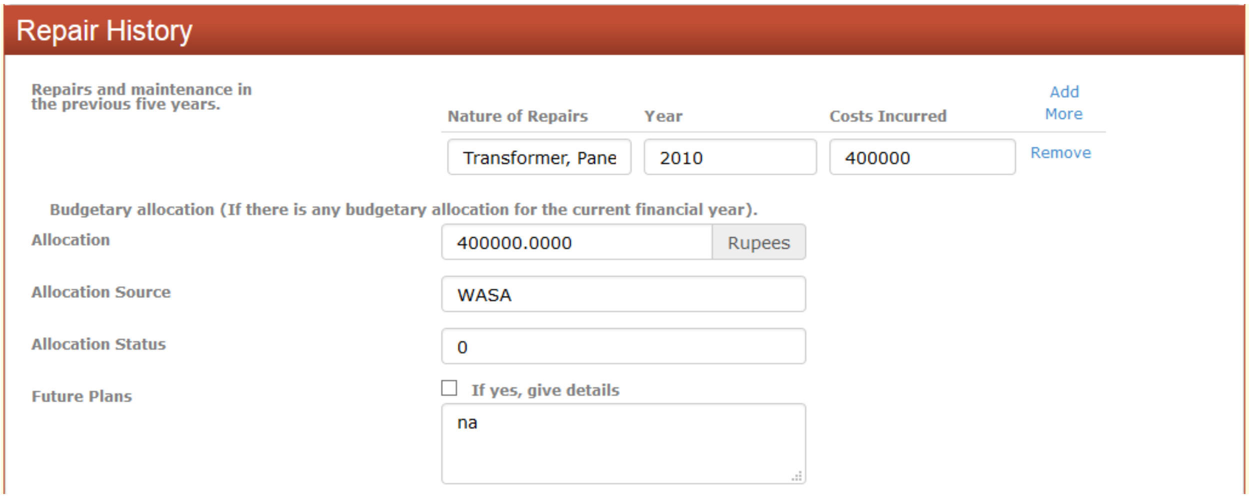
Basic Information

Name/ no. of the tube well	Jamil Park	District	Lahore
City	Lahore	Town	Shalimar Town
Sub Division	Select SubDivision	UnionCouncil	Gujjar Pura



Information of Parts

Motor Maker	Siemens	Motor Model	Borewell Drilling
Capacity of Motor	150 Horse Power	Capacity of Transformer	200 KWH
Flow Meter	Yes / No (selected)	Type of Pump	Vertical Turbine (selected) / Submersible
Pump Current Setting	cusecs	Pump Design Setting	cusecs
Head of the Pump	210 cusecs	Draw down of Tube well (static level of water)	Feet
Type of Pipe	MS / PVC / Fibre Glass / Other (selected)	tubeWell Diameter (Suction)	10 Inches
tubeWell Diameter (Delivery)	10 Inches		



- You can modify the required information on page as per need
- You can also modify basic information, condition analysis, repair history, remarks & verification detail
- After modification click on the save button to persist all the changes
- Otherwise clicking on the "Cancel" button will take you to the asset list

Exercise 3: Search any tube well and edit information

3. Conclusion **(20 Minutes)**

The lecturer will invite questions from course participants for further clarification related to addition of asset, searching and editing the asset attributes.

The lecturer will distribute lecture feedback forms among participants for feedback and reflection.

Assignment: Add one Asset of each category and give a presentation highlighting the attributes you feel are missing.

Lecture 4

1. Lecture Information

Topics: 1) Operation & Maintenance expenses of Assets 2) Reports	
Lecture Duration:	2 Hours

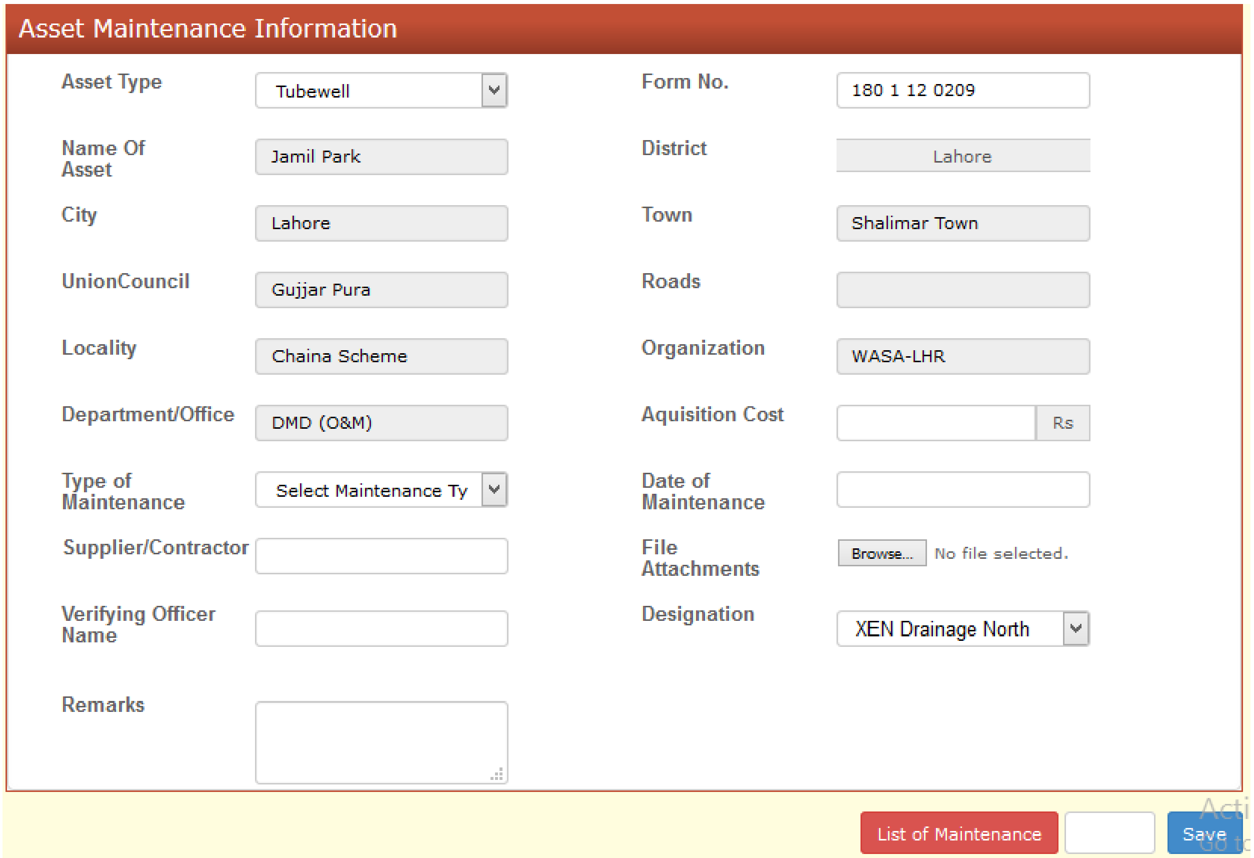
2. Introduction to Topic

2.1 Operation & Maintenance expenses of Assets: (90 minutes)

The instructor will teach the methods of adding information related to asset maintenance. The steps include;

- Hover on the Asset Maintenance Menu & Click on the First Option

- You will be presented with the following form



- Select the Required Asset Type for which you want to enter maintenance information
- Enter Form number and hit enter key
- The grey labels will automatically show up as depicted in above screenshot
- Then enter the maintenance related information of this particular asset
- Click save to persist your changes
- To view already entered maintenances click “List of Maintenance” button
- It will take you to the following screen

Asset Maintenance

Serial No.	Form No.	Asset Type	Asset Name	Maintenance Cost	Supplier/Contractor	Detail
1	180 1 50 BGTST	Bridge	Shadman Bridge	64000000	Wajahat Hussain	
2	020-0-4-0074	Machinery Equipment	MughalPura	64000000	Jawad Ahmed	
3	020-0-4-0074	Machinery Equipment	MughalPura	64000000	Jawad Ahmed	
4	020-0-2-0004	Bridge		25000	Shaban Ahmed	
5	020-1-11-0110	Pipes	Mehran Pipe	25000	Shaban Ahmed	

- You can view maintenance detail by clicking on the detail button, it will look like following screen

Repair & Maintenance Details

Form No. 180 1 50 BGTST **Asset Type:** Bridge

Print

Location

District	Lahore
City	Lahore
Town	Samanabad Town
Union Council	Gulshan Ravi
Road /Street	Fawerra Raod
Locality	Assembly Hall to Shimla

Organization Information

Name of Organization	CDG-LHR
Name of Department/Office	EDO(F & P)

Basic Information

Name of Particular Asset	Shadman Bridge
Aquisition Cost of Asset	64,000,000 (RS)
Type of Maintenance	----
Date of Maintenance	
Supplier/Contractor Name	Wajahat Hussain
Remarks	Nobi

Signing Officer

Name	---
Designation	

2.2 Asset Billing

- Hover on the Asset Maintenance Menu & Click on the 2nd Option

- You will be presented with the list of billing as depicted below

ReferenceNo	Name	Feeder Name	Tariff	City	Town	Cost
24112459005700	H-2 Block	SABAZA ZAR COLON	46	Lahore	Iqbal Town	15118136
24111349010000	Bagh Munshi Ladha	DATA DARBAR	12	Lahore	Datta Ganj Baksh Town	14225507
24113529003701	B-I Block Gujarpura	CHINA SCHEEM	46	Lahore	Shalimar Town	13513084
24115159005402	G-Block Gulberg-II	RABI CENTER	10	Lahore	Gulberg Town	10669323

- Like the other lists it can be exported to excel
- Like the other lists it can be filtered based on criteria selection from dropdowns

2.3 Asset Depreciation

- Hover on the Finance Menu & Click on the 1st Option

- Here you can make selection of asset type and enter form number
- After it hitting enter key, asset information will automatically show up in grey labels
- Then you can select deprecation year, method from dropdown list
- After it specify rate of depreciation
- Then you can save the specified depreciation for the asset by clicking save button
- To view old depreciations click on list button
- You will be presented with the list of depreciations as depicted below

Asset Depreciation

Serial No.	Form No.	Asset Name	Year of Acquisition	Acquisition Cost	Depreciation Rate	Current Year Depreciation	Detail
1	120050008	Parking Stand	2005	810000	0.255	53999	
2	BR-7241	Bridge	1998	2100000	25000	138333	
3	1200950003	Parking Stand	2005	1820000	211	7136	
4	020-0-6-0610	Land		150000	25000	8333	
5	0200-0-7-0012	Building	1978	12000000	0.255	22018	

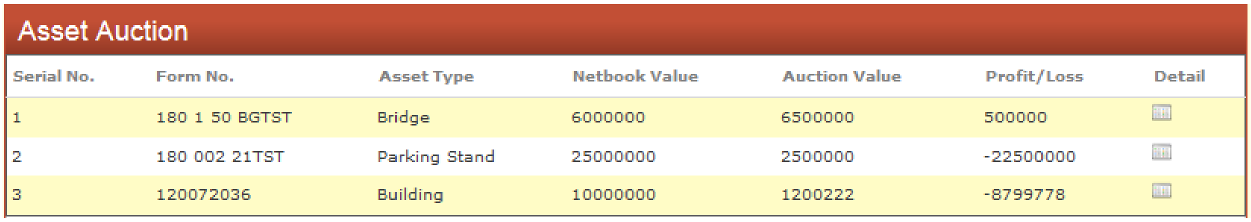
- Like the other lists it can be exported to excel
- Like the other lists it can be filtered based on criteria selection from dropdowns

2.4 Asset Auction

- Hover on the Finance Menu & Click on the 3rd Option

- Here you can make selection of asset type and enter form number
- After it hitting enter key, asset information will be auto populated in grey labels
- Then you can specify net book value, auction value & date

- After it you can upload any attachment
- Then you can save the specified depreciation for the asset by clicking save button
- To view accumulated depreciation click on list button
- You will be presented with the list of depreciations as depicted below



Asset Auction

Serial No.	Form No.	Asset Type	Netbook Value	Auction Value	Profit/Loss	Detail
1	180 1 50 BGTST	Bridge	6000000	6500000	500000	
2	180 002 21TST	Parking Stand	25000000	2500000	-22500000	
3	120072036	Building	10000000	1200222	-8799778	

- Like the other lists it can be exported to excel
- Like the other lists it can be filtered based on criteria selection from dropdowns

2.5 Energy Audit

- Hover on the Finance Menu & Click on the 4th Option

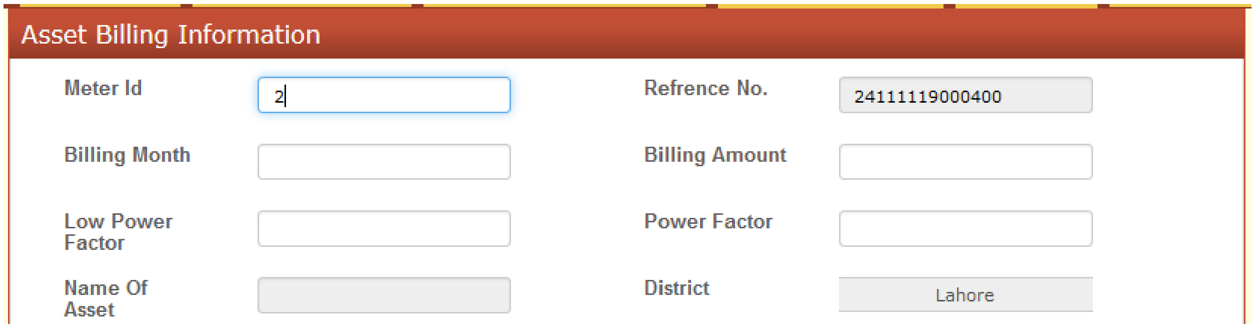
- You will be presented with the list of meters/connections as depicted below

New Meter

Meters/Connections

Meter No	Reference No	Tariff	Sancationed Load	Feeder Name	
2	24111119000400	46	135	SANT NAGAR	Associate Assets | Details | Add Bill
4	24111119000900	46	61	SANDA	Associate Assets | Details | Add Bill
5	24111119001000	46	61	SIR SYED	Associate Assets | Details | Add Bill
6	24111119001600	46	116	SIR SYED	Associate Assets | Details | Add Bill

- You can view detail of connection by clicking on “Details” link
- This detail page also enlist previous bills and its trend graphically
- You can add bill by clicking on “Add Bill” link in meters listing
- The add bill screen looks like the following screenshot



- Here you can add Billing amount along with the month & power factors
- You can also upload any attachment relating to this bill

Exercise 4: Insert information related to Operations and maintenance of a disposal station

3. Reports **(20 minutes)**

Currently there are three types of asset reports available

3.1 Asset Condition

- Hover on the Asset Reports Menu & Click on the 1st Option

- You will be presented with the list of assets condition wise as in the following figure

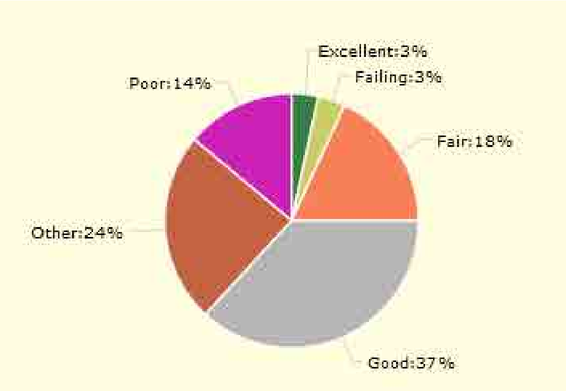
Asset Condition

Asset	Poor	Fair	Good	Excellent	Total
Building	1749	424	1749	2274	6196
Tubewell	392	79	410	0	881
Disposal Station	11	116	29	0	156
Total	**2152**	**619**	**2188**	**2274**	**7233**

- There is also a graphical representation of asset condition wise & its depicted below

Building Assets Condition

Type	Condition
Excellent	424
Failing	435
Fair	2274
Good	4620
Other	3030
Poor	1749
Total	**12532**



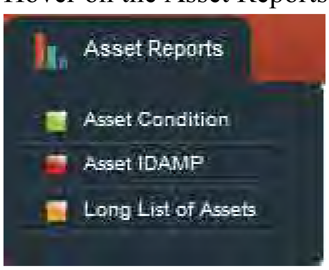
3.2 Asset IDAMP

- Hover on the Asset Reports Menu & Click on the 2nd Option

- From here, you can view IDAMP graphically

3.3 Long List of Assets

- Hover on the Asset Reports Menu & Click on the 3rd Option



- It will take you to the page of long list of assets
- Its screenshot is given below

Asset Code	Category	Sub Categ	Condition	Risk	Residual	Classification	Condition	Residual	Long List	Type of	Estimated	SSE(30%)	Feasibility(1	Environment	Service	PP(10%)	Total Grade
180185010400020020-11	Building	--	Fair		5	A		5	No		--						
180185010400020020-41	Building	--	Good		21	A		21	No		--						

- It can be exported to excel by clicking on “Export” button

3.4 Logout

You can sign out of the AMS System by clicking on the logout button at the top bar

- It will clear your session & take you to the login page

Lecture 5

1. Lecture Information

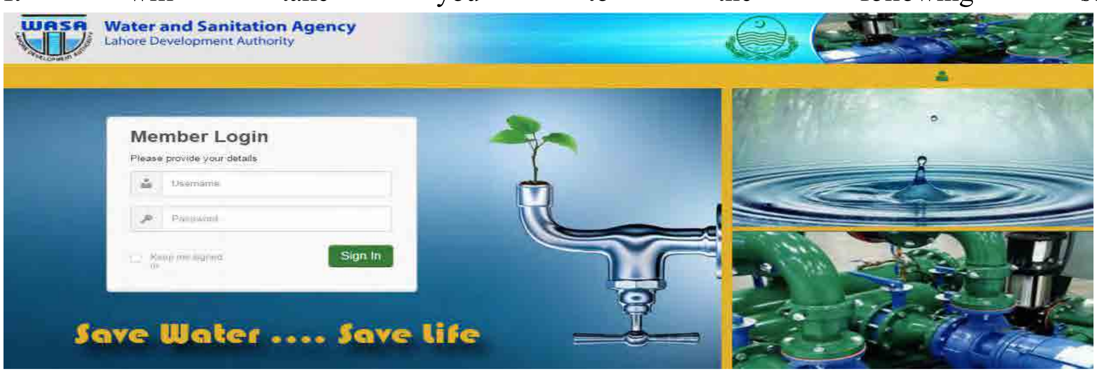
Topics: 1) Addition of Underground pipelines and plan the replacement 2) Reports
Lecture Duration: 2 Hours

2. Introduction to Topic

2.1.**Addition of Underground Pipelines and plan the replacement: (100 minutes)**

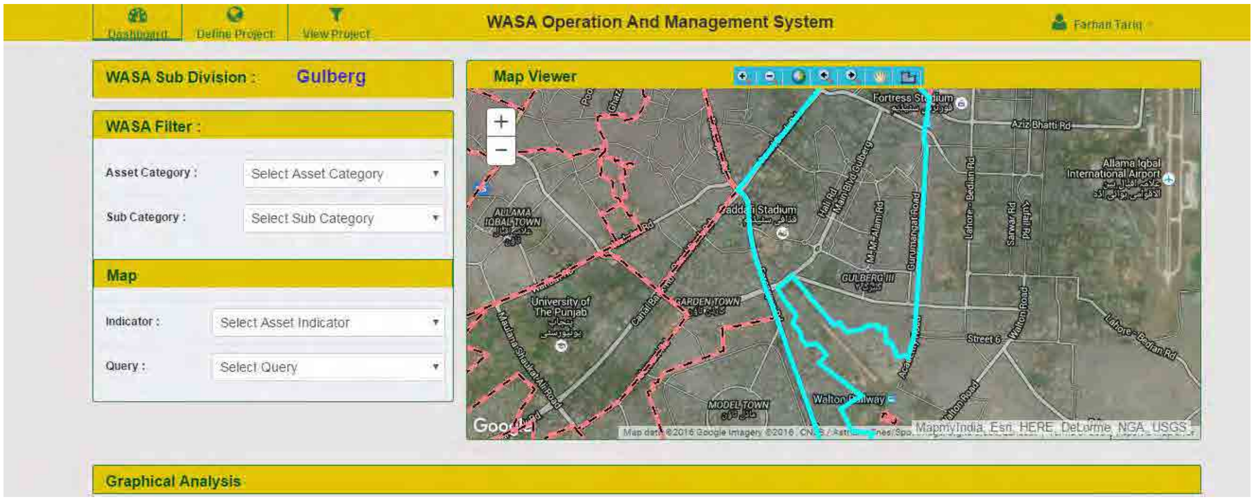
The trainer will tell the CPs about the login information of underground GIS based software. To login into the system follow following steps;

- Open web browser
- Go to the login page by typing the following URL address
  http://202.166.167.126/wasa_asset/login.php
  It will take you to the following screen



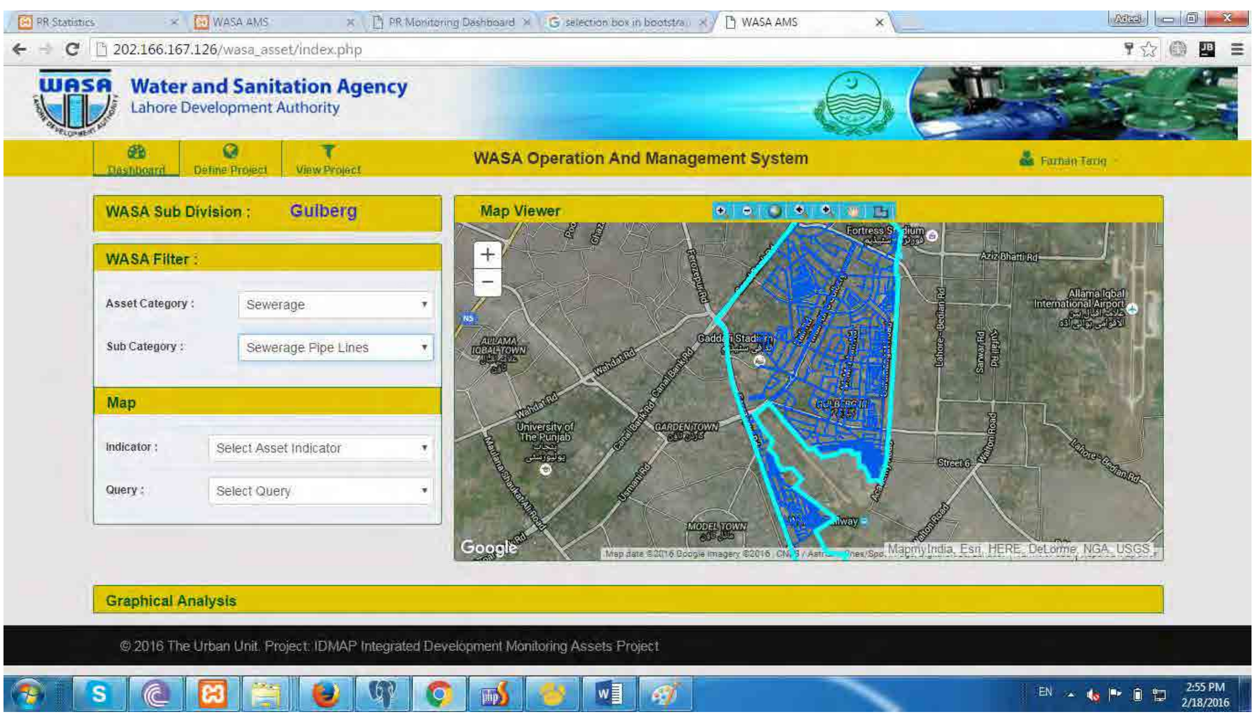
- Enter your username and password
- Click Login button
- After authentication you will be redirected to your dashboard

At present, all the underground assets have been included into the software and Subdivision Officer is required to plan the replacement and extension of these water supply and sewerage pipelines. The SDO Dashboard looks like;



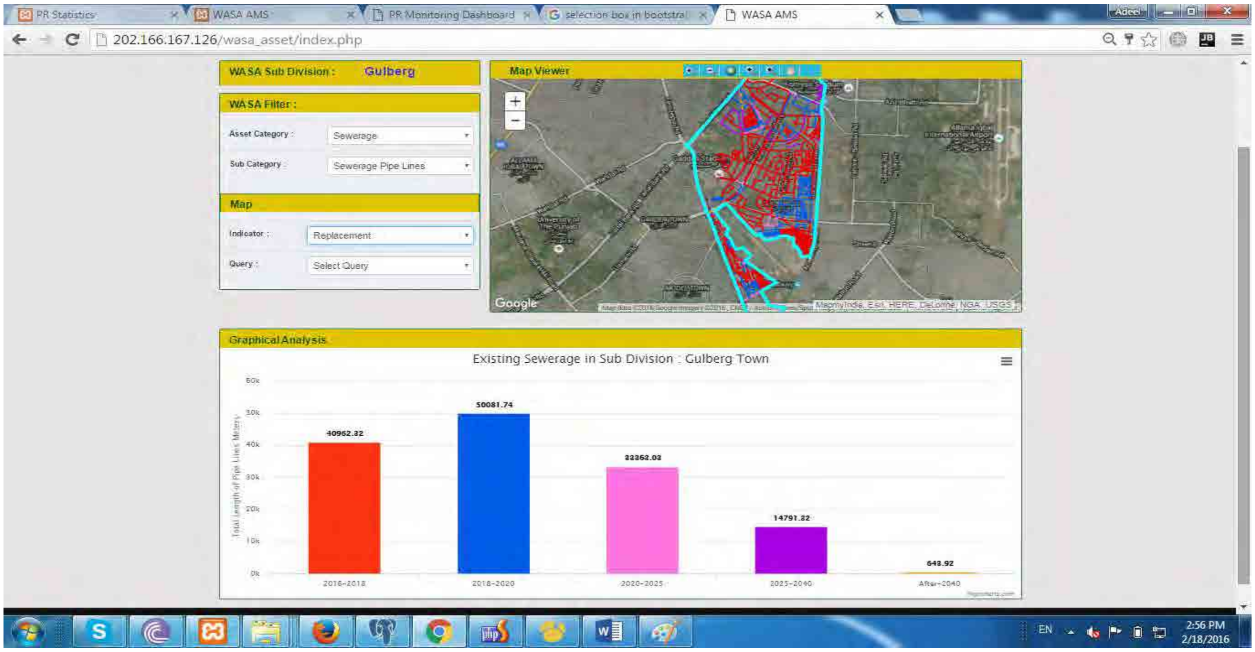
Then the trainer will tell how to see the sewerage lines of a subdivision. In order to see the sewerage lines, the following steps are to be followed;

- Select the sewerage from the asset category
- Select the sewerage pipelines from the sub category. Then the dashboard will look like;

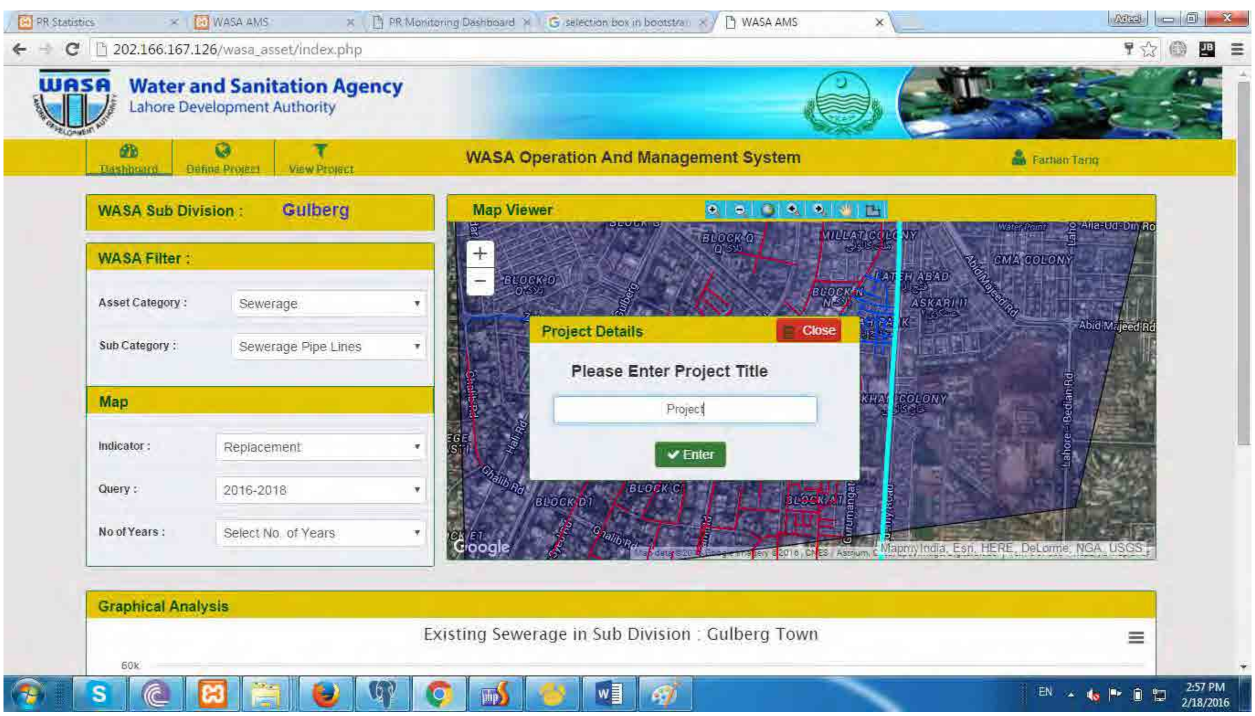


The lecturer will explain how to see the replacement planning of any subdivision. In order to see that follow the steps;

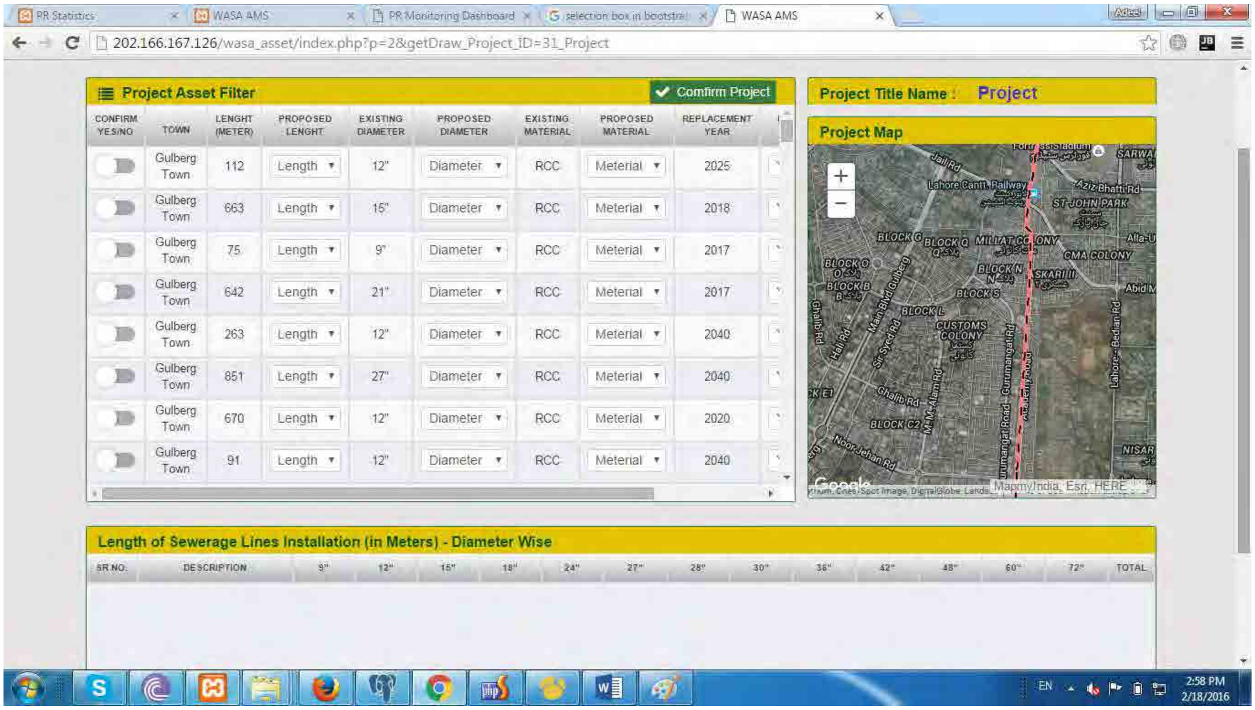
➢ Select replacement from indicator. The window looks like;

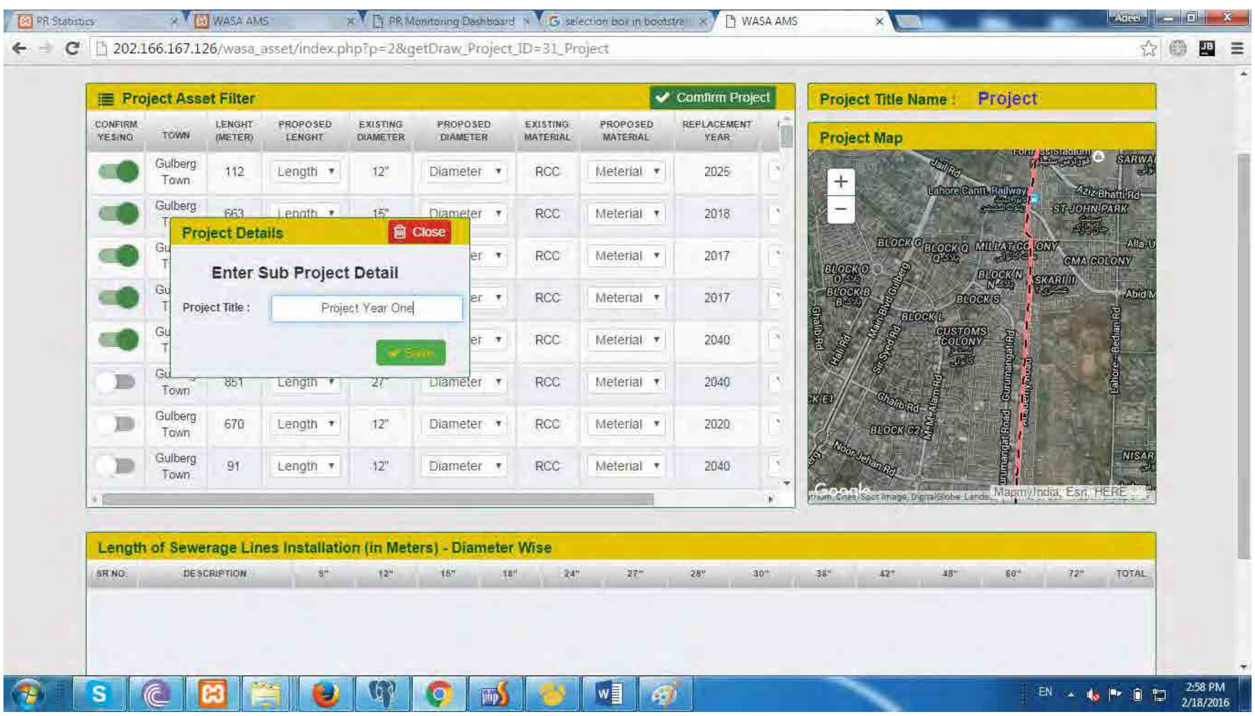


The lecturer will explain how to create projects, sub-projects, view the aspects and prioritize the projects from the replacement planning. In the process the following windows will appear;



Creation of sub-projects:

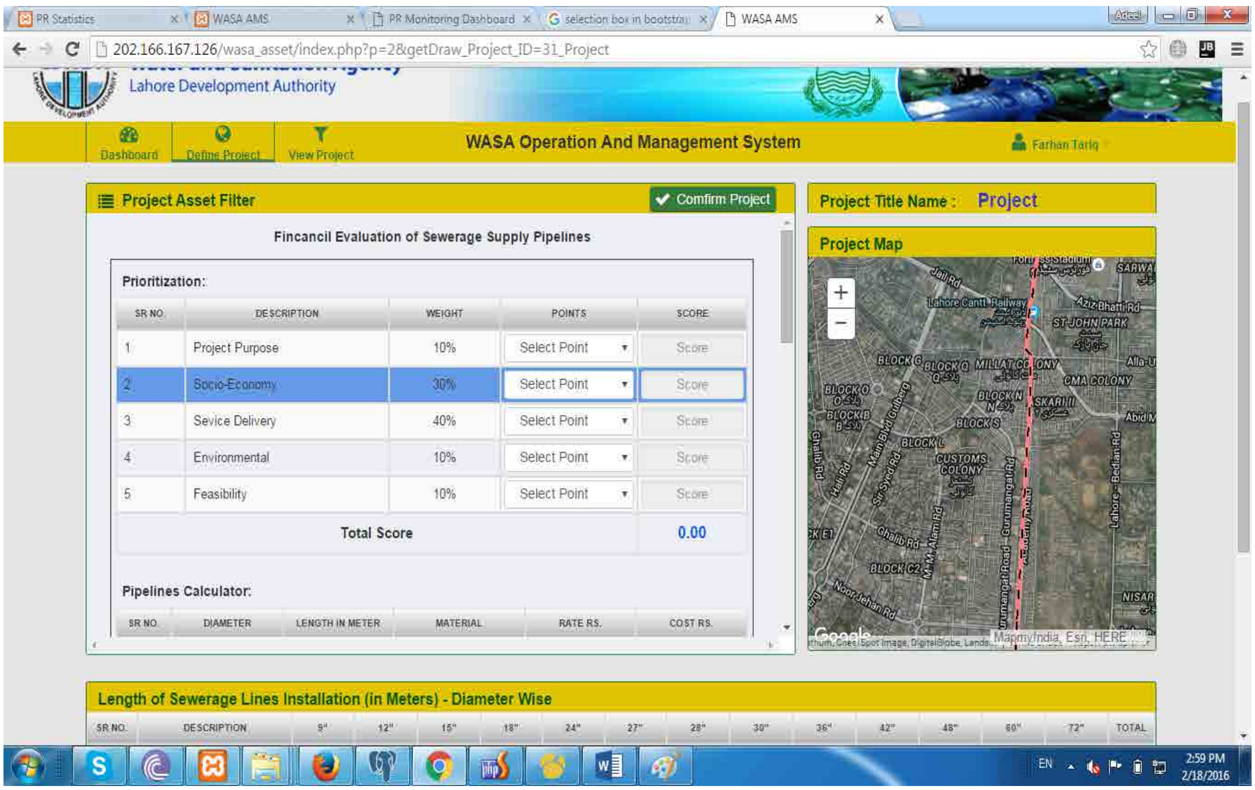


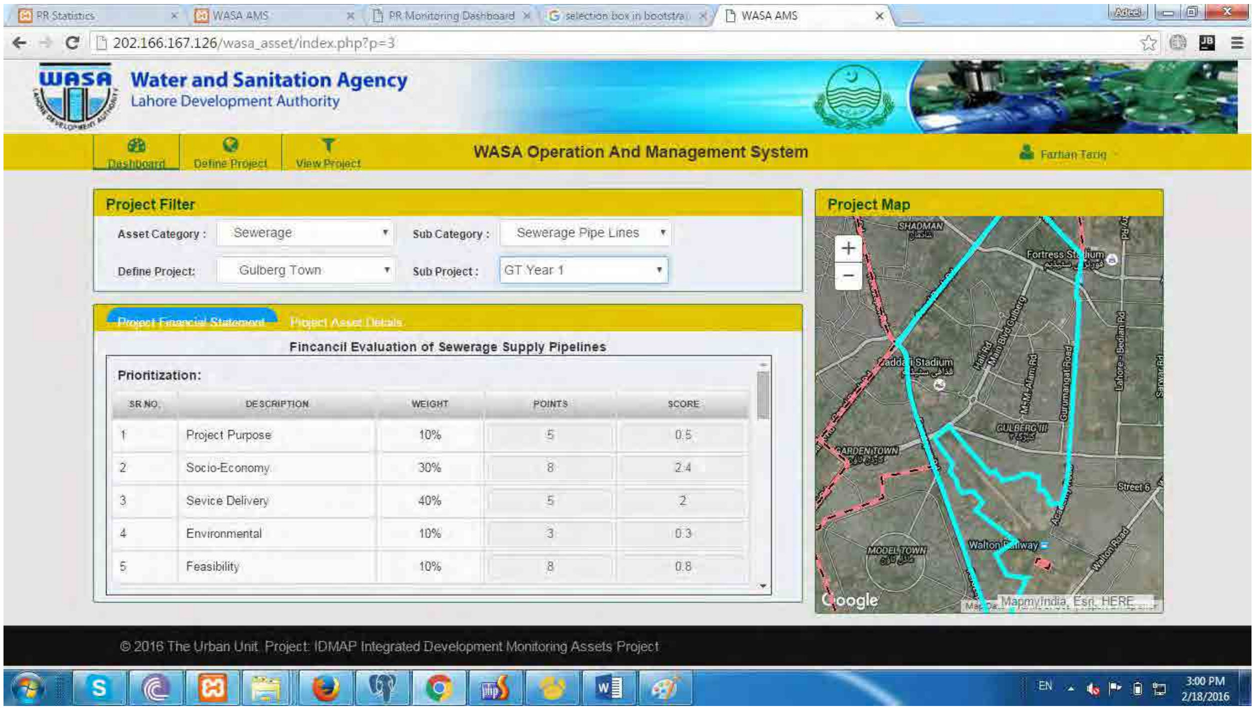


Length of Sewerage Lines Installation (in Meters) - Diameter Wise

SR NO.	DESCRIPTION	9"	12"	15"	18"	24"	27"	28"	30"	36"	42"	48"	60"	72"	TOTAL
1	Project Year One	75	374	663	0	0	0	0	0	0	0	0	0	0	1112

Filling of Project Digest Form:





Exercise 5: Create project, sub-project and fill the financial evaluation form for water supply pipelines

3. Conclusion (20 Minutes)

The lecturer will invite questions from course participants for further clarification related to addition of underground water supply pipelines, Sewerage Pipelines, creation of projects and evaluation.

The lecturer will distribute lecture feedback forms among participants for feedback and reflection.

In the name of Allah, the most Gracious and ever Merciful

Table of Content

- Introduction of Faculty & Participants.
- Course Structure, Time Schedule and Assignments.
- Assets, Types of Assets and Assets of WASAs
- Asset Life Cycle.
- Accounts and Finance in Asset Life Cycle Management.
- What is Residual Life?
- Fixed Asset Policy in WASAs of Punjab.
- Depreciation & Ways to use information.
- Fixed Asset Register.

Introduction of Faculty and Participants:

- NAME : ___________________________
- ORGANIZATION: _________________________
- AREA OF EXPERTISE: ______________________
- EXPECTATIONS FROM THIS COURSE:___________________

Asset Management Course- Assessment

Assessment	Marks	Remark
Attendance:	25	5 each day
Assignments: Task 1: Asset Management Information System (AMIS)	5	Individual
Task 2: Asset Condition Assessment	10	Group
Task 3: asset Management Plan	15	Individual
Task 4: GIS Map of Subdivision	10	Individual
Task 5 Asset Replacement Plan with Cost	10	Individual
Presentation on Asset Management Plan and Asset Replacement Plan	25	Individual Presentation on Asset Management Plan and Asset Replacement Plan.

Asset Management Course: Schedule

Microsoft Excel Worksheet

Module-2 Lecture-1

4

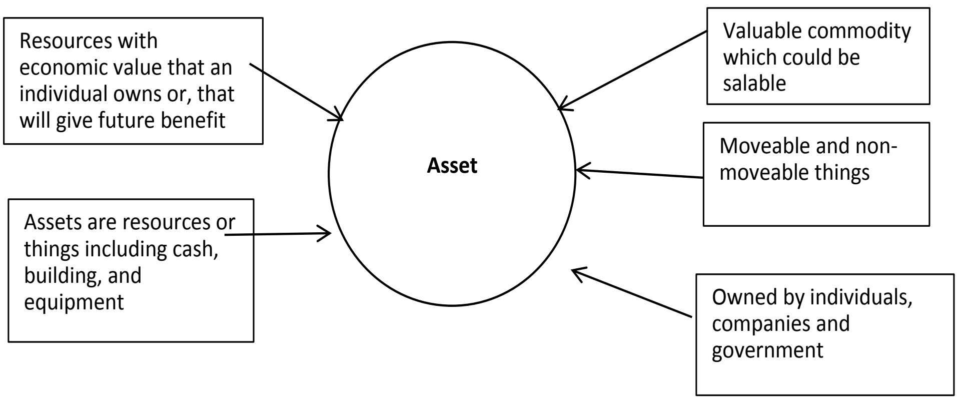
Asset:

- What is an Asset & Why Asset Management ??
  - 'What is an asset?'
  - 'What can asset information used for?',
  - 'How do we know when to replace equipment/assets?

Module-2 Lecture-1

5

Asset:



Asset:

- Assets are the physical resource of a business, such as plants, facilities, fleets or their parts and components (Campbell and Reyes-Picknell)

- “Anything of value such as an area of land, or a building, or an item of plant or equipment or infrastructure that provides service potential or future economic benefits over a period longer than one year and has a cost which is not "immaterial" (typically defined as more than, say, Rs. 100,000). Assets are typically classified as either "financial" (cash, stocks, debt instruments), "intangible" (intellectual property, goodwill) or "physical".

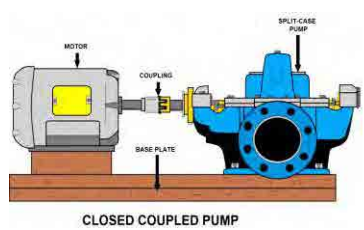
Types of Assets:

❖**Physical assets :**
It is an asset with useful life of over one year owned by individual or enterprise

❖**Financial assets :**
It is a claim for future financial payment such as saving , account and banks

❖**Intangible assets :**
Assets which are used in business which have no physical substance and non-current

Physical Assets of WASAs:

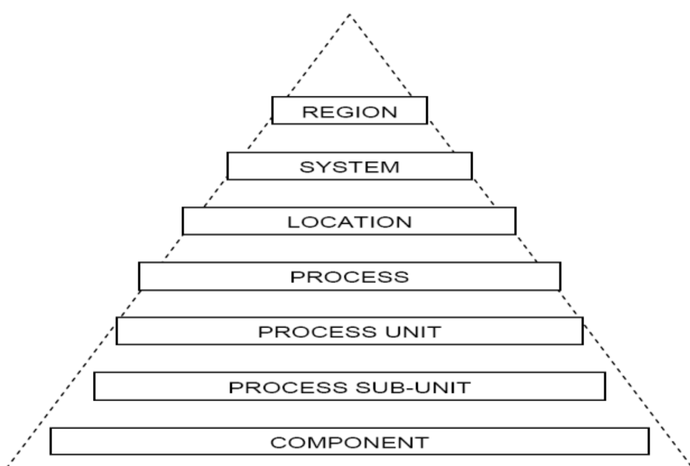


List of Assets of WASAs:

	Lahore	Fsbd	Gjwla	Rwl	Multan
Water Supply Pipelines					
Sewerage Pipelines					
Tube wells					
Disposal Stations					
Vehicles					
Transformers					
Electrical & Mechanical Works					
Buildings					
Any other					

Coding Structure of Assets.

- **What is Codin**



Coding System of Assets for WASAs in Punjab:

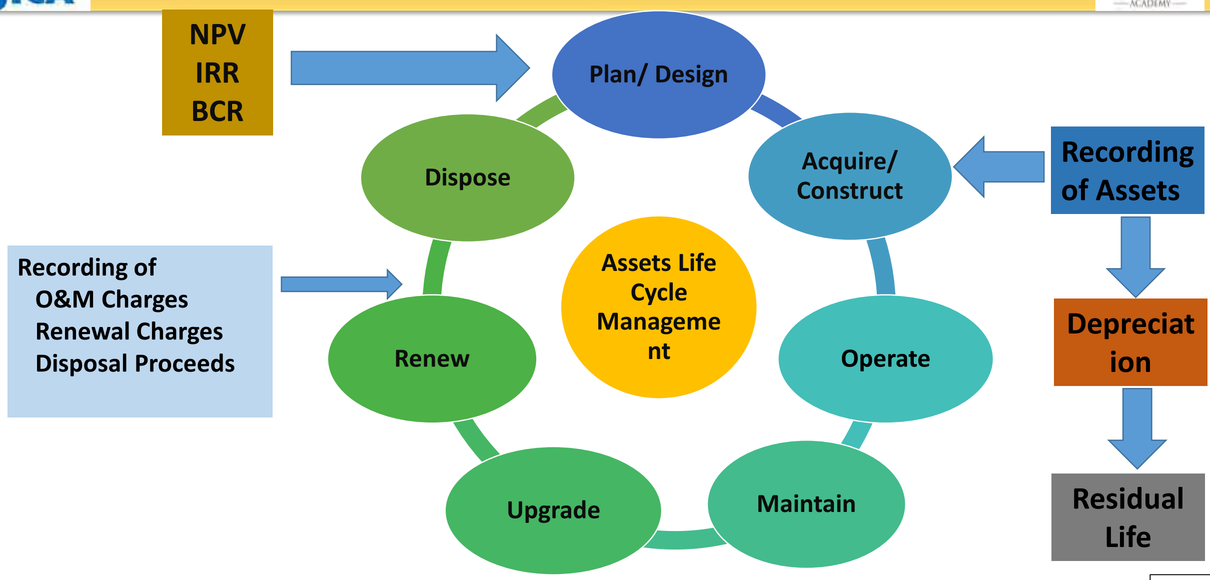
1. District- lahore - 180
2. City- lahore - 1850
3. Town – Gulberg - 104
4. UC – 000
5. Organization WASA – 20
6. Asset auto Generated Code by AMIS - 110

WASA Lahore example of Asset Register by JICA

Table 10.4 Information to Be Input in Ledger (Example)

Facilities	Data to be input
Pipe line	Diameter, Length, Invert level, Flow direction, Material, Installation year, Construction cost
Well, Pumping station	Construction year, Construction cost, Specifications of Equipment, Equipment installation year, Equipment procurement cost
Water/Wastewater treatment plant	Treatment capacity, Treatment method, Construction year, Construction cost, Specifications of Equipment, Equipment installation year, Equipment procurement cost

Asset Life Cycle Management



Module-2 Lecture-1

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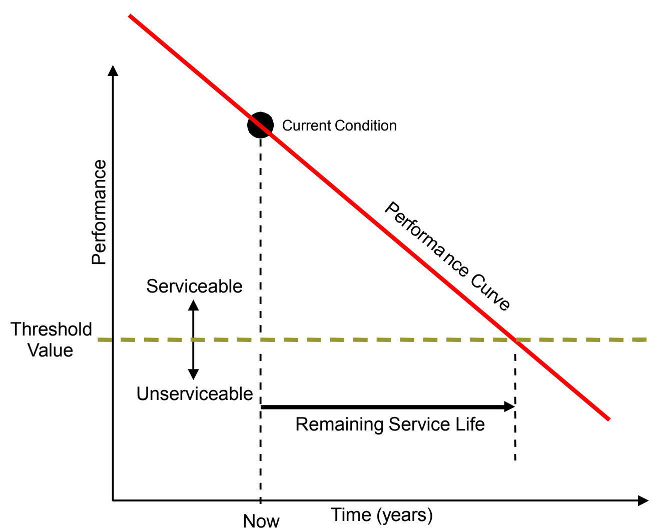
Residual Life of an Asset



Module-2 Lecture-1

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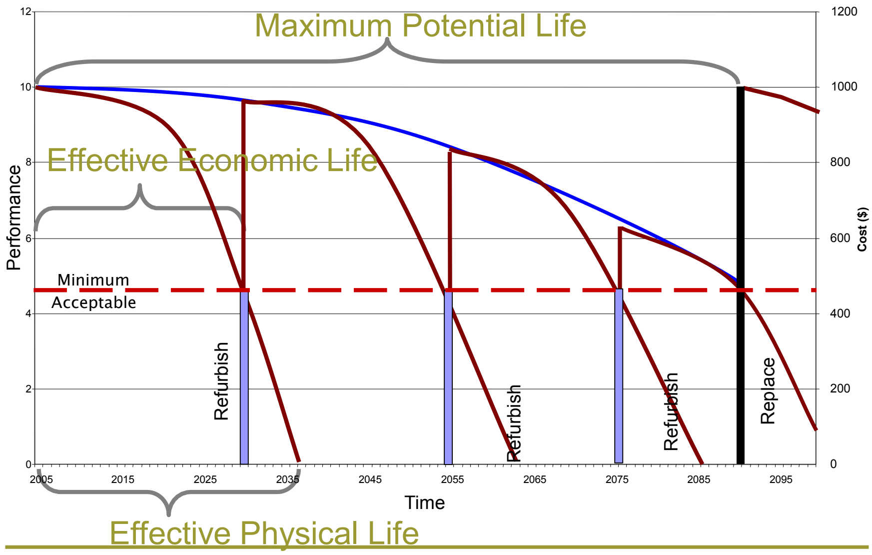
Residual Life of an Asset



Module-2 Lecture-1

16

Introduction of Accounting Manners

- **Modified Cash Basis of Accounting:**
  - **International Public Sector Accounting Standards (IPSAS)**
    - **Accounting Policies and Procedure Manual (APPM) by Auditor General of Pakistan**
    - **New Accounting Manual**

- **Accrual Basis of Accounting:**
  - **International Accounting Standards (IAS) & International Financial Reporting Standards (IFRS)**

Accounting Manners are implemented through Accounting Manual which includes Policies

Module-2 Lecture-1

17

Brainstorming on Fixed Asset Policy in WASAs

- What is Fixed Asset Policy or practice in your Organization?

Module-2 Lecture-1

18

Fixed Assets Management

Fixed Assets shall be classified into following categories:

- Land & building
- Machinery and Equipment
- Water Supply Pipelines
- Sewerage Pipelines
- Tube wells
- Vehicles
- Computer equipment
- Furniture & fitting
- Office equipment

Module-2 Lecture-1

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Fixed Assets Management Policy

- Fixed Assets with
  - Value / Initial cost > Rs. 100,000/-
  - Economic Life > 1 year
- Major Improvement cost is also to Capitalize/ record as addition in Assets.
- Economic life estimates to be reviewed once a year.
- Depreciation to be charged at rates mentioned below.
- Impairment loss shall be recognized if the carrying amount exceeds its estimated recoverable amount.

Module-2 Lecture-1

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Fixed Assets Management Policy- Exercise

Assume a utility has a policy to record assets if its acquisition cost is more than 100,000/- and expected life of more than one (1) year. Please identify the following transactions may or may not be recorded into fixed assets:

Purchase of a table in Rs. 120,000/-	(Yes / No)
Purchase of UPS in Rs. 80,000/-	(Yes / No)
Purchase of stationery of Rs. 110,000/-	(Yes / No)

Module-2 Lecture-1

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Depreciation

- **Depreciation**

Depreciation is the systematic allocation of the depreciable amount of an asset over its useful life.

- **Residual Value**

The residual value of an asset is the estimated amount that an entity would currently obtain from disposal of the asset, after deducting the estimated costs of disposal, if the asset were already of the age and in the condition expected at the end of its useful life

- **Depreciable Amount**

Depreciable amount during usable period is the cost of an asset less its residual value.

Depreciation Methods

- **Straight Line Method**
- **Declining Balance Method**
- **Average Balance Method**

Straight Line Method is being used in WASAs of Punjab as per FM Manual

Annual Depreciation = (Acquisition Cost – Residual Value)/ Economic Life

Depreciation Rates as per FM Manual of WASAs

Description	Depreciation %age	Tax Depreciation %age
Freehold land	0%	0
Building	2%	10
Plant and Machinery		
• Tube-wells and water supply	7%	10
• Sewerage and disposal station	7%	10
Pipelines		
• Water supply	3%	10
• Sewerage	3%	10
Office equipment	10%	30
Furniture and fixture	10%	10
Vehicles	20%	20
Computer equipment	20%	30

Application of Depreciation Information

- Average Depreciable Life = Investment/ Annual Depreciation Expense
- Average Age (Years used) = Accumulated Depreciation/ Annual Depreciation Expense
- Remaining Useful Life = Net investment/ Annual Depreciation Expense (Average Depreciable Life – Average Age)

Fixed Asset Register

Fixed asset register is a compulsory accounting record. Accounting Policies and Procedural Manual (APPM) requires to record following attributes into the Fixed Asset Register at minimum (Section 13.4):

- Description
- Classification of asset
- Year of Purchase or completion
- Original Cost in PKR
- Cost in foreign currency (if applicable)
- Asset Identification Number
- Current Location
- Ownership / Responsibility of Asset

Fixed Asset Register- Conti…

International Accounting standard requires following additional information into the Fixed Asset Register (TS 6):

- Addition / Deletion of assets
- Depreciation
- Accumulated Depreciation
- Revaluation
- Date of Revaluation

Assignment:

Suppose you are an Asset Manager of XYZ Subdivision of WASA-A. The fixed asset register for Financial Year 2014-15 is attached at annexure-A. In July 2015, you extended services in liberty area and installed water supply pipelines in 50 million and a Tubewell in Rs. 13 million. Please do the following;

1. Prepare Fixed Asset Register for FY 2015-16.

Questions?

1

Business Planning

Capital Budgeting, Financial and Economic Appraisal

Asif Iqbal
Financial Management Specialist

2

Technical

Social and Environmental

PROJECT APPRAISAL

Economic and Financial

Organizational and Management

Financial Appraisal:
CBA based on purely financial terms

Economic Appraisal:
CBA includes societal perspective

FINANCIAL APPRAISAL

3

- **Appraisal on purely financial terms**
- **Incremental financial benefits & costs to the project & the IRR or NPV**
- **Methods of financial appraisal (discounted cash flow techniques) – consider time value of money**
  - Net Present Value (NPV)
  - Internal Rate of Return (IRR)
  - Benefit Cost Ratio (BCR)

These differing appraisal techniques may give contradictory conclusion

LEARNING FOCUS

4

1) Understanding of Technique
2) Calculation Methods
3) Interpretation of Results and how to base decisions on Results.

5

Which Project will you choose?

Table 1: Expected Net After-Tax Cash Flows

Year (t)	Project A	Project B
0	–$2,000	–$2,000
1	1,000	200
2	800	600
3	600	800
4	200	1,200

Project A: Net Cash Inflow of $ 600
Project B: Net Cash Inflow of $ 800

6

TIME VALUE OF MONEY

The value of money decreases as the time passes.
Costs and benefits occur at different point of time.
How to compare benefits with costs ?

a. Compounding $F=P(1+r)^n$ ⟶ Future Value

b. Discounting $P=F/(1+r)^n$ ⟶ Present Value

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Net Present Value (NPV)

"The revenues and costs of a project are estimated and then are discounted and compared with the initial investment."

Preferred option - highest positive NPV
Reject projects with negative NPVs

Disadvantages of NPV

Rank projects in order of ascending NPV (smaller project with lower NPV might be more attractive due to higher ratio of discounted benefits to costs)

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Example: NPV

Example: NPV analysis

Using the project cash flows presented in Table 1, compute the NPV of each project's cash flows and determine for each project whether it should be accepted or rejected. Assume that the cost of capital is 10%.

Table 1: Expected Net After-Tax Cash Flows

Year (t)	*Project A*	*Project B*
0	–$2,000	–$2,000
1	1,000	200
2	800	600
3	600	800
4	200	1,200

Example: NPV

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Example: NPV analysis

Using the project cash flows presented in Table 1, compute the NPV of each project's cash flows and determine for each project whether it should be accepted or rejected. Assume that the cost of capital is 10%.

Table 1: Expected Net After-Tax Cash Flows

Year (t)	*Project A*	*Project B*
0	–$2,000	–$2,000
1	1,000	200
2	800	600
3	600	800
4	200	1,200

NPV:
Project A: $ 157.6
Project B: $ 98.4

Internal Rate of Return (IRR)

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"The IRR is the discount rate that, when applied to cash inflows of a project, sets them equal to the initial investment"

Preferred option - with the IRR most in excess of a specified rate of return
IRR of 10% means that with a discount rate of 10%, the project breaks even
Interest rate used for discounting future cash flows to compute present value of those cash flows.
IRR exceeds the hurdle cost of capital - discount rate, the project is accepted

Disadvantage of using IRR method
Not suitable for ranking of competing projects
Two projects may have same IRR but different NPVs when time horizon differs

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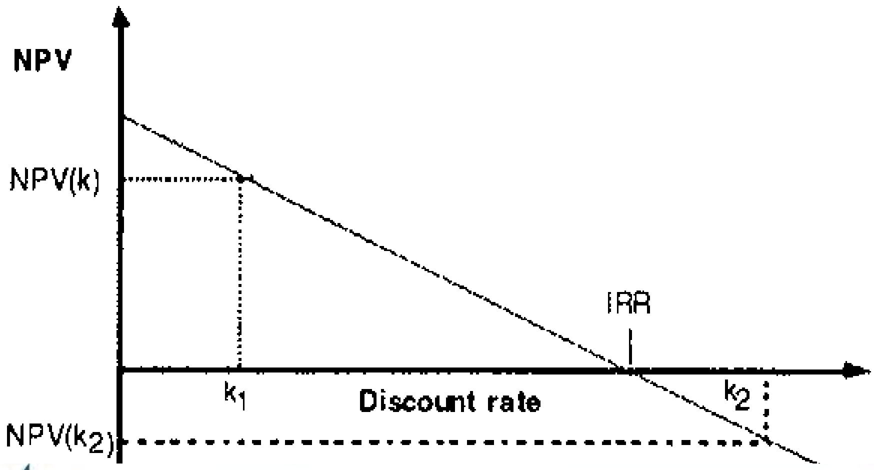
NPV and Discount Rate



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IRR FORMULA

$$IRR = r_a + \frac{NPV_a\ (r_b - r_a)}{(NPV_a - NPV_b)}$$

r_a = lower discount rate

r_a = higher discount rate

NPV_a = NPV using the lower discount rate

NPV_b = NPV using the higher discount rate

Example: IRR

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Table 1: Expected Net After-Tax Cash Flows

Year (t)	*Project A*	*Project B*
0	–$2,000	–$2,000
1	1,000	200
2	800	600
3	600	800
4	200	1,200

Example: IRR

14

Table 1: Expected Net After-Tax Cash Flows

Year (t)	*Project A*	*Project B*
0	–$2,000	–$2,000
1	1,000	200
2	800	600
3	600	800
4	200	1,200

IRR:
- **Project A: 14.5%**
- **Project B: 11.8%**

Benefit Cost Ratio

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Benefit Cost Ratio (BCR) or Profitability Index (PI)
"The BCR is the discounted net revenue divided by the initial investment"

Preferred option - ratio most in excess of 1
Project with a BCR of less than 1 should generally not proceed
Advantage is simplicity of the method

Disadvantage of using BCR method
Suboptimal decision as a project with higher BCR will be selected over a project with lower BCR even when the latter project has the capacity to generate much greater economic benefits because it has a higher NPV value and involves greater scale

Example: BCR

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Table 1: Expected Net After-Tax Cash Flows

Year (t)	Project A	Project B
0	–$2,000	–$2,000
1	1,000	200
2	800	600
3	600	800
4	200	1,200

Example: BCR

Table 1: Expected Net After-Tax Cash Flows

Year (t)	*Project A*	*Project B*
0	–$2,000	–$2,000
1	1,000	200
2	800	600
3	600	800
4	200	1,200

BCR/PI:
Project A: 1.08
Project B: 1.05

Exercise1: Financial Appraisal of PFI Panel Installation.

	Year 2016	**Year 2017**	**Year 2018**	**Year 2019**	**Year 2020**	**Year 2021**
	0	**1**	**2**	**3**	**4**	**5**
Investment Expenditure						
Maintenance Expenditure						
Electricity Charge Saving						
Net Cash flows						

Calculate NPV, IRR & BCR?

Exercise1: Financial Appraisal of PFI Panel Installation.

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	Year 2016	Year 2017	Year 2018	Year 2019	Year 2020	Year 2021
	0	1	2	3	4	5
Investment Expenditure	(2,000,000)					
Maintenance Expenditure			(140,000)		(140,000)	-
Electricity Charge Saving		660,000	660,000	660,000	660,000	660,000
Net Cash flows	**(2,000,000)**	**660,000**	**520,000**	**660,000**	**520,000**	**660,000**

Calculate NPV, IRR & BCR?

Exercise1: Financial Appraisal of PFI Panel Installation.

20

	Year 2016	Year 2017	Year 2018	Year 2019	Year 2020	Year 2021
	0	1	2	3	4	5
Investment Expenditure	(2,000,000)					
Maintenance Expenditure			(140,000)		(140,000)	-
Electricity Charge Saving		660,000	660,000	660,000	660,000	660,000
Net Cash flows	**(2,000,000)**	**660,000**	**520,000**	**660,000**	**520,000**	**660,000**

NPV= 178,573
IRR= 15.56%
BCR= 1.09

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Sensitivity Analysis

- Possible to identify those parameters and assumptions to which the outcome of the analysis is most sensitive
- Challenges the robustness of the results to changes in the assumptions made (i.e. discount rate, time horizon, estimated value of costs and benefits, etc.)

Scenario Analysis

- Scenarios are formulated: best case, worst case, etc.
- Potential values assigned for each cost and benefit variable

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Case Study- Water Bottling Plan in Faisalabad

1. Please review and rationalize (if any) assumptions for Water Bottling Plant as used by WASA Fsb and mentioned in Case.
2. Determine initial investment, revenues and expenditures based on revised assumptions considering life of the project is 5 years.
3. Perform Financial Appraisal including NPV, IRR and BCR.
4. Perform sensitivity analysis for 10% change in production and 10% change in electricity Cost.

Economic Appraisal

Economic soundness of the project - **Societal Perspective**

Considers non-market impacts

- Externality: Cost or benefit that affects a party that did not choose to incur that cost or benefit.
- Example: Environmental degradation by a dam or improved income by construction of Road

Frequently used analytical techniques:

- Cost Benefit Analysis (CBA): Impacts can be quantified in monetary terms
- Cost Effectiveness Analysis (CEA): Impacts cannot be quantifies in monetary terms

Economic Appraisal

1. Identify Benefits and Costs to the Society e-g
   i. Decrease in Diarrhea.
   ii. Time and effort savings
2. Quantify these Benefits and Costs.
3. Add them into Financial Cash flows.
4. Calculate ENPV, EIRR & BCR.

In the name of Allah, the most Gracious and ever Merciful

Table of Content

- Why do we need Asset Registry/ Database?
- Introduction of Asset Management Information System.
- Basic Functions of AMIS.
- Overview of complete AMIS.

Module-2 Lecture-2

1

Asset Registry/ Database

Why Do we need Asset Database?

What is the current state of my assets?

- *What* do I own?
- *Where* is it?
- What *Condition* is it in?
- What is its *remaining useful life*?

Decision Support System

Asset Management Information System is the Answer

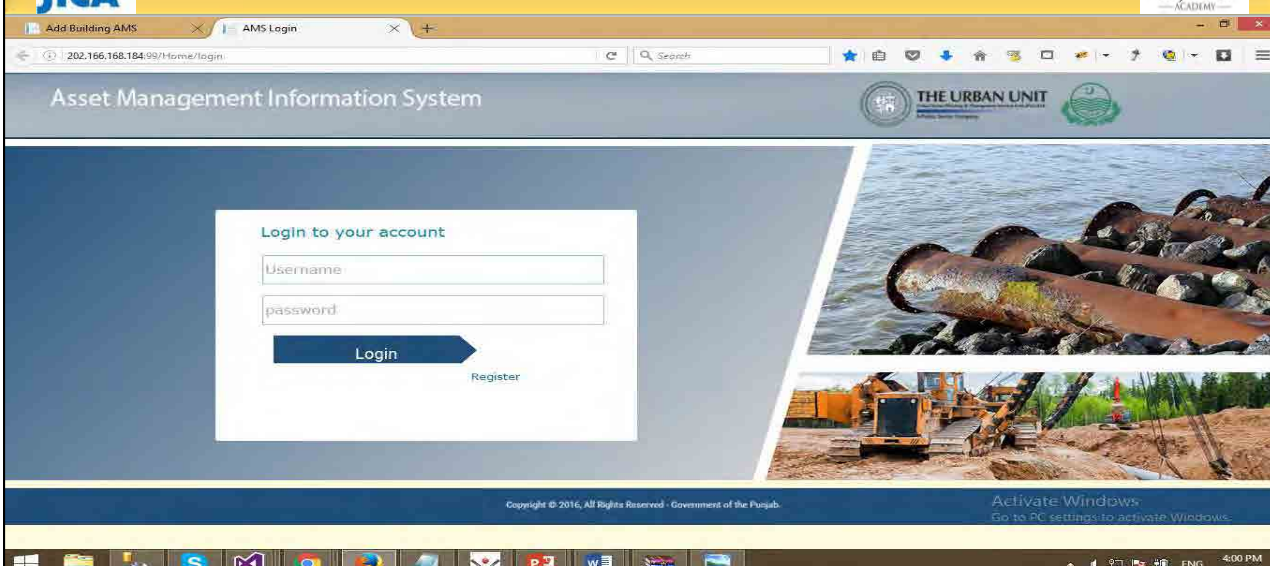
A Web System integrated with Geographic Information System (GIS)

Automate processes related to asset management

Module-2 Lecture-2

2

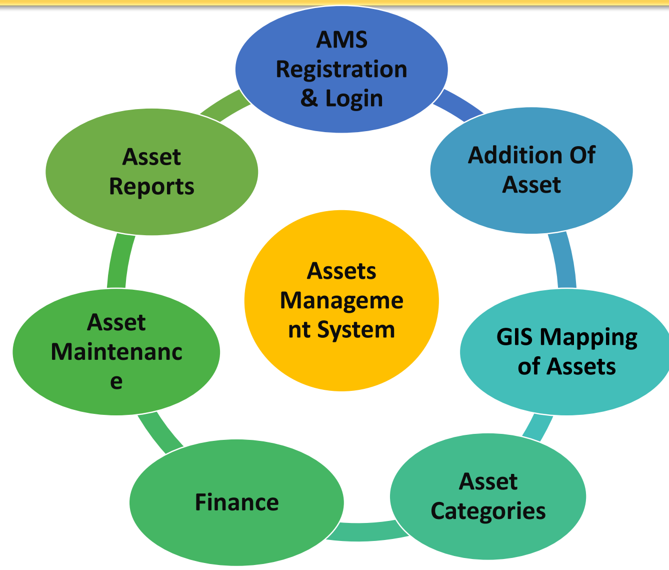
Asset Management Information System



Module-2 Lecture-2

3

Basic Functions of AMIS

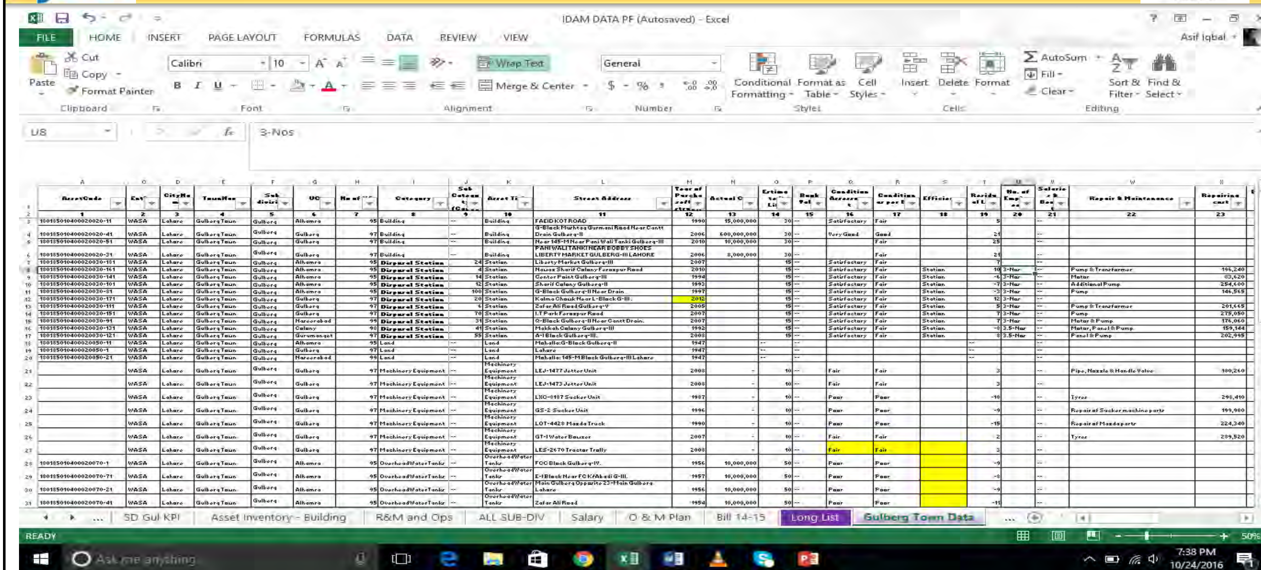


GIS Based Asset Inventory

AMIS includes following information regarding Assets:

- **Asset Code**
- **Asset Category & Subcategory**
- **Asset Ownership details**
- **Asset Location including information of town, UCs and specific address**
- **Capacity, technical specification and installation details**
- **Accounting information like purchasing cost, book value, estimated life, R&M cost, HR cost etc.**
- **Engineering details like Condition, Risk etc**

GIS Based Asset Inventory



Module-2 Lecture-2

6

Dashboard (1/4)

Total Number of Assets in all Districts

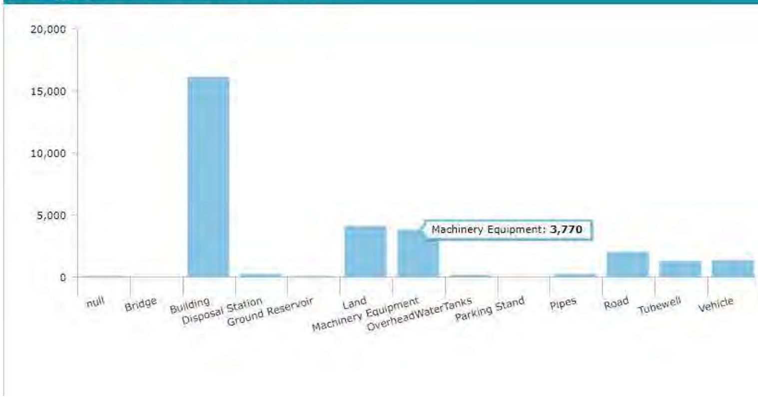
Module-2 Lecture-2

7

Dashboard (2/4)

Category Wise Number of Assets

Category Wise Number of Assets



Assets Type	Assets
Bridge	14
Building	16110
Disposal Station	229
Ground Reservoir	51
Land	4120
Machinery Equipment	3770
OverheadWaterTanks	163
Parking Stand	18
Pipes	250
Road	2017
Tubewell	1267
Vehicle	1340

Module-2 Lecture-2

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Dashboard (3/4)

Organization Wise Number of Assets

Assets of Wasa's

Asset Name	WASA-LHR	WASA-GUJ	WASA-RWP	WASA-MUL	WASA-FSD
Machinery Equipment	256	44	0	13	127
Parking Stand	0	0	0	0	0
Pipes	61	3	178	0	9
Road	0	0	0	0	0
Vehicle	204	25	133	43	74
Land	14	0	0	26	166
Disposal Station	94	30	0	11	35
Water Treatment Plant	1	0	0	0	0
Tubewell	424	69	339	106	49
Building	46	14	6	6	17
Ground Reservoir	0	0	8	0	27
Bridge	0	0	0	0	0
OverheadWaterTanks	18	12	31	18	42

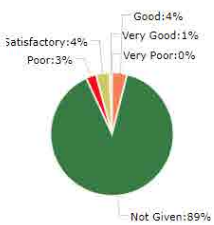
Module-2 Lecture-2

9

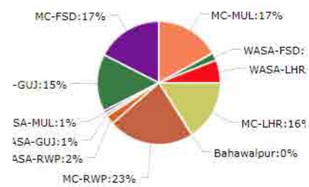
Dashboard (4/4)

Condition/ Organization wise Number of Assets

Condition/Department Wise Number of Assets

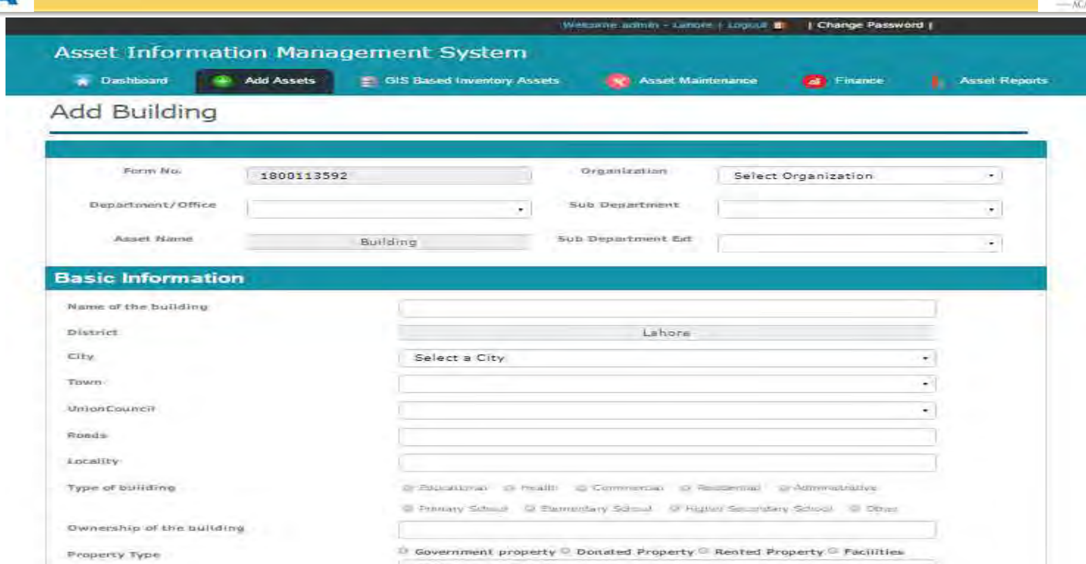


Condition Type	Count
Good	1164
Not Given	25928
Poor	773
Satisfactory	1037
Very Good	196
Very Poor	5

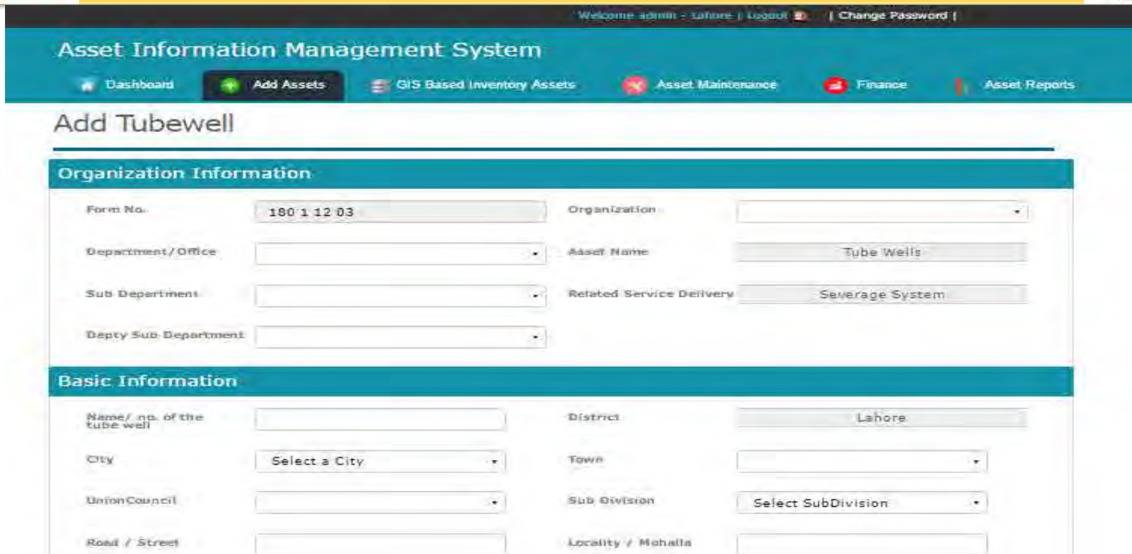


Condition Type	Count
MC-MUL	4947
WASA-FSD	583
WASA-LHR	1745
MC-LHR	4631
Bahawalpur	30
MC-RWP	6555
WASA-RWP	695
WASA-GUJ	239
WASA-MUL	223
MC-GUJ	4363
MC-FSD	5092

GIS Based Asset Inventory-Add Asset



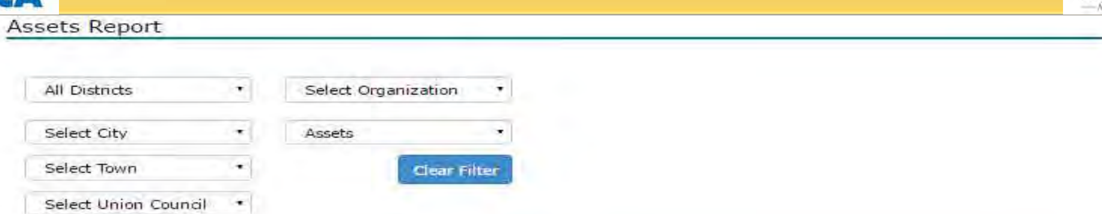
GIS Based Asset Inventory-Add Asset



Module-2 Lecture-2

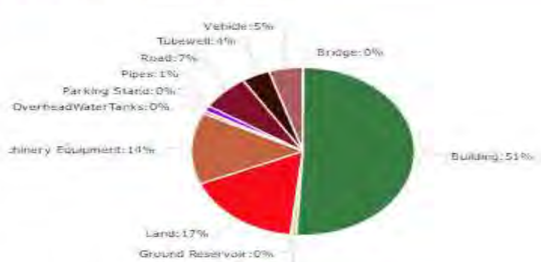
11

Asset Reports



Assets of All Departments, All Organizations in All Districts

Asset Type	Count
Bridge	14
Building	12389
Disposal Station	173
Ground Reservoir	35
Land	4093
Machinery Equipment	3360
OverheadWaterTanks	121
Parking Stand	18
Pipes	250
Road	1685
Tubewell	987
Vehicle	1205
Total	24300



Module-2 Lecture-2

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Asset Reports

Assets Report

Lahore ▾ | CDG ▾
Lahore ▾ | Buildings ▾
Ravi Town ▾ | Clear Filter
Select Unioncouncil ▾

Select Building Filters

Building Type

Educational ▾

Select Building Type ▾

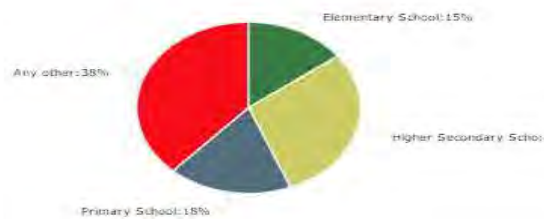
Ageing Analysis ▾

Group By

Select Criteria ▾

Buildings of All Departments, CDG in Lahore

Asset Type	Count
Elementary School	18
Higher Secondary School	36
Primary School	22
Any other	47
Total	123



GIS Location of Assets

Map | Full Extent

Survey Information

Name	RHC Chung
Town	Iqbal Town
UC No	Chung
Road	Multan Road
Locality	RHC Chung Multan Road Lahore
Condition Rating	3
IMEI	359661045552889
Date	2015-04-05 00:58:46.677

1

2015-04-05

In the name of Allah, the most Gracious and ever Merciful

Table of Content

- What is Risk
- Types of Risks
- Risk Management Framework
- Application of Risk Management Framework
- Asset Risk Management In WASAs
- Measurement of Asset Risk
- Management of Asset Risks in WASAs

Risk:

➢ **What is Risk?**

- It can be defined as, "a situation involving exposure to danger or possibility of loss".
- The risk related to physical assets is called Asset Failure risk.
- Simply put, it means that assets have inherent risks or the potential for failure.

Types of Risks:

➢ **Financial Risk:**
- Market Risk
- Credit Risk
- Liquidity Risk

➢ **Non-Financial Risk:**
- Operations Risk or Operational Risk
- Model Risk
- Sovereign
- Regulatory Risk
- Tax, Accounting and Legal/ Contract Risk

➢ **Other Risks e-g ESG (Environmental, Social and Governance)**

Risk Management Framework: (1/2)

- **Identify Risks**
- **Measure Risks**
- **Manage Risk**

❖ The following scale is used worldwide to determine risk of an asset;

I) Significant
II) High
III) Medium
IV) Low

	Occurs Regularly (High Probability)	Infrequent (low Probability)
Very Severe	Significant / High Risk	High/ Medium Risk
Not Severe	Medium Risk	Low Risk

Risk Management Framework: (2/2)

- **Manage Risk**

Risk	Risk Management
Significant / High Risk	Risk Avoidance
High / Medium Risk	Risk Transfer/ Risk Prevention/ Risk Reduction
Low Risk	Risk Retention

Application of Risk Management Framework:

Identify Risk, Measure Risk and Suggest Risk Management Strategy?

Asset Risk Management:

- The risks must be clearly understood and managed to assure cost-effective service delivery.
- ISO 55002 states that “the organization should determine the actions that are necessary for addressing risks when planning for its asset management system. The overall purpose is to understand the cause, effect and likelihood of adverse events occurring, to manage such risks to an acceptable level, and to provide an audit trail for the management of risks”.

Asset Risk Measurement:

a) **Probability of Asset Failure**

- Following factors can be analyzed to predict the probability of Asset Failure:
  - Asset Condition
  - Asset Effective Age
  - Past Failure history

PROBABILITY

- Asset probability of failure can be calculated according to the following scales:

Condition	A	B	C	D	F
Probability of Failure Rating	1	2	3	4	5

Asset Risk Measurement:

b) **Impact of Asset Failure**

- **Scale showing the Extent of Impact of an Asset :**

  Based on the already potential impacts/ consequences associated with the failure of asset, Impact of an asset to the service delivery can be assigned using the following scale :

Impact	Total System Failure	Facility/ Sub-Division Failure	Asset Failure	Major Component Failure	Minor Component Failure
Scale Value	5	4	3	2	1

Asset Risk Measurement:

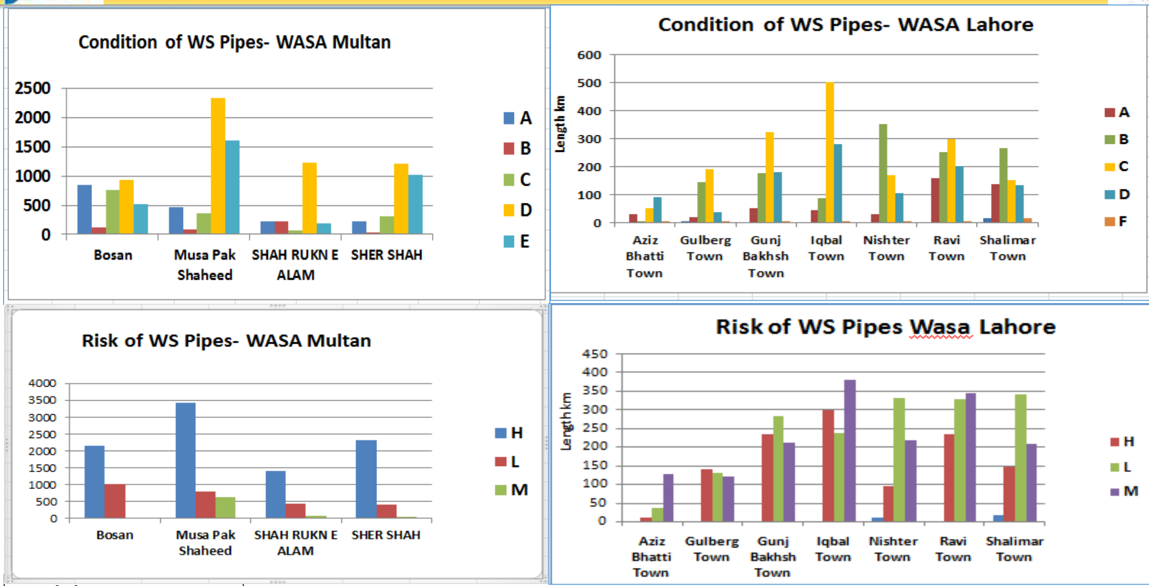
- **Risk Rating**
- Calculation steps for the product of probability rating and impact rating are shown in the following table :

Probability	Impact (criticality assessment)				
	1	2	3	4	5
A	Low Risk	Low Risk	Low Risk	Moderate Risk	High Risk
B	Low Risk	Low Risk	Moderate Risk	High Risk	High Risk
C	Low Risk	Moderate Risk	High Risk	High Risk	Significant Risk
D	Moderate Risk	High Risk	High Risk	Significant Risk	Significant Risk
F	High Risk	High Risk	Significant Risk	Significant Risk	Significant Risk

Asset Risk Measurement:

- **Exercise:**
- **Please Identify and Measure Risk of Green Town Tubewell Station.**

Asset Risk in WASAs:



Module-2 Lecture-1

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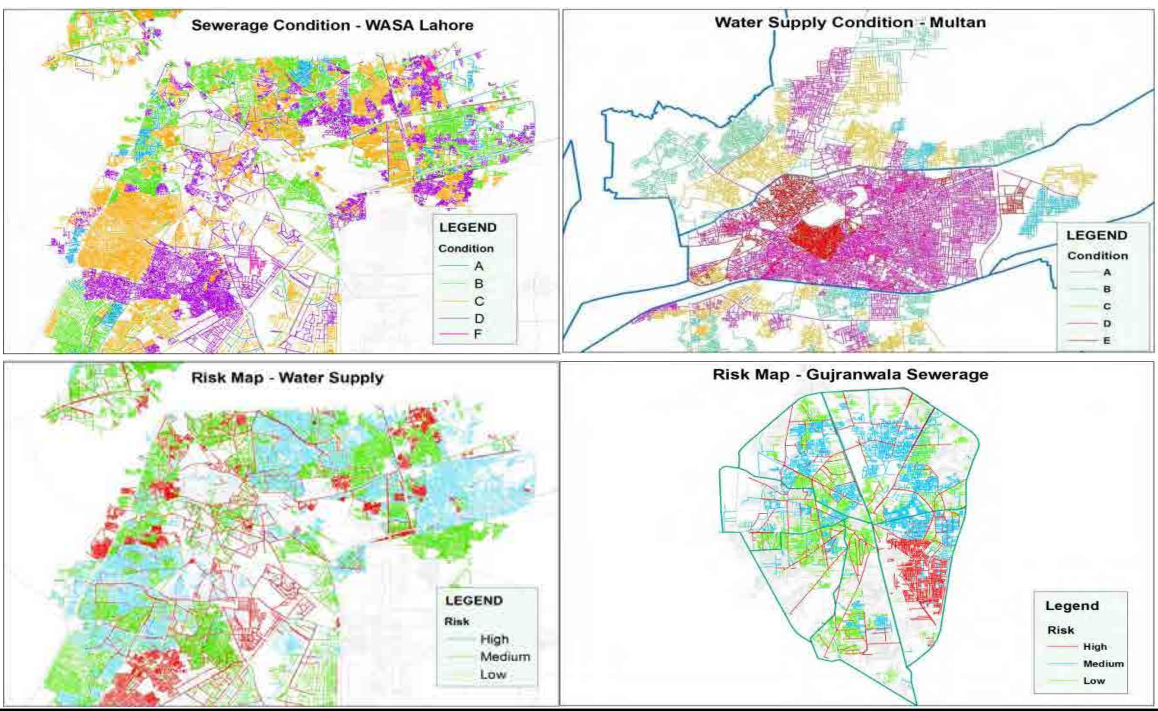

Asset Risk Management:

- **Combining Condition, Risk and Residual life to plan**
- In order to plan asset management in light of the ***Physical Condition*** and assessed ***Asset Failure Risks*** the following matrix may be used to identify action plan for asset management :

Condition	Failure Risk State			
	Low	*Moderate*	*High*	*Significant*
A	Regular Maintenance	Regular Maintenance	Preventive Maintenance	Priority Maintenance
B	Regular Maintenance	Preventive Maintenance	Priority Maintenance	Priority Rehabilitation
C	Preventive Maintenance	Priority Maintenance	Priority Rehabilitation	Immediate Rehabilitation
D	Priority Maintenance	Priority Rehabilitation	Immediate Rehabilitation	Immediate Replacement
F	Priority Maintenance	Immediate Rehabilitation	Immediate Replacement	Immediate Replacement

Asset Risk Management:

- **Combining Condition, Risk and Residual life to plan**
- Assets that require "immediate Replacement/ Rehabilitation" should be top priority
- Assets that require " Priority Rehabilitation" should be accommodated if resources allow
- Assets that require "Preventive/ Priority maintenance" should be carefully monitored to prevent the need for their replacement
- Note that the assets that require regular maintenance does not pose a risk and can be operated with regular maintenance schedule.

EXERCISE

Questions?

Asset Risk Management:

- **Combining Condition, Risk and Residual life to plan**
- In order to plan asset management in light of the ***Physical Condition*** and assessed ***Asset Failure Risks*** the following matrix may be used to identify action plan for asset management :

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Asset Risk Management:

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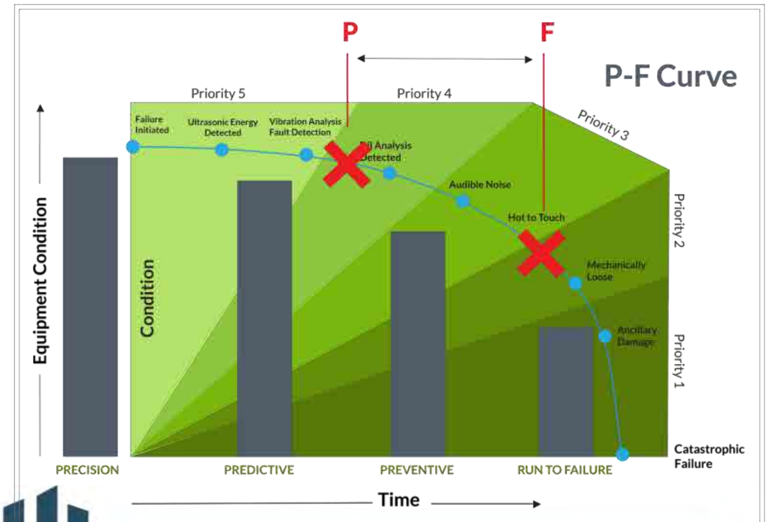
Asset Risk Management (Contd.)



Preventive Maintenance

- Preventative maintenance is maintenance that is regularly performed on a piece of equipment to lessen the likelihood of it failing.
- Preventative maintenance is performed while the equipment is still working, so that it does not break down unexpectedly.
- Preventative maintenance is planned so that any required resources are available.
- Preventive maintenance involves the systematic inspection of equipment where potential problems are detected and corrected in order to prevent equipment failure before it happens.

Preventive Maintenance

- In practice, a preventive maintenance schedule may include:

- Cleaning,
- Lubrication
- Oil changes
- Adjustments
- Repairs
- Inspecting and replacing parts
- Partial or complete overhauls that are regularly scheduled.

Benefits of Preventive Maintenance

- Preventive maintenance offers companies a number of important benefits including
- Prolonged life of company equipment
- Less unplanned downtime caused by equipment failure
- Less unnecessary maintenance and inspections
- Fewer errors in day-to-day operations
- Improved reliability of equipment
- Fewer expensive repairs caused by unexpected equipment failure that must be fixed quickly
- Reduced risk of injury

Asset Rehabilitation

- The action of restoring something that has been damaged to its former condition.
- **Civil Works:**
- Plaster
- Flooring
- Face Lifting
- Casting of Pump Foundation

Asset Rehabilitation

- **Mechanical Works:**
- Make operational/install new chlorinator
- Control gland leakage
- Maintain ratchet plate
- Adjust impeller
- Repair & maintenance of pump
- Replace existing pumping system
- Maintain/install new non return valve

Asset Rehabilitation

- **Electrical Works:**
- Repair/Replace
  - VFD
  - Hour Meter
  - ampere meter
  - volt meter
  - over current relays
  - over voltage relay
  - electrical meter
  - Electrical motor
  - main circuit breaker
  - PFI plant
  - motor terminal box
  - panel condition
  - wiring condition

Exercise

- Please suggest suitable actions for Tubewell at Green Town?

Frequencies of Preventive Maintenance

- International best practices regarding frequencies of preventive maintenance for different assets of WASA;

▪ Instrumentation Maintenance Frequencies
▪ M&E Maintenance Frequencies
▪ Pumping Station M&E Maintenance Frequencies

Instrumentation Maintenance Frequencies

Asset type	Monthly	3 monthly	6monthly	Annual
Control panel meters			•	
Level sensors/transmitters	•			
SCADA control panels				•
Soft starters		•		
Bearing sensors			•	
Chemical dosing	•			
Bulk Flow meters				•
pH Calibration (RO) Plants	• weekly			

Course Title: Asset Management-M Lecture- Module 6: Use of GIS Application in Asset Management 2

M&E Maintenance Frequencies

Asset Type	Monthly	3 Monthly	6 Monthly	Annual	Two yearly	Overhaul Period (yrs)
Pumps (dw/ww)	•			•		•5
Motors		•	•		•	•5
Sub pumps			•			•5
Gear boxes	•		•			•5
Transformers		•	•	•		
Control panels	•					
Control valves	•					
Bulk meters	•					
Compressors	•		•			•3
Generators	•	•		•		•5
Chlorinators	•			•		•3
A/sc blowers	•	•				•3
Bk/w pumps	•		•			•5
Lime handling	•	•				•2-3
Chemical handling	•	•				•3
Tank stirrers			•			•5
Cooling fans	•	•		•		•3
RO plants	•	•				
Lifting equip				•		
Site security	•					
Safety inspections				•		

Pumping Station M&E Maintenance Frequencies

Asset Type	Monthly	3 Monthly	6 Monthly	Annual	Two Yearly	Overhaul Period (years)
Pumps (dw/ww)	•			•		•5
Motors		•	•		•	•5
Sub pumps			•			•5
Gear boxes	•		•			•5
Transformers		•	•	•		
Control panels	•					
Control valves	•					
Generators	•	•		•		•5
Lifting Equipment				•		
Security	•					
Safety inspections				•		

1

Business Planning & GAP Analysis

Integrated Development & Asset Management Plan (IDAMP)

Asif Iqbal
Financial Management Specialist

2

TABLE OF CONTENTS

- Evidence Based Planning
- Integrated Development Practices around the Glob.
- Integrated Development and Asset Management Plan (IDAMP)
  - Introduction
  - Role in Development Planning
  - Methodology
  - Step By Step Approach.
  - Implementation of IDAMP Through ADP

Business Planning B1131 Module 1 : Business Planning & GAP Analysis Session 2

3

What is an Evidence Based Planning?

Condition	Failure Risk State			
	Low	Moderate	High	Significant
A	Regular Maintenance	Regular Maintenance	Preventive Maintenance	Priority Maintenance
B	Regular Maintenance	Preventive Maintenance	Priority Maintenance	Priority Rehabilitation
C	Preventive Maintenance	Priority Maintenance	Priority Rehabilitation	Immediate Rehabilitation
D	Priority Maintenance	Priority Rehabilitation	Immediate Rehabilitation	Immediate Replacement
E	Priority Maintenance	Immediate Rehabilitation	Immediate Replacement	Immediate Replacement

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International Examples

- Canada
  - IDP is part of the 10-year municipal planning and financing strategy
  - Integrated development planning process required for 5-10 years depending on the province
  - IDP are supposed to guide the activities of any agency from other spheres of government, corporate service providers, and the private sector within the municipal area
- South Africa
  - Integrated development planning one of the key tools for local government to deal with its development role
  - Integrated development planning is seen as a function of municipal management
  - IDP
    - Is seen as an integrated system of planning and service delivery
    - Process began under difficult circumstances with a largely incomplete legal framework
    - Process is meant to assist municipalities in arriving and making decisions on:
      - Municipal budgets
      - Land management
      - Promotion of local economic development
      - Institutional transformation

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6

WHAT IS INTEGRATED DEVELOPMENT & ASSET MANAGEMENT PLAN?

INTRODUCTION

- Midterm (3 year) rolling Planning & Asset Management Tool.
- Annual development plan (ADP) will become Objective and result oriented.
- Evidence based planning creates linkage between (level of services (Los) with development and non development activities within a city.
- Helps entities better justify expenditure needs.
- Leads policy makers to better monitoring of performance of entities

How Do You Plan?

A. Development?

B. Non-Development/ Asset Management?

Is this planning an Evidence Based?

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ANNUAL DEVELOPMENT PLAN

DATE	ACTION
January, 2016	Circulation of ADP guidelines
1st Feb to 15th March	Submission of scheme-wise first draft ADP to the Planning & Development by the departments duly cleared by Minister In-charge.
16-25 March	Scrutiny of draft ADP by the Members P&D and submission to Coordination Wing of P&D Department
26 March to 7 April	Departmental meetings / briefing with Chairman, P&D to discuss draft ADP
10th April	Submission of 2nd draft ADP to P&D by the Departments
Up till 15 May	Approval of new schemes proposed for inclusion in ADP by the competent forum

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Methodology of IDAMP

The following steps have been formed after reviewing international literature and practices including iso 55000, cdia toolkit, world bank literature etc;

- Step 1 • Development of GIS based Asset Inventory
- Step 2 • Notification of Level of services (LOS)
- Step 3 • Development of Project Proposal
- Step 4 • Preparation of Operational & Maintenance (O&M) Costs
- Step 5 • Compilation of Project Package
- Step 6 • Financial Capacity Analysis
- Step 7 • Projects selection and approval
- Step 8 • Capital Investment Plan
- Step 9 • Finalization of Integrated Development & Asset Management Plan

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Step1: Development of GIS based Asset Inventory

Why Do we need Asset Database?

What is the current state of my assets?

- *What* do I own?
- *Where* is it?
- What *Condition* is it in?
- What is its *remaining useful life*?

Decision Support System

Asset Management Information System is the Answer

A Web System integrated with Geographic Information System (GIS)

Automate processes related to asset management

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Asset Inventory – WASAs

1. Pipelines (Water Supply and Sewerage)
2. Tube wells
3. Disposal Stations & Disposal Pumps
4. Water Treatment Plants
5. Overhead Reservoirs
6. Machinery & Equipment
7. Vehicles
8. Land
9. Buildings

Below Ground

Above Ground

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Sources of Inventory

1. Below Ground:
   - A Comprehensive Database is formed for all 5 WASAs by UU and Respective WASA.
   - Updated and endorsed in IDAMP
2. Below Ground:
   - AMIS with attributes like cost, life, risk, condition, replacement year etc
   - Updated and endorsed in IDAMP

Microsoft Excel Worksheet

Regular updation is required

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STEP 2: NOTIFICATION OF LEVEL OF SERVICES

Assets are planned and managed for the service delivery to the consumers. Therefore it is pertinent to assess the current service level and set the desired service level over a certain period by keeping in view the community needs and demands. WASAs have computed their existing LOS and set the target LOS for the next three years. Target LOS shall be used as key performance indicators to assess the performance of assets and monitor the extent of service delivery by the WASAs.

List down the Services WASA is required to provide?

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LOS

↕

Assets

Microsoft Excel Worksheet

LOS – WASA

Microsoft Excel Worksheet

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STEP 3: DEVELOPMENT OF PROJECT PROPOSALS

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After completing and updating Existing Inventory record and performance targets, Asset Managers shall assess; what shall be done to achieve those targets. To fulfill the service delivery gap between existing LOS and target LOS, Asset Manager shall identify projects to be done to achieve the target. Asset Manager shall develop project proposal. Project Proposal shall include the following activities:

1. Projects Identification
2. Preparation of Projects
3. Project Appraisal
4. Project Screening and Phasing

Further all the projects identified need to be mapped on GIS system for the identification of respective project lines/area.

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PROJECT PROPOSAL FORM

- The following project proposals format is used by Asset Managers for each project:

Three Components:

a. Evidence
b. Specifications (Scope of Work)
c. Screening and Phasing

Microsoft Excel Worksheet

	Criteria description
1	**Project Purpose** ▪ Does the project fill a gap in a wider system of service delivery? ▪ Whether the existing services are dealing with the problem? ▪ Whether the project will contribute to city master plan/ regional development goals? ▪ Whether the deference/ delay of the project is going to affect citizens' health, safety, property, prosperity etc.?
2	**Public Response & Service Delivery Improvement** ▪ Is the project likely to get support from municipal leadership? ▪ Will the project get approval from higher levels of entity? ▪ Does the project have a local 'champion' or where did the project idea originate from? ▪ Is there support or opposition from residents, NGO's and community groups in the immediate vicinity of the proposed facility/ project?

	Criteria description
3	**Environmental Impact** ▪ Does the project provide any benefits to the quality of public spaces in the city e.g. parks, green infrastructure, water bodies, boulevards, open spaces, etc.? ▪ Does the project confer direct benefits to the quality of the local environment e.g. air quality, water pollution, waste reduction, etc.? ▪ Does the project fulfill the prescribed requirements of environmental and social screening and impacts identification as per Pakistan Environmental Protection Act, 1997?
4	**Socio-Economic Impact** ▪ Does the project bring improvements to low income neighborhoods? ▪ Does the project contribute to a more harmonious society? ▪ Will the project bring in direct revenue?

	Criteria description
4	**Socio-Economic Impact** ▪ Does the project has acceptable economic appraisal/ cost effectiveness? ▪ Are there indirect economic benefits from this project in the long term, e.g. employment creation, investment generation, increase in land/property prices, reduction in citizens' expenditures, etc.?
5	**Project Feasibility of Implementation** ▪ Ease of implementation of project in respect of technical design? ▪ Has an institutional needs assessment been carried out with regard to planning, implementing and managing the proposed infrastructure? ▪ Will the external factors negatively impact the outcome of the proposed project? ▪ Is there a capable system in place to implement and operate this project or is external support needed? ▪ Is the project feasible as per IEE/ EIA studies?

STEP 4: PREPARATION OF OPERATION & MAINTENANCE (O&M) COSTS

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The operation and maintenance (O&M) costs will be compiled on basis of Asset Management Plan and computed for all the assets by the respective Asset Managers. The O&M costs is bifurcated into following sections:

1.O&M costs of existing assets

2.O&M costs of the proposed projects.

- Annual O&M shall include Staff costs, Fuel cost, Electricity costs and Repair & Maintenance Cost for all existing and proposed assets.

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O&M FORM

The following performa/ Form is used for calculation of O&M cost:

For example O&M for tube well:

Microsoft Excel Worksheet

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STEP 5: COMPILATION OF PROJECT PACKAGE

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After completion of above mentioned steps, Asset Manager shall consolidate this working to produce a Project Package. Project Package shall include following at minimum;

1. Screened Project along with allocated score
2. O&M Cost along with AMP
3. Supporting Document(s) that are used by Asset Manager to allocate score

Asset managers shall submit their Project Package to the IDAMP Technical Team for evaluation and approval

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STEP 6: FINANCIAL CAPACITY ANALYSIS

WASAs shall analyze potential financial sources, financial health of organization, operational sustainability and criticality of Service Delivery.

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Step 7: Project Selection & Approval

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Once Planning Department of WASAs has analyzed the potential financial sources and received Project Package from Asset Managers, these shall be presented to Technical Team for selection of projects.

Technical Team shall evaluate the proposed projects against following factors and score to each project

1. Relevance
2. Short Term Assumptions Performance
3. Efficiency
4. Effectiveness
5. Sustainability

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Project Finalization and Approval by TECHNICAL TEAM Criteria 1: *Relevance*

Relevance

- Whether the project design is fundamentally suited for achieving the goals associated with the project?
- Whether the proposed project complied with the applicable legal regulations?

Project Finalization and Approval by TECHNICAL TEAM
Criteria 2: *Short Term Assumption Performance*

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Short Term Assumption Performance

- Has funding been secured/allocated within the Local Government budget for this project?

- If required then whether the external sources of funding have been secured?

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Project Finalization and Approval by TECHNICAL TEAM
Criteria 3: *Efficiency*

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Efficiency
- Whether the proposed project is financially and/ or economical viable?
- Whether the proposed project would be able to attain time & cost efficiency?
- Will the proposed project going to improve the overall efficiency of the service delivery?

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Project Finalization and Approval by TECHNICAL TEAM
Criteria 4: *Effectiveness*

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Effectiveness

- Does the project contribute towards long term sustainable development, e.g. renewable energy, clean water supply, waste treatment, recycling, etc.?
- Does the project improve the social status and access to social services (health, education, etc.) for women and children?
- Whether the project will be able in achieving the associated ***wide objectives***?

Project Finalization and Approval by TECHNICAL TEAM
Criteria 5: *Sustainability*

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Sustainability

- If there is risk, does the project design include a risk mitigation strategy?
- Whether the proposed project would be able to sustain if external financial or technical support has been withdrawn after completion?

Project Finalization and Approval by TECHNICAL TEAM Scoring Criteria

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Final project score has been derived on basis of scores allocated by Technical Team and Asset Manager to the individual project. Score given by Technical Team and Asset Manager have been clubbed by **70%** and **30%** respectively. Final Approved and Phased List of Projects have been prepared as per the following scores schedule;

Cumulative Average Score	Phasing Plan
71 – 100	Year 1
51 – 70	Year 2
21 – 50	Year 3
0 – 20	Rejected

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STEP 8: CAPITAL INVESTMENT PLAN

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After having the details of existing and proposed assets, requirements of their operations and maintenance, current and desired level of service delivery, WASAs will prepare their Capital Investment Plan.

Capital Investment Planning involves the following activities:

- Identification of sources of financing
- Assessment of Own Source Revenue
- Assessment of Available Government Grants/ External Financing
- Prioritization of available funds.

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STEP 9: FINALIZATION OF INTEGRATED DEVELOPMENT & ASSET MANAGEMENT PLAN

Finalized Assets shall be compiled in the Form of IDAMP Budget Book

IDAMP budget book shall include the budgeted development expenditures and associated non development expenditures.

Finalized IDAMP book shall be approved and authorized by the competent authority

International Comparison

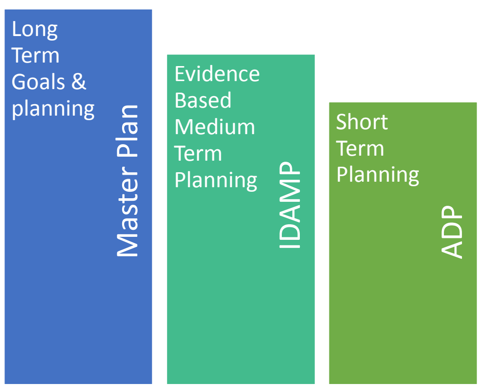
Items	Egypt	Kuwait	Oman	Canada	Pakistan Punjab Pilot
Consistent approach/ methodology for managing assets	No	No	No	Yes	**Yes**
Guidelines for Investment / Service Delivery Objectives	No	No	No	Yes	**Yes**
Principles for Standard Operating Procedures	Yes	Yes	Yes	Yes	**Yes**
Project Selection Criteria Guidelines	No	No	No	Yes	**Yes**
Integrated Development and Asset Management Plan	No	Developing a Plan	Developing a Plan	Yes	**Yes**

IMPLEMENTATION OF IDAMP through IDAMP Cell and Technical Committee

- IDAMP Cell Led by Dir. Planning is responsible for Preparation of IDAMP every year and presentation to Technical Committee. IDAMP Cell must have following capacities;
    1) Engineering Expertise,
    2) Budgeting Expertise,
    3) Financial Expertise
    4) Monitoring Expertise &
    5) GIS Expertise.

- Technical Team Led by Managing Director is responsible for approving & implementing IDAMP every year.

Do you link ADP Schemes to Level of Services?
Is ADP process an Evidence Based Planning?



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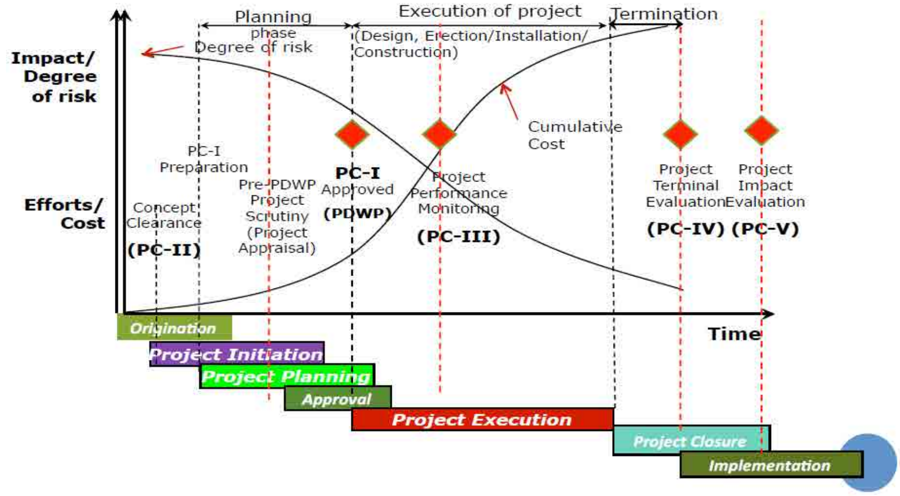
PROJECT CYCLE MANAGEMENT (1/2)



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PROJECT CYCLE MANAGEMENT (2/2)

PC-I	Detailed project document
PC-II	For preparation of pre-feasibility and feasibility surveys
PC-III	For submission of monthly/annual monitoring/progress report of project
PC-IV	For submission of completion report of project
PC-V	For submission of evaluation/implementation report on annual basis for five years

ALJAZARI
ACADEMY

LECTURE NOTES

Asset Management

Asset Condition Survey

Module No: 5

2017

Introduction of the Asset Management Course:

This course is about asset management related to water utilities. It focuses on assets, its attributes, determining their condition, risk, life cycle of an asset, monitoring of existing assets, accounting treatment of assets and preparing asset replacement plan. This course is especially beneficial for officers of grade 17 and 18 who are directly or indirectly involved in planning and routine management of assets.

Course Participants (CPs) will develop knowledge and skills about asset, its life cycle and carry out asset condition survey. They will be able to develop and use asset data base for asset replacement planning. This course will also help the CPs in understanding application of the concepts related to Asset Replacement Plan, Asset Operational Plan and its monitoring. The CPs will learn through OJT, how to use the Asset Management Information System, GIS and other tools.

Upon the completion of this course the CPs will be in a better position to apply their learning in their routine jobs and prepare an Integrated Development & Asset Management Plan (IDAMP) to provide better water supply and sewerage services to their consumers.

Introduction of OJT-1 Asset Conditioning:

Asset conditioning OJT is the most important part of Asset Management Course. It is the practical through which the condition of the asset is determined by doing the physical inspection and some performance parameters most importantly discharge, pressure and electrical are measured by instruments in the field. Based on asset condition survey, interventions to improve the condition of asset is usually carried out. These interventions become the part of asset management planning to maintain the service delivery at good level and further contribute to long term sustainability of the water & sewerage supply.

Course Participants will be able to rate the asset based on their condition and performance after this OJT. They will be able to make a plan to improve the condition of the assets as these assets are responsible for service delivery of water utilities towards their consumers.

Lecture 1

1. **Lecture Information**

Topics: 1) WASA Asset Type 2) Water Supply Assets 3) Disposal Station Asset
Lecture Duration: 40 Minutes

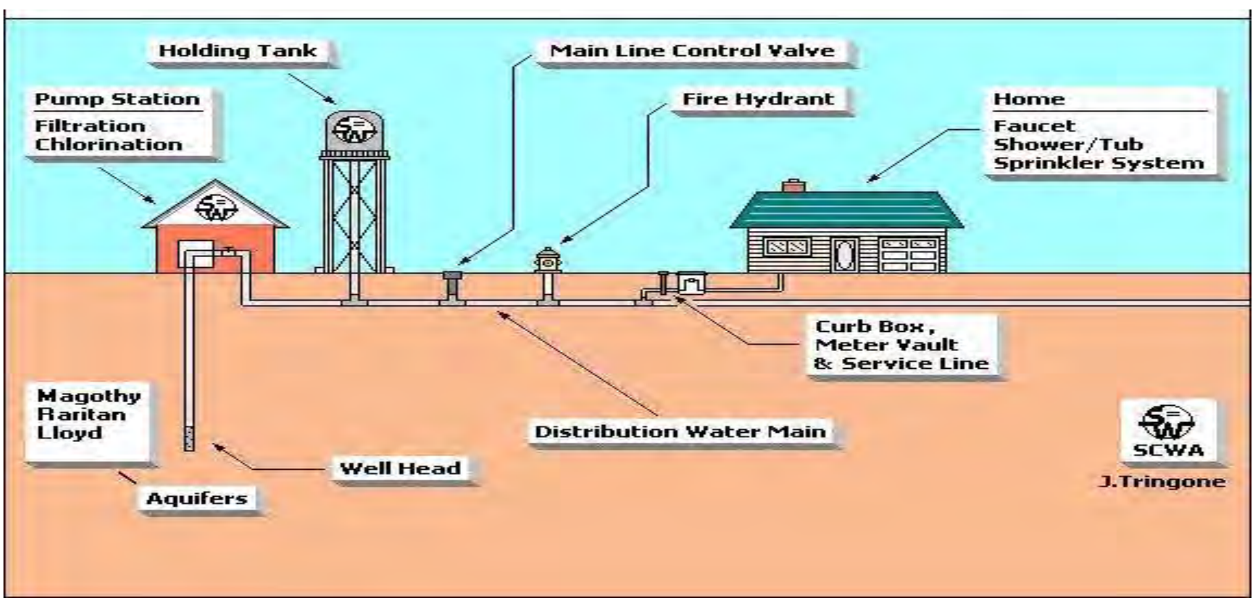
2. **WASAs Asset Types** **(10 Minutes)**

In WASA there are different type of assets through which WASA perform the service delivery. Main Asset types are given below;

- Water Supply Assets
- Disposal Station Assets
- Vehicle, Mechanical Machinery & Other Assets

2.1 Water Supply Assets **(10 Minutes)**

In water supply, WASA has many assets that starts from the tube well station to the water consumer. The following diagram is showing the basic assets of the water supply system.



In water Supply system main assets are listed below;

- Tube well Station
- Transformer

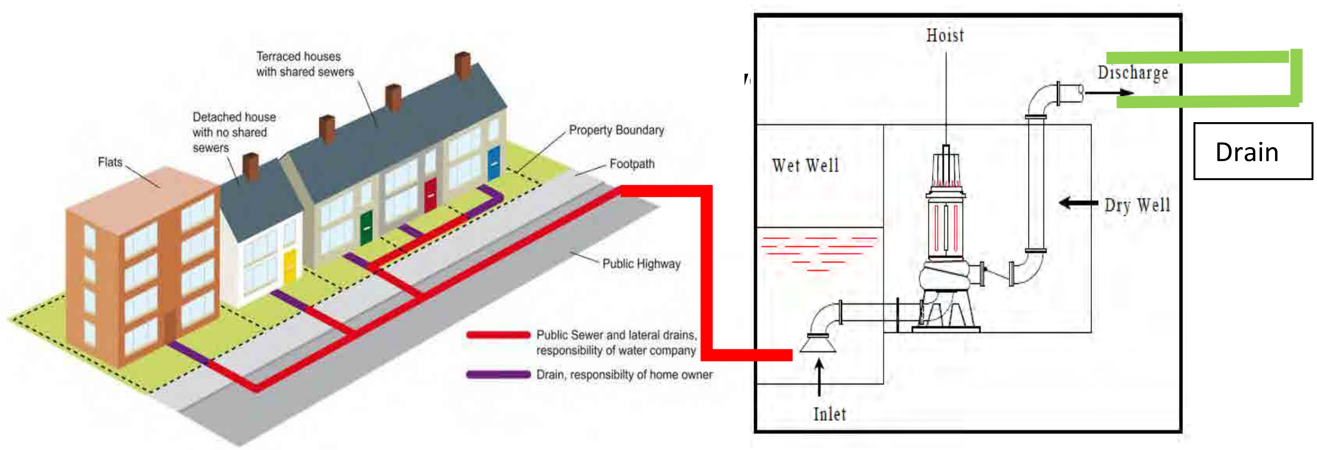
- Energy Meter
- Generator
- Water Supply Lines (Primary, Secondary and Tertiary)
- Control Valves
- Over Head Reservoir
- Water Tankers
- Consumer Meter

Assets which are within the tube well station are listed below;

- Main Breaker
- Motor Control Units
- Electric Motor
- Pump
- PFI Plant
- Non- Return Valve
- Gate Valve
- Air Release Valve
- Bulk Flow Meter
- Pressure Gauges
- Chlorinator
- Priming Box
- Lighting
- Exhaust Fan
- Tube Well Room

2.2 Sewerage System Asset **(20 minutes)**

In Sewerage, WASA has many assets that starts from the house hold to the disposal station and from disposal station to the drain. The following diagram is showing the basic sewer system of the sewerage system.



Assets which come under the sewerage system are listed below;

- Tertiary Sewer Line (Connects Household sewer to Secondary Sewer Line)
- Secondary Sewer Line (Connects tertiary sewer lines to Primary Sewer line)
- Primary Sewer Line (Connects Secondary Sewer lines to Disposal Station)
- Lifting Station
- Disposal Station
- Drains
- Sucker Jetting Machine
- Tractor
- Trolleys
- De-silting Machines
- Dewatering Set

Assets which are within the disposal station are listed below;

- Wet Wells
- Screens
- Float Switches
- Motor
- Pumps
- Motor Control Units
- Main Breaker
- PFI Plant
- Energy Meter
- Transformers
- Generators
- Lifting Machines
- Lights
- Disposal House
- Non-Return Valve
- Gate Valves
- Log Books
- Plantation

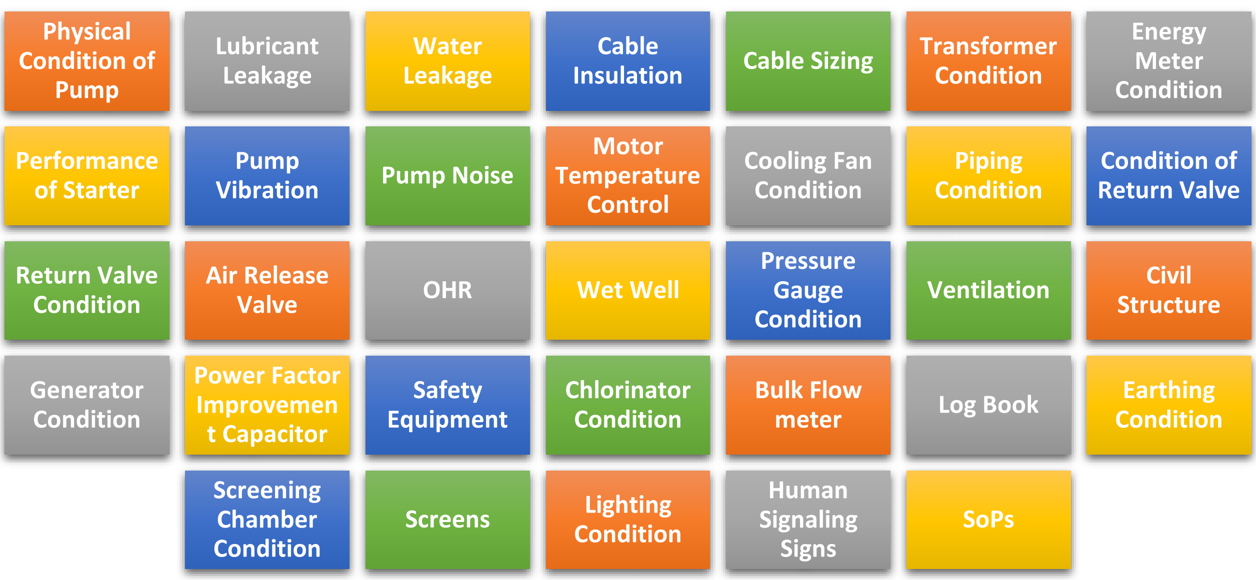
Lecture 2

1. Lecture Information

Topic:	1) Asset Conditioning 2) Asset rating
Lecture Duration:	80 Minutes

2. Asset Conditioning (40 Minutes)

All of the assets contribute in the WASA service delivery. Each asset contribute in the service delivery based on its performance and condition. Performance and condition of the asset is primarily important to know and should be evaluated after certain time. It is also important for the asset management planning and asset replacement plan. There are different asset condition parameters based on that condition of the asset is usually evaluated through physical and measurement inspection of the assets. A survey is usually carried out to know the condition of the asset which is called condition survey. Indicators of physical condition survey are given below in the fig;



2.1 Measurement Parameters of the condition Survey

There are parameters which are measured during the condition survey. These parameters are used to evaluate the performance of the asset. These parameters are listed below;

- Pressure Measurement at Tube well station, Disposal station and water & waste water network (This can be checked from the log book of the operator)
- Flow Measurement at tube well station, disposal station and Water & Waste Water Network (This can be checked from the log book of the operator)

- Power factor measurement at the tube well station & Disposal Station (This can be checked from the log book of the operator)
- Residual Chlorine testing in the network

2.2 Measurement Tools

In order to measure pressure, head, flow (Discharge) power factor and other electrical parameter in the measurement condition survey following tools are used.

1. Pressure Gauge
2. Ultrasonic Flow Meter
3. Power Analyzer

2.2.1 Pressure Gauge

Pressure is the primary factor to measure the suction and discharge head in the water supply and on disposal pumps. Pressure gauge is installed vertically on the suction and delivery side of the pump to know the pressure. Pressure is then converted in to feet that constitute the suction and delivery head of the pump. This is important parameter in calculating the efficiency of the pump. Following is the formula to convert the pressure (bar) in to feet.

$$h = p * \frac{1}{0.0981 * SG}$$

H= head (m)

P= Pressure (bar)

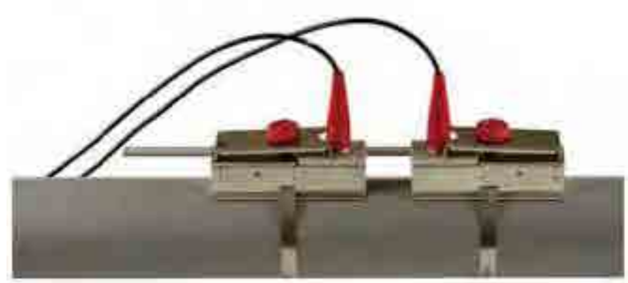
SG= Specific Gravity

2.2.2 Ultrasonic Flow Meter

Discharge of the fluid is measured with the ultrasonic flow meter. This instrument has two sensors upstream and downstream. There are two main methods (V and Z) of mounting sensors on the pipe but we prefer V method to measure the discharge and discharge velocity in the pipe. Following figure shows V method for measuring the flow in the pipe.

Following parameters are to be feed in the flow meter before installation;

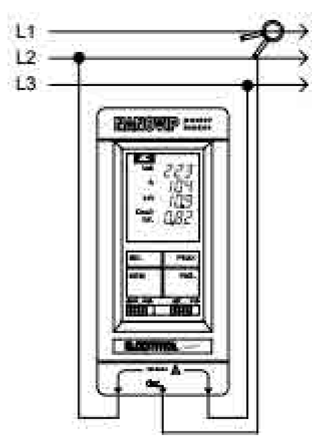
1. Perimeter of the pipe (mm)
2. Pipe Thickness (mm)
3. Type of Fluid (water, gas and etc.)
4. Method of installation (V or Z)



Flow meter calculates mounting distance between two sensors on the pipe. Sensors should be installed at the distance given by the flow meter in straight direction. If the signal strength is greater than 50 then flow meter main screen will show the discharge in the pipe otherwise make the direction of sensor correct, rub the pipe surface or add ultrasound gel on the sensor to get better signal for discharge reading. Flow meter manual is attached as Annex-1

2.2.3 Power Analyzer

Power analyzer is the electrical instrument that is used to measure all six parameters of the Power both for single and three phase electric supply like kilowatts, KVARS, KVA, Voltages, Amperes, Power factor and frequency of the electric supply. Following figure shows power analyzer and the installation procedure to measure electrical parameters. Power Analyzer manual is attached as Annex-2



2.3 Asset Condition Rating (40 Minutes)

Asset is rated in to different grades between A-F during the condition survey. These grades translate different actual conditions, findings and observations during the physical inspection of the condition survey. Description or meaning of the grades is given below;

A = No noticeable defects. Some aging or wear may be visible.

B = only minor deterioration or defects are evident.

C = some deterioration or defects are evident, but function is not significantly affected.

D = Serious deterioration in at least some portion of the structure. Function is inadequate.

F = No longer functional. General failure or complete failure of a major structural component.

These grades can to translated into different other ratings like Score and position indicators are given in the table below;

Average Score	*1*	*2*	*3*	*4*	*5*
Asset Condition	Excellent	Good	Fair	Poor	Failing
Category	*A*	*B*	*C*	*D*	*F*

Example Rating of the Asset:

The following picture showing the motor terminal box
Where the cable are bear and housekeeping of the cable is
Very poor and cable insulation is seriously deterioration. So
The condition of the insulation is rated as **"D"** and same in
The case of the priming box.

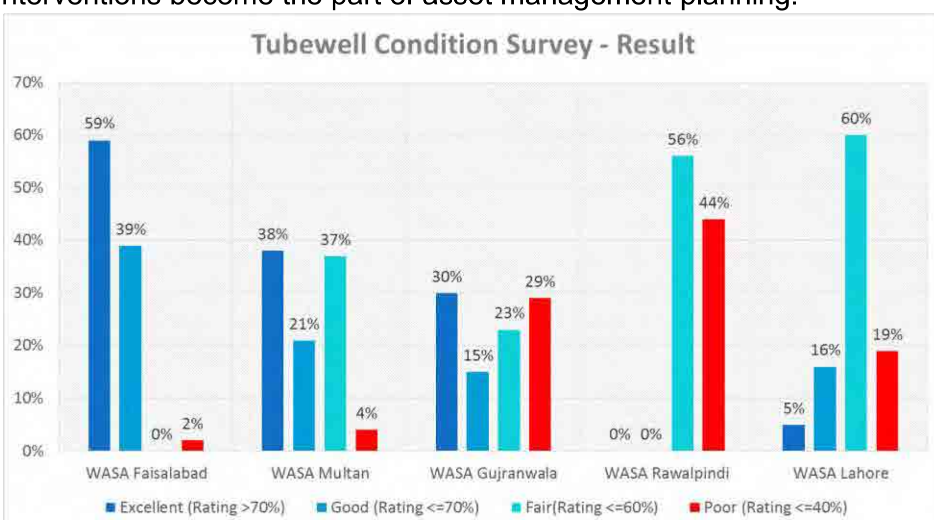
Figure 1: Poor Priming Box and Poor Cable Insulation

Condition of the motor terminal box is rated as **“Excellent”** as there is no noticeable defects in it.

Figure 2 : Excellent Condition of Priming Box and Insulation of cable of Motor Terminal Box

2.4 Generating Reports based on the Asset Condition

Based on condition survey of assets a report is generated in the form of pie graphs or bar graphs. For example in WASAs of Punjab condition survey was conducted and based on the condition survey parameters and following bar graph was generated to visualize overall condition of assets in WASAs. No of interventions were derived to improve existing condition from Fair/Poor to Excellent/Good. These interventions become the part of asset management planning.



Exercises

Activity: 1) Condition Survey of Tube Well Station (Day 1) 2) Condition Survey of the Disposal Station (Day 2) 3) Condition Survey of the Water Supply & Waste Water Lines (Day 3) 4) Condition Survey of Filtration Plant (Day 3)	
Activity Duration: 3 Hours	

1. **Conduct the condition survey of the tube well station of C-1 Block Gulberg Subdivision Lahore**

Condition Survey of Tube well					
1. Asset Location Information					
Sub Division Name					
Tube well Name					
Tube well Station Address					
2. Asset Technical Information					
Operational Status (YES/No)					
Year Of Installation					
Type of Pump (Turbine/Submersible/Centrifugal)					
Operational Hours (Avg)					
Pump Make					
Pump Design Discharge (Cusec)					
Pump Design Head (ft.)					
Motor Make					
Motor Rating (HP)					
Attached to Over Head Reservoir	Yes	No	Year of Construction		
Operational Status of OHR	Operational		Non- Operational	Capacity (G)	
Attached to Filtration Plant	Yes	No	Year of Construction		
Operational Status of Filtration Plant	Operational		Non- Operational	Capacity (L/H)	
Filtration Type (RO/UV/Multimedia					

3. Asset Condition Rating

Physical Condition of Pump	A	B	C	D	F	Attach Pic
Physical Condition of Motor	A	B	C	D	F	Attach Pic
Lubricant Leakages Condition	A	B	C	D	F	Attach Pic
Water Leakages	A	B	C	D	F	
Electric Cable insulation	A	B	C	D	F	
Electric Cable Sizing	A	B	C	D	F	
Transformer Condition	A	B	C	D	F	Attach Pic
Generator Condition	A	B	C	D	F	Attach Pic
Energy Meter Condition	A	B	C	D	F	
Condition of Performance of Starter / Motor Control Unit	A	B	C	D	F	Attach Pic
Power factor Improvement Capacitors	A	B	C	D	F	
Pump Vibration Status	A	B	C	D	F	
Pump Noise Level	A	B	C	D	F	
Motor Temperature Control	A	B	C	D	F	
Cooling Fan Condition						

	A	B	C	D	F	
Piping Condition	A	B	C	D	F	Attach Pic
Bulk Meter Condition	A	B	C	D	F	
Condition of Return Valve	A	B	C	D	F	Attach Pic
Condition of Gate Valve	A	B	C	D	F	Attach Pic
Condition of Air Release Valve	A	B	C	D	F	Attach Pic
Pressure Gauges Condition	A	B	C	D	F	Attach Pic
chlorinator Condition	A	B	C	D	F	Attach Pic
Civil Structure Condition of Assets	A	B	C	D	F	Attach Pic
OHR Condition	A	B	C	D	F	Attach Pic
Pipe Line Condition (Tube well to OHR)	A	B	C	D	F	
Safety Equipment	A	B	C	D	F	
Ventilation Condition	A	B	C	D	F	
Log Book	A	B	C	D	F	
Discharge (Cusecs) =________________	A	B	C	D	F	
Power Factor =_______________	A	B	C	D	F	
Pressure Head (Ft) =_______________	A	B	C	D	F	

A = Excellent: No noticeable defects. Some aging or wear may be visible.
B = Good: Only minor deterioration or defects are evident.
C = Fair: Some deterioration or defects are evident, but function is not significantly affected.
D = Poor: Serious deterioration in at least some portion of the structure. Function is inadequate.
F = Failed: No longer functional. General failure or complete failure of a major structural component.

DAY 2

Review of Day -1 **(100 Minutes)**

The lecturer reviews the day 1 activity about the condition assessment of the tube well station. The lecturer suggests a list of improvement steps that are to be done to improve the condition of the tube well based on the day-1 survey. Lecturer will analyze the data of the condition survey and will prepare asset management plan for the tube well.

Reflection of Day-1 **(20 Minutes)**

The lecturer promotes each participant to present what he /she learned in day -1

Activity No. 2 **(3 Hours)**

Conduct condition survey of the Out Fall Road disposal station.

Disposal Station Condition Survey						
1. Asset Location Information						
Subdivision						
Disposal Station Name						
Disposal Station Address						
2. Asset Technical Information						
Operational Status (YES/No)						
Total No. of Pumps						
Year Of Installation						
Type of Pump (Turbine/Submersible/Centrifugal)						
Operational Hours (Avg)						
Pump Make						
Pump Design Discharge (Cusec)						
Pump Design Head (ft.)						
Motor Make						
Motor Rating (HP)						
No. of Wet Well						

Year of Construction of Wet Well						
3. Asset Condition Rating						
Physical Condition of Pump	☐ A	☐ B	☐ C	☐ D	☐ F	Attach Pic
Physical Condition of Motor	☐ A	☐ B	☐ C	☐ D	☐ F	Attach Pic
Lubricant Leakages Condition	☐ A	☐ B	☐ C	☐ D	☐ F	Attach Pic
Water Leakages	☐ A	☐ B	☐ C	☐ D	☐ F	
Electric Cable insulation	☐ A	☐ B	☐ C	☐ D	☐ F	
Electric Cable Sizing	☐ A	☐ B	☐ C	☐ D	☐ F	
Transformer Condition	☐ A	☐ B	☐ C	☐ D	☐ F	Attach Pic
Generator Condition	☐ A	☐ B	☐ C	☐ D	☐ F	Attach Pic
Energy Meter Condition	☐ A	☐ B	☐ C	☐ D	☐ F	
Condition of Performance of Starter / Motor Control Unit	☐ A	☐ B	☐ C	☐ D	☐ F	Attach Pic
Power factor Improvement Capacitors	☐ A	☐ B	☐ C	☐ D	☐ F	
Pump Vibration Status	☐ A	☐ B	☐ C	☐ D	☐ F	

Pump Noise Level	A	B	C	D	F	
Motor Temperature Control	A	B	C	D	F	
Cooling Fan Condition	A	B	C	D	F	
Piping Condition	A	B	C	D	F	Attach Pic
Condition of Return Valve	A	B	C	D	F	Attach Pic
Condition of Gate Valve	A	B	C	D	F	Attach Pic
Pressure Gauges Condition	A	B	C	D	F	Attach Pic
Wet Well Condition	A	B	C	D	F	Attach Pic
Civil Structure Condition of Assets	A	B	C	D	F	Attach Pic
Screen Condition	A	B	C	D	F	Attach Pic
Earthing Condition	A	B	C	D	F	
Desilting Condition	A	B	C	D	F	
HSE Sign Condition	A	B	C	D	F	
Plantation Condition	A	B	C	D	F	
Safety Equipment	A	B	C	D	F	

Ventilation Condition	A	B	C	D	F	
Log Book	A	B	C	D	F	
Discharge (Cusecs) =________________	A	B	C	D	F	
Power Factor =_______________	A	B	C	D	F	
Pressure Head (Ft) =_______________	A	B	C	D	F	

A = Excellent: No noticeable defects. Some aging or wear may be visible.
B = Good: Only minor deterioration or defects are evident.
C = Fair: Some deterioration or defects are evident, but function is not significantly affected.
D = Poor: Serious deterioration in at least some portion of the structure. Function is inadequate.
F = Failed: No longer functional. General failure or complete failure of a major structural component.

DAY 3

Review of Day -2 **(100 Minutes)**

The lecturer reviews the day 1 activity about the condition assessment of the disposal station. The lecturer suggests a list of improvement steps that are to be done to improve the condition of the disposal station based on the day-1 survey. Lecturer will analyze the data of the condition survey and will prepare asset management plan for the disposal station.

Reflection of Day-2 **(20 Minutes)**

The lecturer promotes each participant to present what he /she learned in day -1

Activity No. 3 **(140 Minutes)**

Conduct the condition survey of the filtration plant.

Filtration Plant Condition Survey	
1. Asset Location Information	
Subdivision	
Filtration Plant Name	
Filtration Plant Address	
2. Asset Technical Information	
Operational Status (YES/No)	
Filtration Type (RO/UV/Multimedia	
Year Of Installation	
No. of Pumps	
Type of Pump (Turbine/Submersible/Centrifugal)	
Operational Hours (Avg)	
Pump Make	
Pump Design Discharge (LPM)	

Pump Design Head (ft.)						
Motor Make						
Motor Rating (HP)						
Source of Raw Water	Ground Water		Canal		OHR	
Attached to Over Head Reservoir	Yes	No	Year of Construction			
Operational Status of OHR	Operational		Non- Operational		Capacity (G)	
4. Asset Condition Rating						
Physical Condition of Pump	A	B	C	D	F	Attach Pic
Physical Condition of Motor	A	B	C	D	F	Attach Pic
Lubricant Leakages Condition	A	B	C	D	F	Attach Pic
Water Leakages	A	B	C	D	F	
Electric Cable insulation	A	B	C	D	F	
Electric Cable Sizing	A	B	C	D	F	
Transformer Condition	A	B	C	D	F	Attach Pic
Generator Condition	A	B	C	D	F	Attach Pic
Energy Meter Condition						

	A	B	C	D	F	
Condition of Performance of Starter / Motor Control Unit	A	B	C	D	F	Attach Pic
Power factor Improvement Capacitors	A	B	C	D	F	
Pump Vibration Status	A	B	C	D	F	
Pump Noise Level	A	B	C	D	F	
Motor Temperature Control	A	B	C	D	F	
Cooling Fan Condition	A	B	C	D	F	
Piping Condition	A	B	C	D	F	Attach Pic
Water Meter Condition	A	B	C	D	F	
Flow Meter Condition	A	B	C	D	F	
Condition of Return Valve	A	B	C	D	F	Attach Pic
Condition of Gate Valve	A	B	C	D	F	Attach Pic
Condition of Two Way Valve	A	B	C	D	F	Attach Pic

Condition of the Butterfly Valve	A	B	C	D	F	
Pressure Gauges Condition	A	B	C	D	F	Attach Pic
chlorinator Condition	A	B	C	D	F	Attach Pic
Condition of the UV filter	A	B	C	D	F	Attach Pic
Condition of Multimedia Filter	A	B	C	D	F	Attach Pic
Condition of Coconut Filter	A	B	C	D	F	Attach Pic
Condition of the Membrane	A	B	C	D	F	Attach Pic
Condition of Raw Water Tank	A	B	C	D	F	Attach Pic
Condition of the Treated Storage Tank	A	B	C	D	F	Attach Pic
Condition of the control System	A	B	C	D	F	Attach Pic
Civil Structure Condition of Assets	A	B	C	D	F	Attach Pic
OHR Condition	A	B	C	D	F	Attach Pic
Pipe Line Condition (Tube well to OHR)	A	B	C	D	F	

Safety Equipment	A	B	C	D	F	
Ventilation Condition	A	B	C	D	F	
Log Book	A	B	C	D	F	
Discharge (Cusecs) =_________________	A	B	C	D	F	
Power Factor =________________	A	B	C	D	F	
Pressure Head (Ft) =________________	A	B	C	D	F	
A = Excellent: No noticeable defects. Some aging or wear may be visible.						
B = Good: Only minor deterioration or defects are evident.						
C = Fair: Some deterioration or defects are evident, but function is not significantly affected.						
D = Poor: Serious deterioration in at least some portion of the structure. Function is inadequate.						
F = Failed: No longer functional. General failure or complete failure of a major structural component.						

Activity No. 4 **(40 Minutes)**

Conduct the condition survey of the water Supply / Sewerage Line

Condition Survey of Water Supply /Sewer Line						
1. Asset Location Information						
Subdivision						
Tehsil/Town						
2. Asset Technical Information						
Type of Line	Water Supply		Sewer		Drains	
Operational Status	Yes/ No					
Length of Line (ft.)	Primary		Secondary		Tertiary	
Year of Installation	Primary		Secondary		Tertiary	
Existing Diameter (In)	Primary		Secondary		Tertiary	
Material of Pipe (PVC/RCC/PCC/HDPE)	Primary		Secondary		Tertiary	

No of Line Failure (Annual)	Primary		Secondary		Tertiary	
No of Line Repairs (Annual)	Primary		Secondary		Tertiary	
No of Valves on the Lines	Primary		Secondary		Tertiary	
Undersized Remarks	Primary	Yes/No	Secondary	Yes/No	Tertiary	Yes/No
Replacement Dia (In)	Primary		Secondary		Tertiary	
Contamination	Primary	Yes/No	Secondary	Yes/No	Tertiary	Yes/No
3. Asset Condition Rating						
Condition of Primary	A	B	C	D	F	Attach Pic
Condition of Secondary	A	B	C	D	F	Attach Pic
Condition of Tertiary	A	B	C	D	F	Attach Pic
A = Excellent: No noticeable defects. Some aging or wear may be visible.						
C = Fair: Some deterioration or defects are evident, but function is not significantly affected.						
D = Poor: Serious deterioration in at least some portion of the structure. Function is inadequate.						
F = Failed: No longer functional. General failure or complete failure of a major structural component.						

بسم الله الرحمن الرحيم

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Introduction to Asset Condition Survey

"It is the practical exercise through which the condition of the asset is determined by doing the **physical inspection** and **some performance parameters** most importantly discharge, pressure and electrical usually measured by instruments in the field."

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WASAs Asset Types

- Water Supply Assets
- Disposal Station Assets
- Vehicle, Mechanical Machinery & Other Assets

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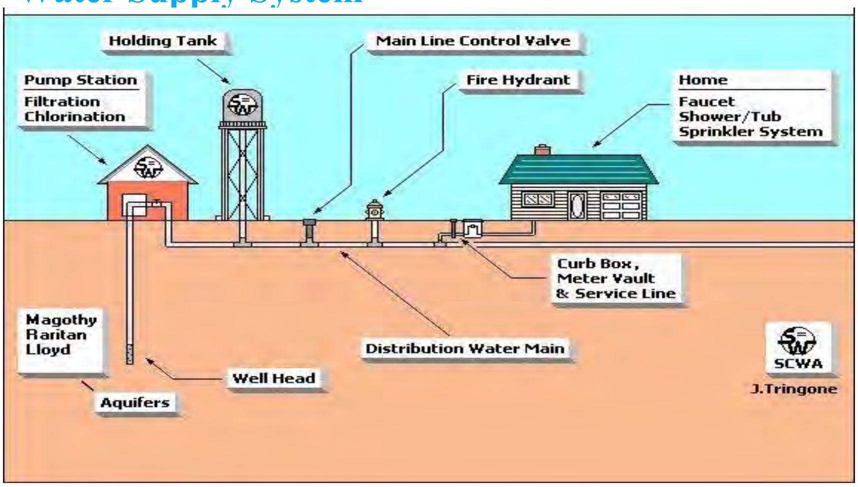
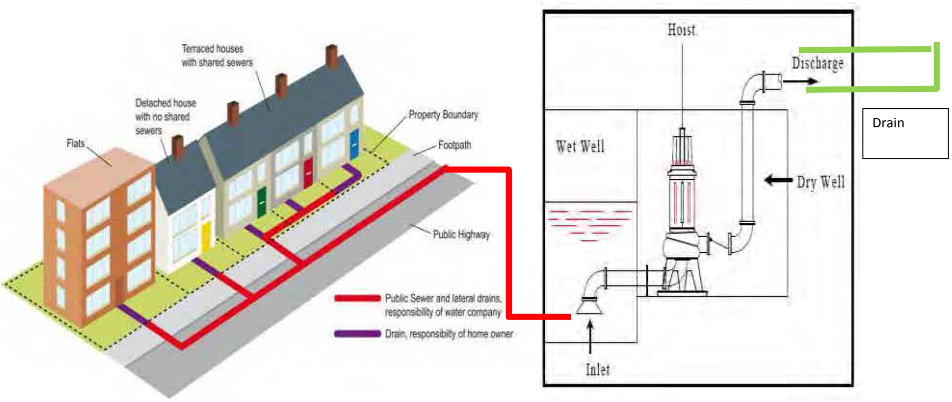
Water Supply System



Sewerage System



Exercise

What are assets used in your water Supply?

What are the assets used in your disposal station and sewer system?

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Asset Condition Parameters

Physical Condition of Pump	Lubricant Leakage	Water Leakage	Cable Insulation	Cable Sizing	Chlorinator	Transformer Condition
Energy Meter Condition	Performance of Starter	Pump Vibration	Pump Noise	Motor Temperature Control	Cooling Fan Condition	Piping Condition
Condition of Return Valve	Return Valve Condition	Air Release Valve	OHR	Wet Well	Pressure Gauge Condition	Ventilation
Civil Structure	Generator Condition	Power Factor Improvement Capacitor	Safety Equipment	Chlorinator Condition	Bulk Flow meter	Log Book
	Earthing Condition	Screening Chamber Condition	Lighting Condition	Human Signaling Signs	SoPs	

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Asset Condition Performance Parameters

Pressure	Current, Voltage & Kilowatts
Power Factor	Flow (Discharge)

Asset Condition Rating

A = No noticeable defects. Some aging or wear may be visible.

B = only minor deterioration or defects are evident.

C = some deterioration or defects are evident, but function is not significantly affected.

D = Serious deterioration in at least some portion of the structure. Function is inadequate.

F = No longer functional. General failure or complete failure of a major structural component.

Average Score	1	2	3	4	5
Asset Condition	Excellent	Good	Fair	Poor	Failing
Category	A	B	C	D	F

Exercise

What is condition rating of Terminal Box and cabling of Motor?

Exercise

What is condition rating of Terminal Box and cabling of Motor?

Exercise

What is condition rating of Priming Box?

Exercise

What is condition of equipment?

1. 4.
2. 5.
3. 6.

View of motor & pump-Shahdin Park

Panel and cabling condition-Shalimar Scheme

Cabling condition-Fateh Garh Dispensary

Out of order water flow meter-Maskeen Pura

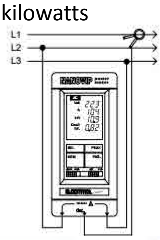
Motor and pump without any shade-Gawala Colony

Condition of motor terminal-Gawala Colony

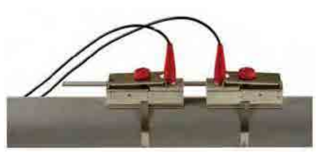
Tools to measure performance parameters at tube well & disposal Station.

Pressure Gauge:
Used to measure Suction & Discharge Head

Power Analyzer:
Used to Measure Amps, Voltage, Power Factor, Kvars & kilowatts



Tools to measure performance parameters at tube well & disposal Station.



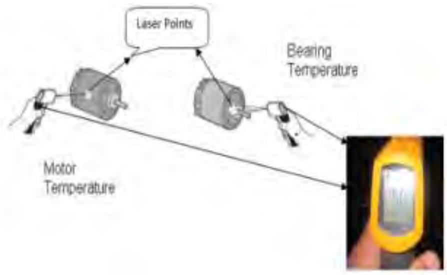
Flow Meter:
Used to measure discharge and discharge velocity in the pipe.

Inputs:
Pipe Perimeter (mm)
Pipe Thickness (mm)
Liquid Type W/WW
Pipe Material (CS/PVC)
Sensors Distance (mm)
Method (V/Z)

Outputs:
Flow (m3/hr)
Disc Velocity (m/s)

Rotational Speed Measurement: Tachometers

Temperature Measurement: IR Gun



Exercise
Watch Video and
Rate the overall condition of Tube well station?

VIDEO

OJT Assignment

- List down all the components within the tube well station
- Briefly explain the application of each component
- Measure the performance parameters of the tube well station- Performa given in Lecture Notes
- Perform a condition survey of the tube well station
- Prepare Asset Replacement Plan or O/M requirement at the tube well station
- Prepare a budget sheet to improve the condition of the tube well station

Module 5 : Asset Condition Survey

Day 2

Engr. Ali Raza

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Review of Day 1

1. **Present the condition survey and their results of tube well station – Group Activity**

2. **Being in charge of the utility, prepare a basic asset management plan based on the condition survey**

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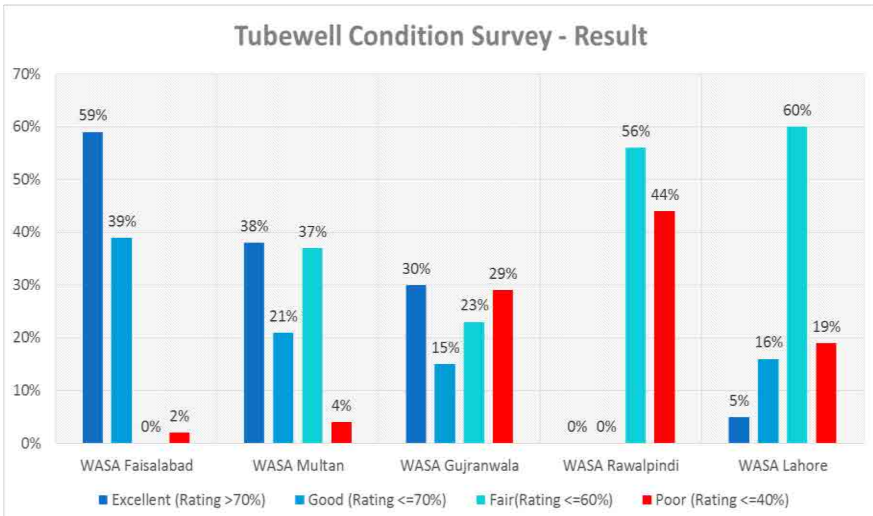


OJT Assignment- 2

- **List down all the components within the disposal station**
- **Briefly explain the application of each component**
- **Measure the performance parameters of the disposal station-** **Performa given in Lecture Notes**
- **Perform condition survey of the disposal station**
- **Prepare Asset Replacement Plan or O/M requirement at the tube well station**
- **Prepare a budget sheet to improve the condition of the disposal station**

Thank You

Engr. Rao Ali Raza

ALJAZARI ACADEMY

Participant Notes

Course Code: M 4131

Use of GIS Application in Asset Management

Module 6

2017

ALJAZARI ACADEMY

1. Topic Information

Course Title: Asset Management	Course Code: M 4131
Module Title: Use of GIS Application in Asset Management	Module No: 6
Lecture Topics: Introduction to GIS and Its applications in Assets Mapping • Introduction to GIS • GIS Data Types • Referencing System • Map Scale • GIS applications in context to AMIS & WASA	Lecture Duration: Two Hours

1.2. Introduction to GIS and Its applications in Assets Mapping

Lecture 1: introduction to GIS and its application in assets mapping covers the sub-topics; introduction to GIS, data types, reference system, map scales and GIS applications especially explained about the assets management information system related to WASA under module 6 “use of GIS applications in assets management”. This course is designed for WASA assets mapping so here we discuss case studies related to 5 WASA’s (Rawalpindi, Faisalabad, Lahore, Multan and Gujranwala), water supply & sewage network for Madurai Region-India and concept paper- mapping for water supply and sanitation (WSS) in Ethiopia and water supply GIS-Yokuhama water-Japan. The IRIS demonstration related to WASA is also covered in this lecture.

Lecture 1 is formulated in strengthening the concept of course participants regarding GIS and its applications in assets mapping. After completion of lecture 1; the course participant will be familiar about the concept of GIS and its applications regarding the assets management.

The explanation of the sub-topics are given as;

1.2.1. Introduction to GIS

Introduction to GIS covers, GIS overview, GIS components, GIS functions, GIS capabilities, and data sources. The questions like; “What is GIS?” & why GIS is necessary in Assets mapping? is also explained.

The acronym GIS stands for *geographic information system* to collet, store, retrieve, analyze and display the geographic data related to WAS. It helps in maintaining the assets data related to WASA about geographic space and provides answers to questions, from assets data resource. Use of GIS technology, WASA decision makers can perform decision easily.

- ✓ *Geographic* -- 80% of government data collected is associated with some location in space.
- ✓ *Information* -- attributes, or the characteristics (data), can be used to symbolize and provide further insight into a given location.
- ✓ *System* – a seamless operation linking the information to the geography – which requires hardware, networks, software, data, and operational procedures.

In relation to decision making by the decision maker in governance, the quality of governance is directly dependent upon the quality of decision making by the Government.

Good Governance = Good Decision making

So the quality of decision making is directly dependent upon the quality of Information available with the decision Maker.

GIS is, a key element of the information used by utilities is its location relative to other geographic features and objects. GIS technology that offers the combined power of both geography and information systems is an ideal solution for effective management of water industry infrastructure. Geo-technology and geospatial technology are alias names of GIS technology.

GIS is necessary for assets mapping as well as other applications, because GIS gives the following answers;

- ✓ Location: Where specific asset (pipelines, tube well etc.) is?
- ✓ Condition: Status of assets (pipelines, tube well etc.)?
- ✓ Trends: What has changed since...?
- ✓ Patterns: What spatial patterns exist?
- ✓ Modeling: What if…?

For GIS mapping of assets, the basics GIS elements; people, data, software, hardware, procedures/methods, are necessary.

1.2.2. GIS Data Types

A logical data type model is how data are organized for use by the GIS. GIS have traditionally used either raster or vector data for maps.

There are two major types of GIS data; spatial data (vector data & raster data) & non-spatial (Attribute/tabular) data.

- **Vector Data-** In the vector data model features on the earth are represented as point, line and polygon as shown in figure 1.1.

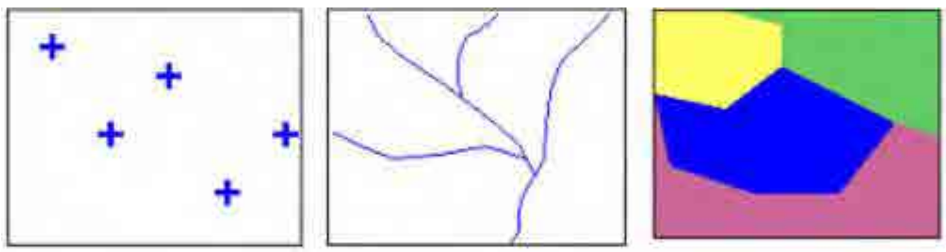


Figure 1.1. Vector Data Model

  - **Point Data-** A point is a combination of two numbers (X, Y), and some time in three (x, Y, Z), z represents hieght value. The examples are; disposal station, filteration plant, mainhole, OHR, etc.
  - **Line/polyline Data-** A line is the shortest distance between two points. It consists of begining and an ending point. The examples are; sewerge line, water supply line, road, stream, etc.
  - **Polygon Data-** A polygon is a set of points connected by line segments that close back to the first vertex. The examples are; WASA town boundary, sub-division boundary, etc.

- **Raster Data-** Raster data is comprised of discrete pixels with a value. The example of raster data are cell based/pixel based data such as satellite image with spatial resolution 0.6 meter, which is used for the demarcation of pipeline and above ground assets as shown in figure 1.2.

Figure 1.2. Raster Data

- **Attribute Data**- the information which is associated with the assets spatial features is called attribute data of assets. The example of attribute data are; name, diameter, condition, age, material of asset as shown in the figure 1.3.

Existing_WS

Shape *	Street_Nam	Sub_Divisi	Town	Materia	Age	Cond	Repl_Di	Repl	Ris
Polyline ZM	Zubair Road	Krishan Nagar	Gunj Bakhsh To	AC	1985	C	4"x6"	3	L
Polyline ZM	Zaman Park to Nich	Shimla Hill	Gulberg Town	AC	1990	B	12"	15	H
Polyline ZM	Zaitoon colony	Fateh Garh	Shalimar Town	AC	2000	B	4"	5	L
Polyline ZM	Zaitoon colony	Fateh Garh	Shalimar Town	AC	2000	B	4"	5	L
Polyline ZM	Zaitoon colony	Fateh Garh	Shalimar Town	AC	2000	B	6"	5	L
Polyline ZM	Zaitoon colony	Fateh Garh	Shalimar Town	AC	2000	B	4"	5	L
Polyline ZM	Zaitoon colony	Fateh Garh	Shalimar Town	AC	2000	B	4"	5	L
Polyline ZM	Zaitoon colony	Fateh Garh	Shalimar Town	AC	2000	B	4"	5	L
Polyline ZM	Zaitoon colony	Fateh Garh	Shalimar Town	AC	2000	B	4"	5	L
Polyline ZM	Zaitoon colony	Fateh Garh	Shalimar Town	AC	2000	B	4"	5	L
Polyline ZM	Zaitoon colony	Fateh Garh	Shalimar Town	AC	2000	B	4"	5	L

0 (0 out of 35865 Selected)

Figure 1.3. Attribute data

1.2.3. GIS applications in context to AMIS & WASA

There are many applications but here we discuss applications related to WASA assets mapping. The asset management information system (AMIS) of 5 WASA is also discussed.

- **Suitable Site for Disposal Station**

Disposal sites for the waste water can be selected by using GIS technology.

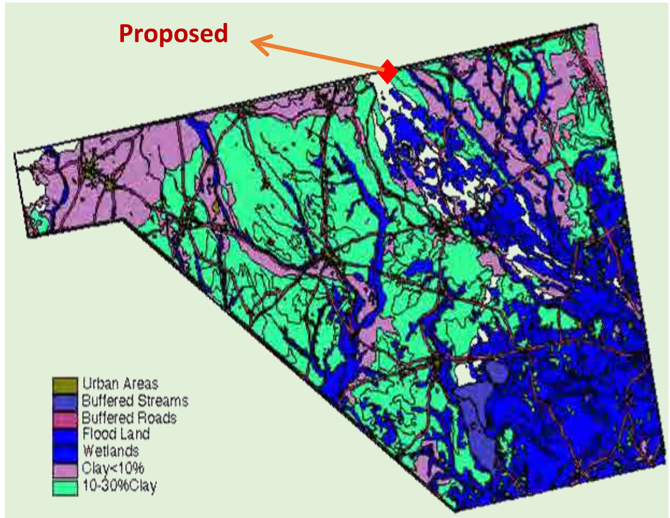


Figure 1.4. Proposed Disposal Site

- **Utility Management**

Due to the urban growth in the city, water and sewerage are crucial to the growth and survival of any city. GIS is used as tool in utility management to enhance the effectiveness and efficiency of the facilities of an area. The water supply and sewerage distribution replacement plan of Allama Iqbal Town subdivision, Lahore is shown in figure 1.5 and 1.6.

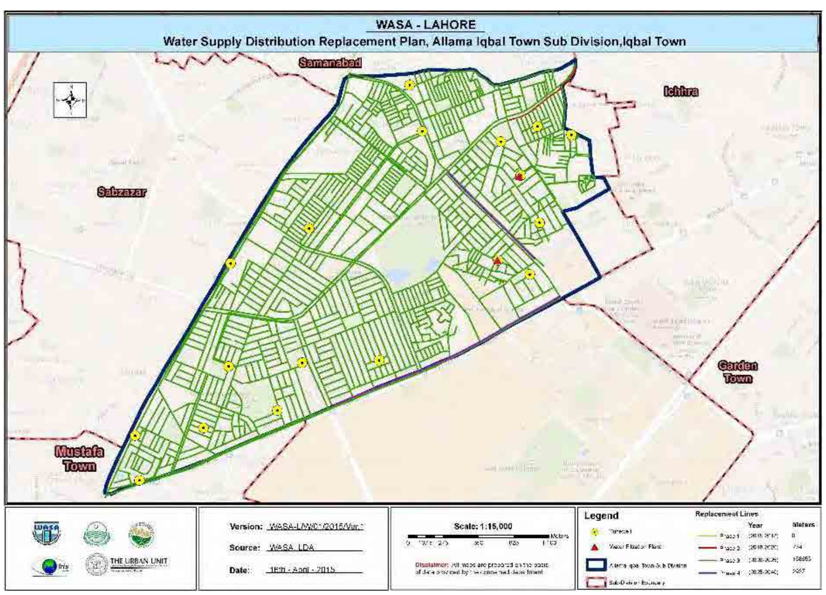


Figure 1.5.Water Supply Distribution Replacement Plan

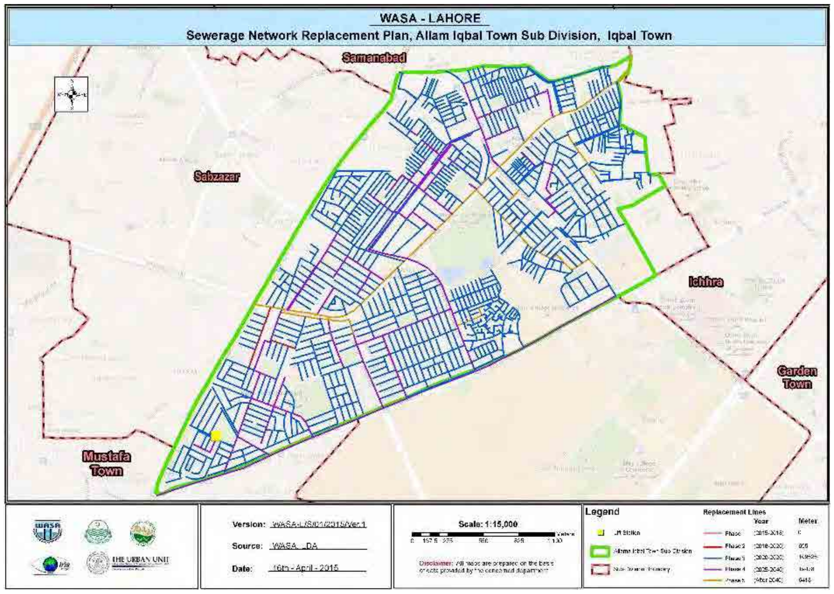


Figure 1.6. Sewerage Distribution Replacement Plan

- **Water and Sewerage Network of Sialkot City**

The Iris GIS web interface of water supply and sewerage network of Sahiwal city under PICIIP project is developed and can be seen by using URL; http://www.irispunjab.gov.pk/IntermediateCities.aspx, is shown in figure 1.7.

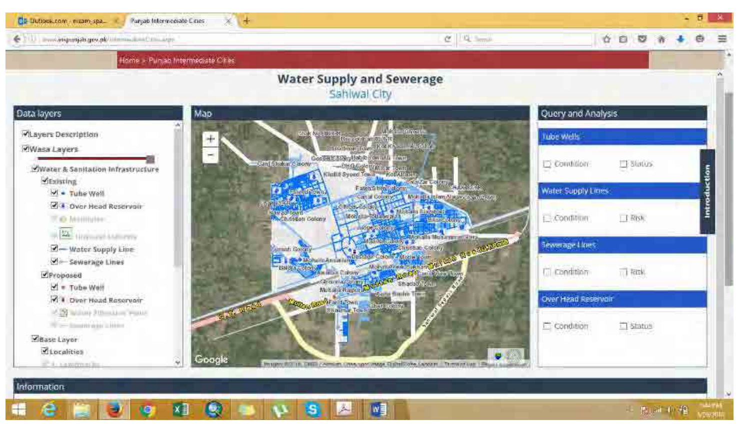


Figure 1.7.Water Supply Sewerage-Sahiwal City

When we select water supply pipelines with condition C and risk medium (m) and condition of tube well B with status functional, the result is shown in figure 1.8 & 1.9.

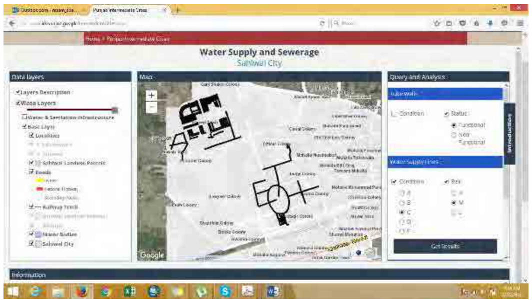


Figure 1.8.Water Pipelines

Figure 1.9.Tube Wells

When we select sewerage pipelines with condition C and risk high (h) and condition of OHR B with status functional, the result is shown in figure 1.10 & 1.11.

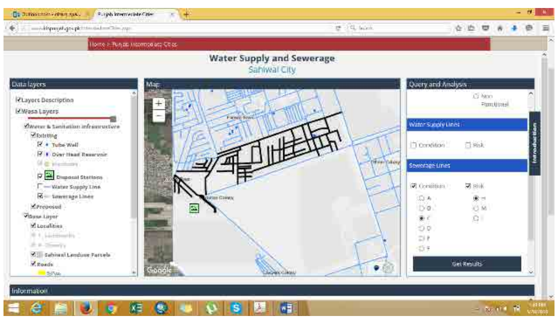


Figure 1.10.Sewerage Pipelines

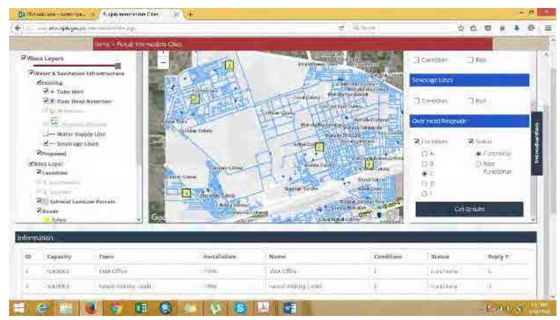


Figure 1.11.Over Head Reservoir

- **Asset management Information System for 5 WASA's**

The detail water supply network and sewerage network with necessary attribute information of Rawalpindi, Faisalabad, Gujranwala, Multan and Lahore has been developed by the Urban Unit and perform different analysis. Asset management information system for 5 WASA's also developed by the Urban Unit and can be seen by using the following URL; http://202.166.168.184:99/Common/Superadmin.

The WASA number of assets information, category wise number of assets, daily progress with pie chart, GIS based number of assets, finance information and assets maintenance is available on this AMIS. The dashboard information of WASA assets of 5 cities is shown in figure 1.12 and bills of tube wells of Gulberg sub-divion Lahore under asset maintenance is shown in figure 1.13.

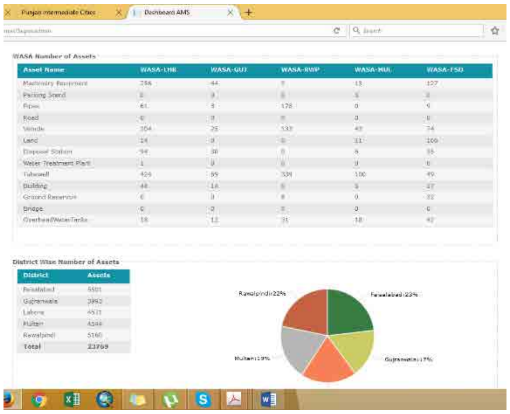


Figure 1.12.WASA Assets

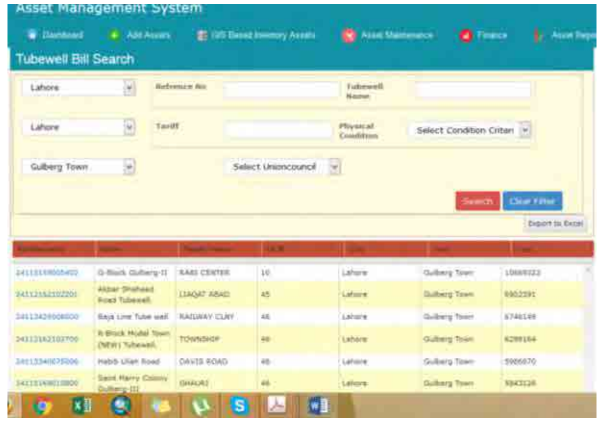


Figure 1.13.Tube Wells Bills

- **Case Study**

The case studies related to assets mapping; water supply & sewage network for Madurai Region-India and concept paper- mapping for water supply and sanitation (WSS) in Ethiopia and water supply GIS-Yokuhama water-Japan are given as;

- **Water Supply & Sewage Network for Madurai Region-India**

The study has focused on the utility of Remote Sensing and GIS in the identification of existing system. The present scenario situation of sewage and water network of Madurai City as shown in figure 1.14 & 1.15. Present population and expected rate of growth are critical factors in design of Water Distribution and Sewage Network in Madurai City.

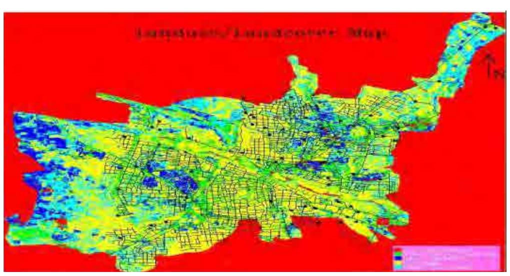


Figure 1.14.Water Network Map

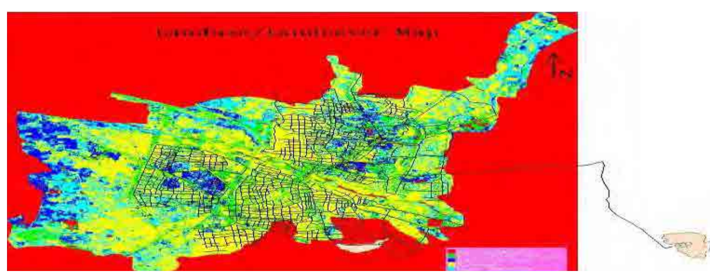


Figure 1.15.Sewerage Network Map

- **Mapping of Water Supply and Sanitation (WSS) in Ethiopia- Concept Paper**

Mapping has many benefits for WASH, and can play a crucial role in helping WASH services be more effective. Mapping framework highlights the important role that maps have in turning raw data into information and knowledge the challenges of undertaking mapping effectively in Ethiopia highlights the need for careful planning of mapping activities.

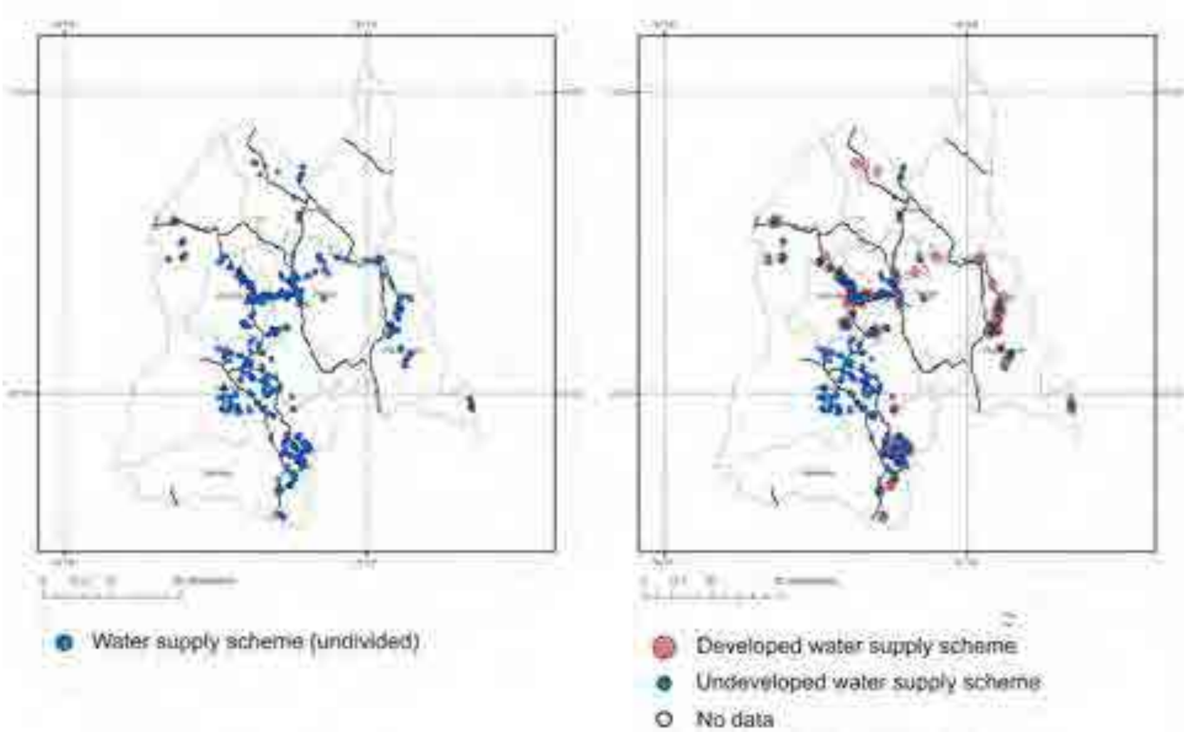


Figure 1.16.Sewerage Network Map

On the left are the water schemes as mapped by a GIS consultancy. On the right, the water schemes are differentiated into developed schemes and unprotected, undeveloped schemes.

- **Water supply GIS-Yokuhama water-Japan**

Pipeline Mapping Information System constructed the network with the lease line of YOKOHAMA City, and are operated in Headquarter bureau and in the office in 30 places such as the water service maintenance sections. An individual information for water service facilities used under the strict management system. It works on the leakage prevention of information.

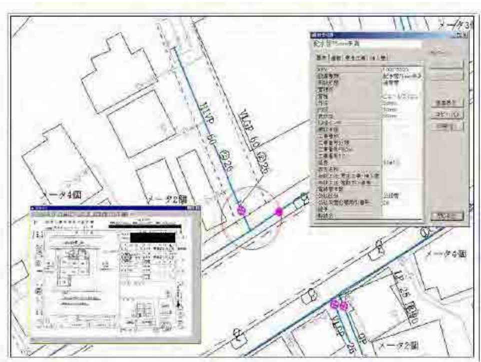


Figure 1.17. Retrieval & Indication

Figure 1.18.Support for Water Stoppage

The process which involves for the preparation of final map for leakage prevention is shown below;

Figure 1.19.Construction Map

Figure 1.20.Tracing

Figure 1.21.Overlay

Figure 1.22.Digital Tracing

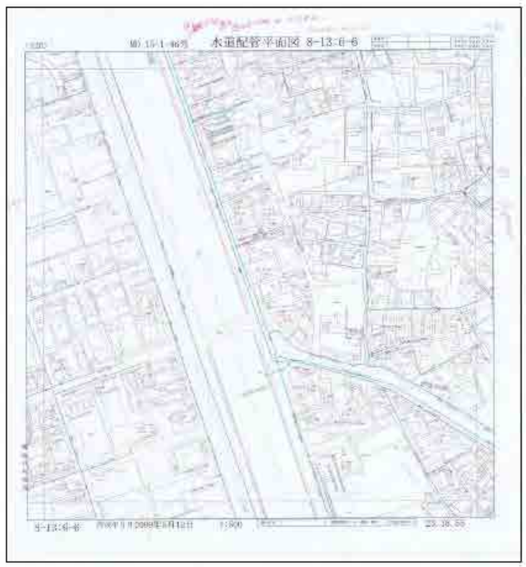


Figure 1.23.Final Map

2. Topic Information

Course Title: Asset Management	Course Code: M 4131
Module Title: Use of GIS Application in Asset Management	Module No: 6
Lecture Topics: Asset data browsing and study • ArcGIS & its components. o ArcCatalog o ArcMap o ArcToolbox • Browsing the Asset GIS Database	Lecture Duration: Four Hours

2.1. Asset data Browsing and Study

Lecture 2: asset data browsing and study, covers the sub-topics; ArcCatalog, ArcMap and ArcToolbox and browsing the assets GIS database related to WASA under module 6 “use of GIS applications in assets management”. This lecture consists of practical work and practical assignment. The demonstration and practices regarding components of ArcGIS is covered in strengthening the practical skills of course participants. The existing GIS data related to assets is browsed and explored in the lab activity.

Lecture 2 is formulated in strengthening the practical skills of ArcGIS and its components to course participants regarding GIS and its applications. After completion of lecture 2; the course participant will be familiar about practical skills of ArcGIS software & its components, and they can explored and browsed the assets data in ArcGIS.

The explanation of the sub-topics are given as;

2.1.1. ArcGIS & its Components

ArcGIS & its components covers, over view of ArcGIS component’s ArcCatalog, ArcMap and ArcToolbox and browsing the assets GIS database in the GIS lab. The detail function of these three components is covered.

Here we start from GIS software ArcGIS which is the ESRI producti.

❖ ArcGIS:

It is an operating system which is used in for mapping of WASA assets in GIS.

➢ How to Access ArcGIS?

In-order to access the ArcGIS 10.2, it must be installed in your workstation/computer. For installation of ArcGIS on your workstation/computer must be at high efficiency to run the ArcGIS. Otherwise it will not run in a smooth way and you will feel problem during working in ArcGIS.

The ArcGIS has been installed on the workstations in the GIS lab and you can access as;

- ➢ ***Start>>program>>ArcGIS***

The snap shot is given as;

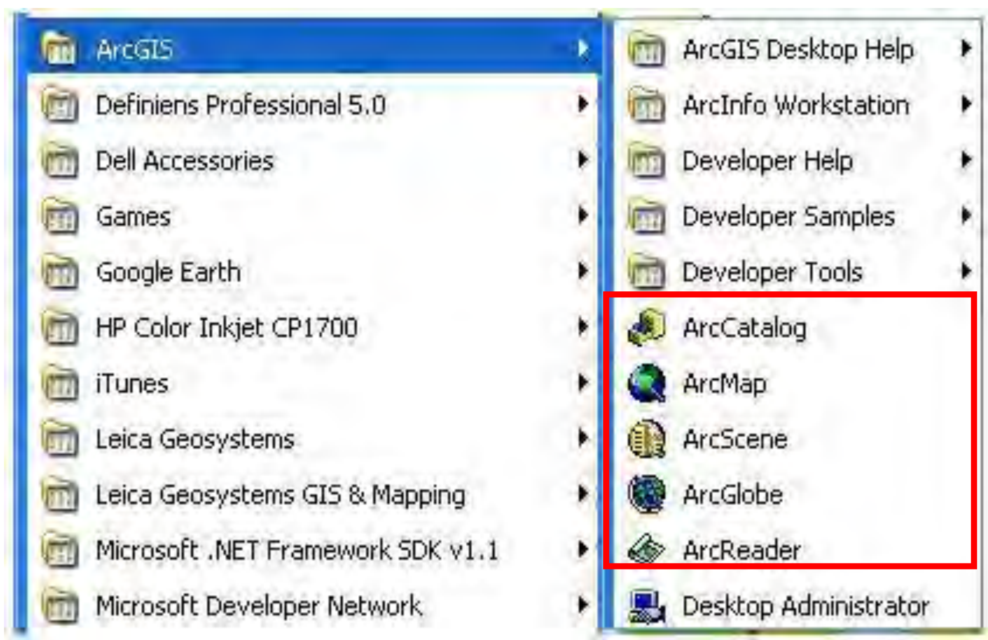


Figure 2.1. Accessing of ArcGIS

➢ ArcCatalog:

ArcCatalog is an application within ESRI's ArcGIS suite, whose primary role is to maintain geospatial data and the corresponding metadata. Data management, processing and symbolization are the main tasks of ArcCatalog. In order to develop GIS data, shapefile is developed in ArcCatalog for spatial data storage, you will prepare shapefile in future.

- **Launch of ArcCatalog**
  - Go to Start>>program>>ArcGIS
  - Open ArcCatalog
  - Click connect to folder icon in the menu bar.
  - Navigate to the folder where the data for this exercise are saved (e.g., C:\GIS Training in the Connect to Folder dialog Click OK.
  - The C:\GIS Training folder now appears in the Catalog tree.

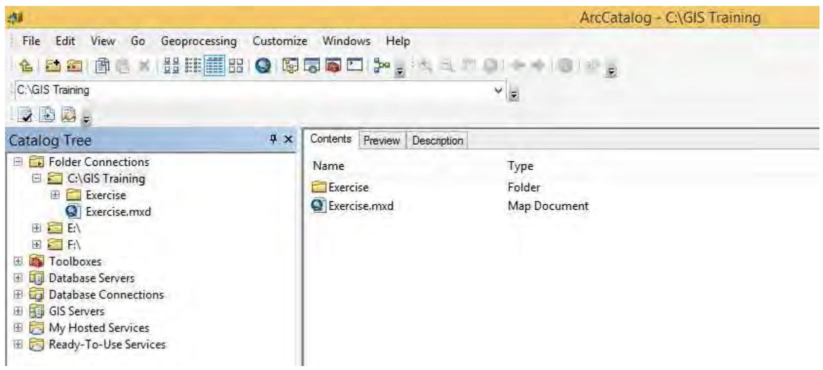


Figure 22. ArcCatalog

The geography preview, content and description about data is seen in ArcCatalog.

- **ArcMap:**

ArcMap is the main component of Esri's ArcGIS suite of geospatial processing programs, and is used primarily to view, edit, create, and analyze geospatial data. ArcMap allows the user to explore data within a data set, symbolize features accordingly, and create maps for decision makers. ArcMap is used for preparation, management and processing of spatial vector data and prepared layout.

- **Launch of ArcMap**
  - Go to Start>>program>>ArcGIS
  - Start ArcMap, "ArcMap – Getting Started" dialog box is opened.
  - Pick an existing map or choose to create a new map.
  -

Here new maps is selected for the creation of new map document.

  - Select new maps in dialog box and click on blank map.

- Click OK.
- A new map document is opened.
- Click on file button and click on Save as option and save the document in the folder path C:\GIS Training\Exercise.mxd. This document is saved and can be used in future for further working.

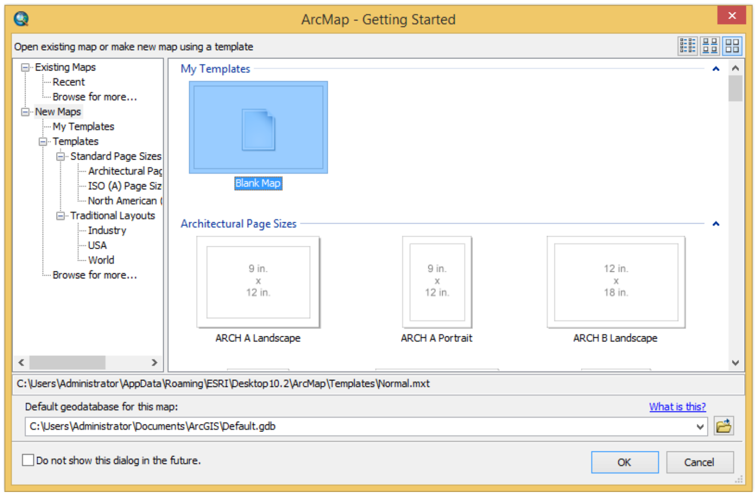


Figure 2.3. Content Tab

ArcMap is also opened from ArcCatalog.

2.1.2. Browsing the Asset Database

In this section GIS data related to WASA asset is browsed and explored in the ArcMap. In-order to access the GIS exercise data;

- Click the Add Data button  which opens a window similar to start-up splash window.

Figure 2.4. Data add

- Make a folder connection to add the data. To browse to the file you want to work with, you can link to the folder containing all these files by clicking the Connect to Folder button shown in figure, then browse to add the folder that contains your related files and click OK.

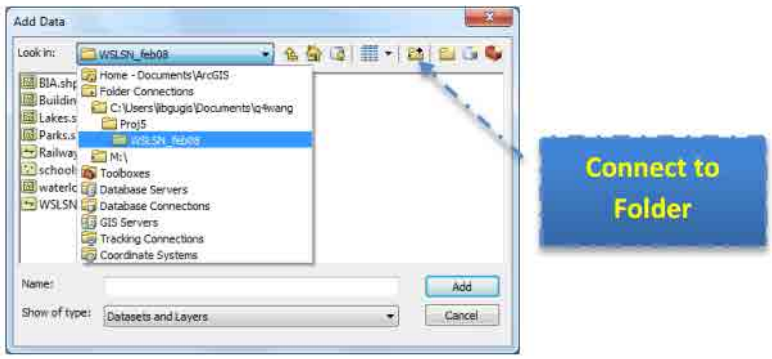


Figure 2.5. Folder Connection

- Locate the required vector files from the list of personel database and add them all at once by holding the Ctrl or Shift button while clicking on each selection. Here we add the following data by using the Lahore WASA personel database “WASA-Lhr.mdb”;

  ✓ *The SubDiv_Boundary City of Lahore*
  ✓ *All Valves in the SubDiv_Boundary*
  ✓ *Existing_WS*
  ✓ *Existing _TW*
  ✓ *Existing _OHR*

- When the data is loaded, all files will be listed in the left pane, called the table of Contents. The geographic features (contents) are displayed in the main data frame window.

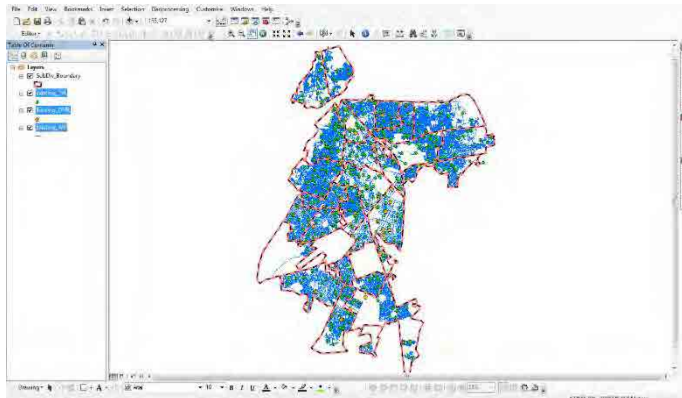


Figure 2.6. ArcMap Data View

- Now the data has been uploaded in the data view window of ArcMap.

Study the data and think about what further this data can be used?

3. Topic Information

Course Title: Asset Management	Course Code: M 4131
Module Title: Use of GIS Application in Asset Management	Module No: 6
Lecture Topics: Study of asset attributes and Classification • Study of Asset Attributes data • Displaying Asset Data in terms of: o Diameter o Condition, o Risk, o Year of construction o Pipe type o Material o etc • Asset Categorizing in Labeling asset's attributes	Lecture Duration: Three Hours

3.1. Study of Asset attributes and Classification

Lecture 3 study of asset attribute and classification, covers the sub-topics; ; study of asset attribute data, displaying asset data in term of asset characteristics and asset categorizing in labeling asset's attribute related to WASA under module 6 "use of GIS applications in assets management". This lecture consists of practical work and practical assignment. The demonstration and practices regarding study of asset attributes and classification by using ArcGIS is covered in strengthening the practical skills of course participants. The existing GIS data related to assets is studied and classified on the basis of their attributes of spatial features in the lab activity.

Lecture 3 is formulated in strengthening the practical skills to categorize and label the attribute data by using ArcGIS to course participants. After completion of lecture 3; the course participant will be familiar about practical skills regarding the study of asset's attribute data, categorizing and labelling of spatial features on the basis of attributes in ArcGIS software.

The explanation of the sub-topics are given as;

3.1.1. Study of Asset Attribute data

ArcGIS 10.2 version is used for the study of asset's attribute data. In a GIS, a spatial feature on a map may be associated with a great deal of information-more than can be displayed at any given time. This information is stored in an attribute table. A spatial layer's attribute table contains a row (or record) for every feature in the layer and a column (or field) for every attribute or category of information.

You have learned about the exploring and browsing of GIS asset data in the previous lecture.

So add the following data in ArcMap by using the Lahore WASA personel database "*WASA-Lhr.mdb*";

- ✓ *The SubDiv_Boundary City of Lahore*
- ✓ *All Valves in the SubDiv_Boundary*
- ✓ *Existing_WS*
- ✓ *Existing _TW*
- ✓ *Existing _OHR*

➢ **Open Attribute Table**

- Right-click on the spatial layer "Existing_WS" in table of content in ArcMap and click "open attribute table" as shown in the figure 3.1.

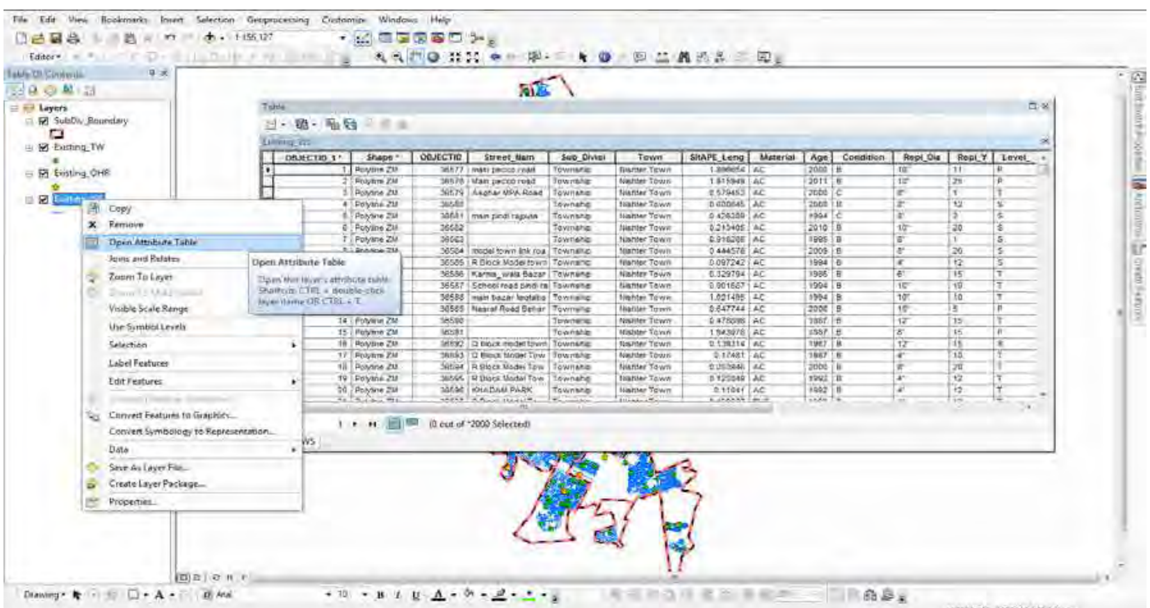


Figure 3.2. Open Attribute Table in ArcMap

- Scroll down through the attribute table, number of attribute records (OBJECTID, Shape, Street_Nam, Sub_Divisi, Town, SHAPE_Leng, material, age, condition, repl_dia, repl_y, Level_, length, diameter, etc.) against each spatial feature of existing water supply pipelines is present in that attribute table.

- There are 12 fields with different names of columns are present in the attribute table. The OBJECTID field is the default field of spatial feature class and contains a unique identification number for every record.

- The Shape field is also the default field and describes the geometry of spatial feature. In this existing water supply feature class, the geometry is mentioned as "Polyline ZM" in default Shape field.

➢ **Turn off field**

- In-order to view only the fields/column if the data fields are in massive then turn of fields which are not necessary at time of processing the data for your interest. For this go to layer properties by right click on spatial feature layer in table of contents of ArcMap as shown in figure 2.

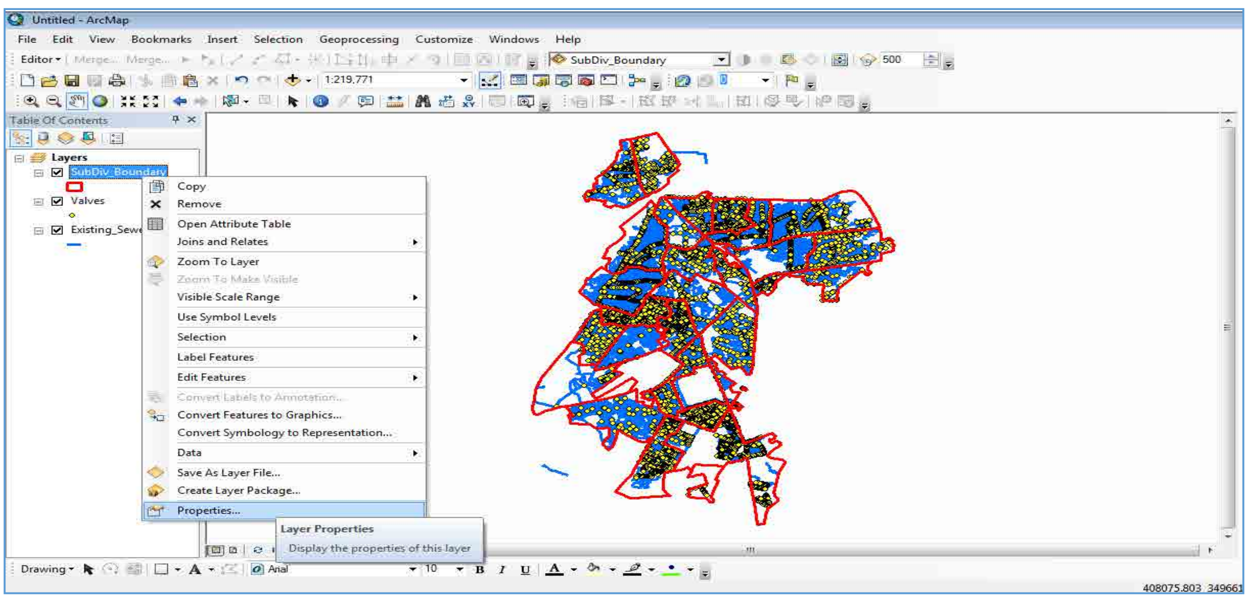


Figure 3.2. Accessing of Properties of Spatial feature

- Select the tab of fields and turn of the fields as shown in figure 3.3.

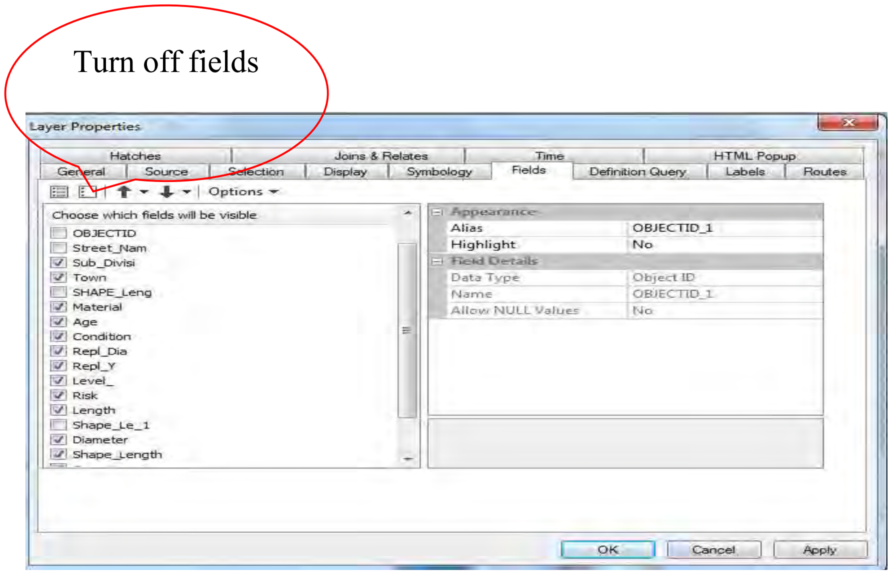


Figure 3.3. Layer Properties

- Un-Check fields/columns which you want to turn off. All the fields is turned off by pressing tab "turn all field off" as shown in figure 3.3.

➢ **Adding field/column to a table-Calculate Length**

- In-order to add the attribute data in a new field/column, add a new field to attribute table of Existing_WS feature class.
- Open the attribute table and click on the pull down button in the top left of the table, then click 'add field' as shown in figure 3.4.

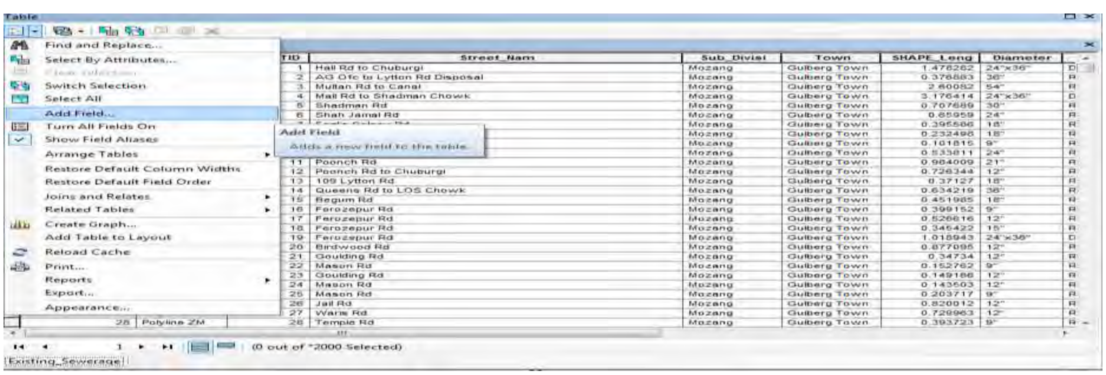


Figure 3.4.Add Field in attribute table

- “Add Field” dialog box is opened as shown in figure 5.
- Add the name of the field/column as ‘length’ and select ‘double’ from drown down list of type and click ok as shown in figure 3.5. There are many different data field types and carefully add that type which is most appropriate for your data. Here field type double is selected, because the length contains decimal values for more precision.

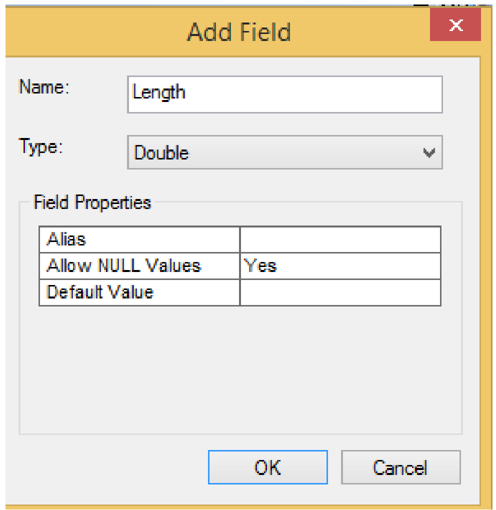


Figure 3.5.Add Field

- The new field is highlighted in the attribute table which contains “Null” values.
- Right click on that length field and click on calculate geometry as shown in figure 6.

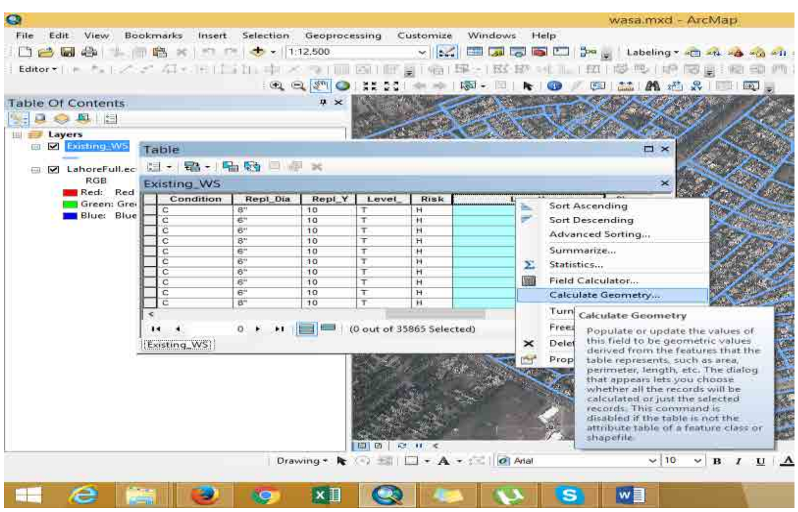


Figure 3.6.Calculate Geometry tab

- Calculate Geometry window is opened as shown in figure 3.7.

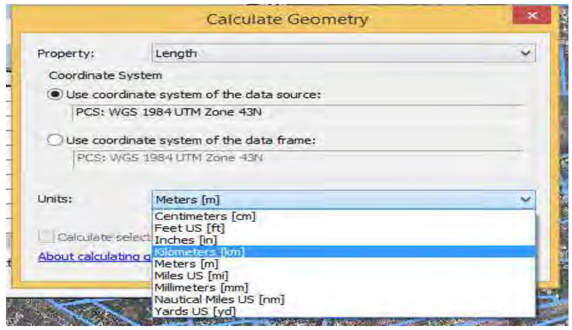
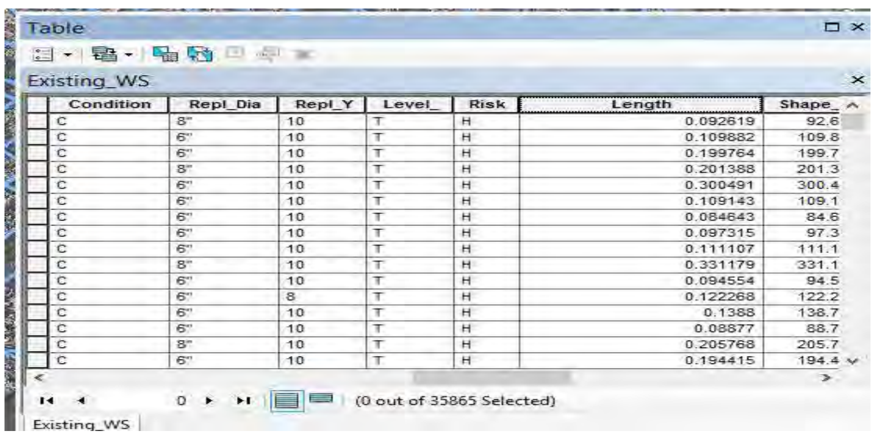


Figure 3.7. Calculate Geometry Window

- Select kilometer (m) from the drop down list of Units and click ok. It takes a few time and the length of water supply is calculated as shown in figure 3.8.



Condition	Repl_Dia	Repl_Y	Level_	Risk	Length	Shape_
C	8"	10	T	H	0.092619	92.6
C	6"	10	T	H	0.109882	109.8
C	6"	10	T	H	0.199764	199.7
C	8"	10	T	H	0.201388	201.3
C	6"	10	T	H	0.300491	300.4
C	6"	10	T	H	0.109143	109.1
C	6"	10	T	H	0.084643	84.6
C	6"	10	T	H	0.097315	97.3
C	6"	10	T	H	0.111107	111.1
C	8"	10	T	H	0.331179	331.1
C	6"	10	T	H	0.094554	94.5
C	6"	8	T	H	0.122268	122.2
C	6"	10	T	H	0.1388	138.7
C	6"	10	T	H	0.08877	88.7
C	8"	10	T	H	0.205768	205.7
C	6"	10	T	H	0.194415	194.4

Figure 3.8. After Length Calculation

Note that in order to calculate length or area, the feature class must have projected coordinate system.

➢ **To locate the Water Supply of maximum length**

- In order to locate the water supply of maximum length, go to length field in attribute table of existing water supply feature class and click on “sort descending order” as shown in figure 9.

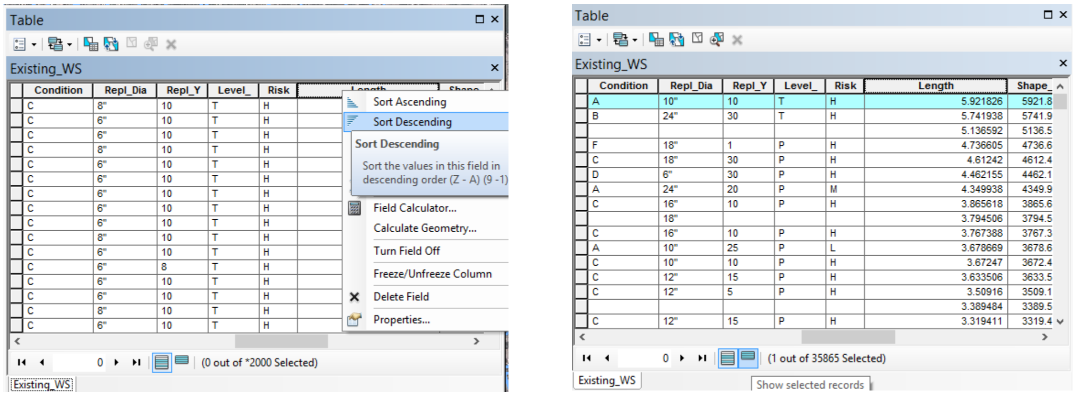


Figure 3.9. Maximum Length

- The maximum length of water supply pipeline is 5.921826 kilometer is highlighed in figure 9.

➢ Calculation of Statistics

Statistics calculate only integer values and not calculate the text values. So be careful about the field entries of spatial feature class. In-order to calculate the statistics right-click the field "length" in attribute table of spatial feature class and click the tab "statistics" as shown in figure 3.10.

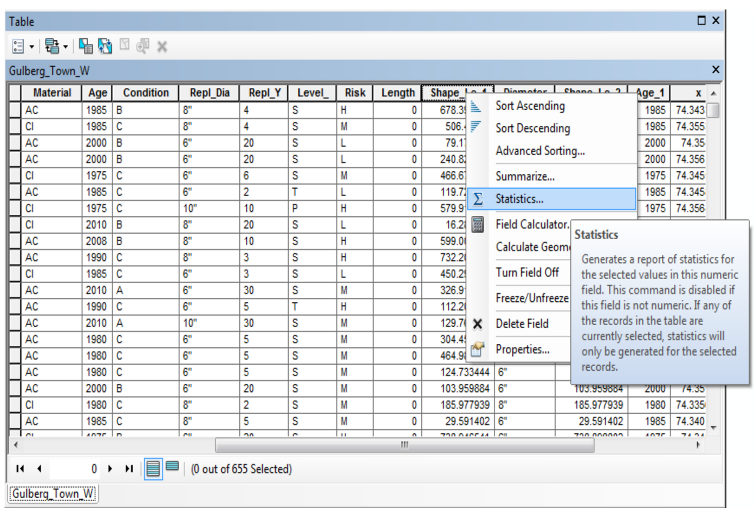


Figure 3.10.Accessing of Statistics tab

- The statistics of water supply Length of Gulberg sub-division is shown in figure 3.11.

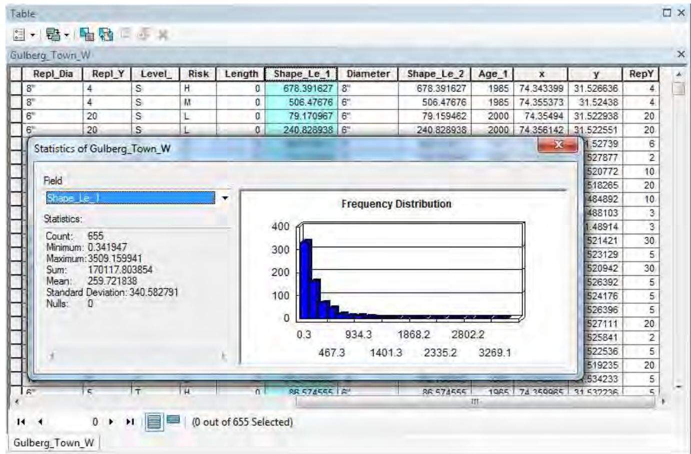


Figure 3.11. Statistics Window

- The statistics window shows the following information;

  Selected Field: Shape_Le_1
  Minimum: 0.341947
  Maximum: 3509.159941
  Sum: 630027.577585
  Mean: 277.789937
  Standard Deviation: 290.156913
  Nulls: 0

- The frequency distribution bar chart represents the distribution of values graphically is shown in figure 11.

- The statistics of other filed can also be calculated by choosing field directly in the statistics window.

3.1.2. Displaying Asset Data

The displaying of data is the function of GIS. For displaying of assets data, cartography regarding in symbology setting must be strong. Symbols are graphic elements that are used in map displays in ArcMap.

➢ **Defining Symbols**

- Start ArcMap document which you have saved in the previous exercise or open new ArcMap and add the data of existing water supply as shown in figure 3.12.

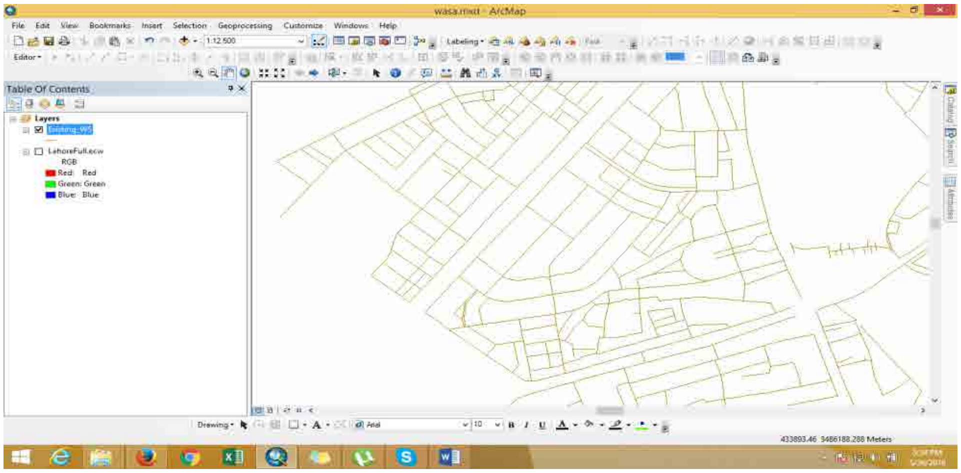


Figure 3.12. Statistics Window

- In the table of contents, click on color symbol below the name of existing water supply. Then symbol selector window is opened and select color "Cretan Blue" and select width 2 as shown in figure 3.13.

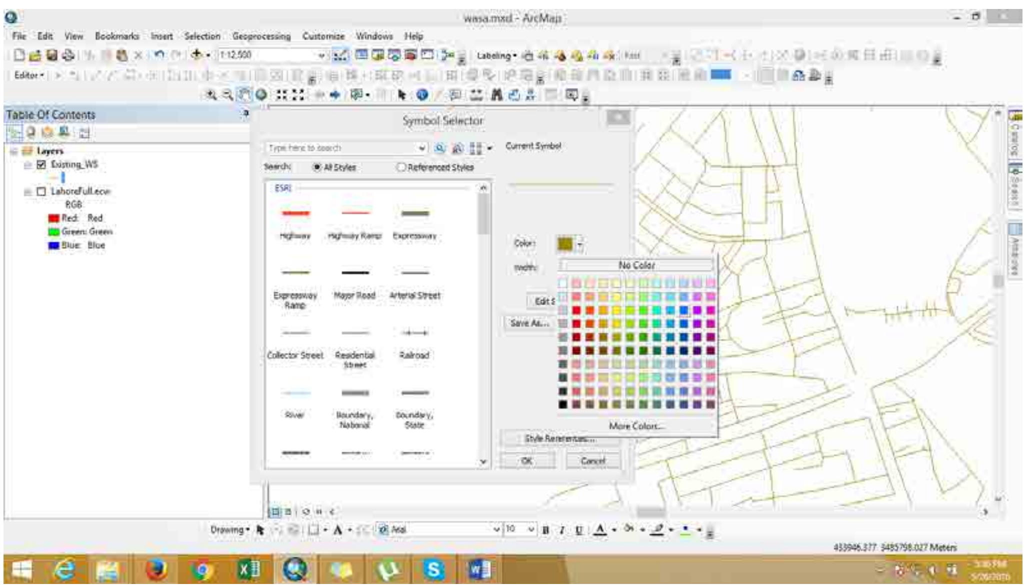


Figure 3.13. Statistics Window

- Then click ok, and also click ok in symbol selector window. The result after symbollogy setting is given as;

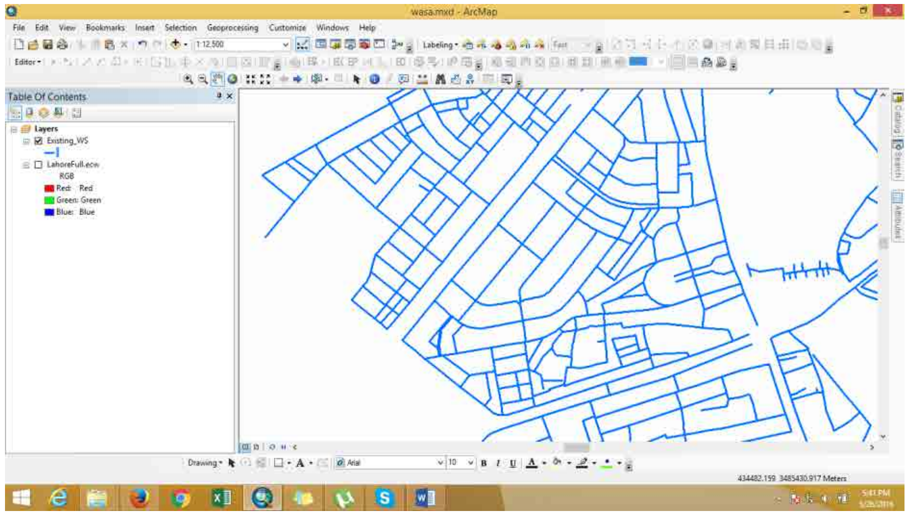


Figure 3.14. After Symbollogy Setting

3.1.3. Asset Categorizing in labeling asset's attributes

The asset data is categorized and labeled on the basis of attribute information which is associated with the vector feature class to display the asset information in better way for the decision maker.

➢ **Labeling Features**

Labels are text strings that are used to label features within map layers in ArcMap. Properties define the attribute column used as the source of the text string.

In ArcGIS, labeling refers specifically to the process of automatically generating and placing descriptive text for map features in ArcMap. Labelling information is based on attribute values associated with vector feature class. So for labelling, existing water supply must have the attribute information of diameter in the attribute table.

- Right Click on Water Supply layer and select properties. A layer properties dialog is opened
- Click on the labels tab and select "Diameter" from labels field as shown figure 15.
- Check the box "label feature in the layer"

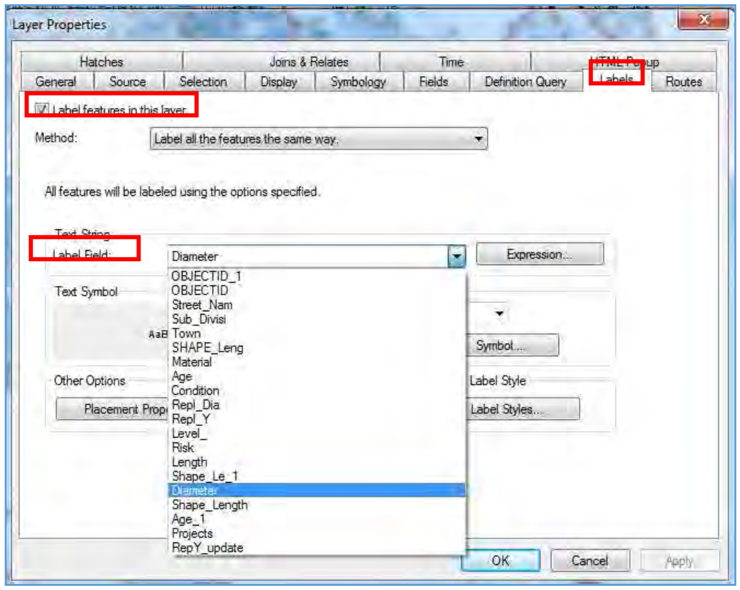


Figure 3.15. Labelling window

- Select symbol option as shown in figure 3.16.

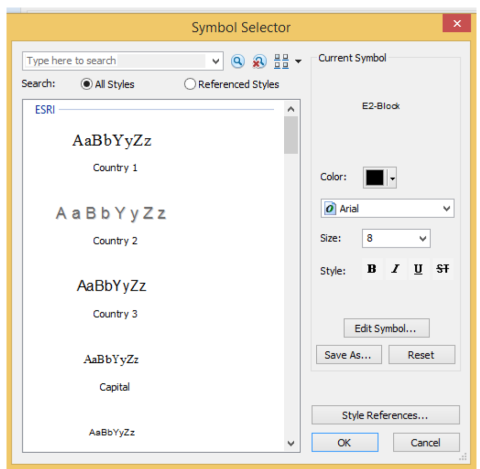


Figure 3.16. Labelling symbol selector

- Select color “Black”, font type “Arial”, size ” 10” , style “B” for bold and then click ok in symbol selector as well as in layer properties.
- The result is shown in figure 3.17.

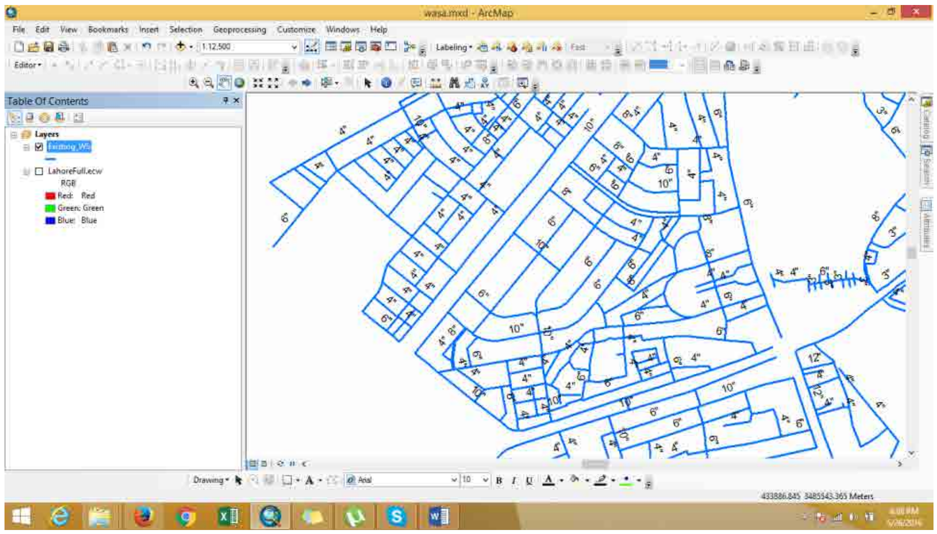


Figure 3.17. After labelling

- **Categorizing the Assets**

Categorizing of assets is based on the attribute information which is associated in the feature class. Categorizing is the function of symbology setting of feature class having different attribute information in the fields to display the information in different category of symbology.

Here we set the categorization on the basis of condition of water supply pipelines.

- Right click the existing water supply feature class in table of content of ArcMap and click on properties.
- Click the symbology tab in layer properties and select unique values after clicking on categories in “Show” window and select condition field from “Value field” as shown in figure.

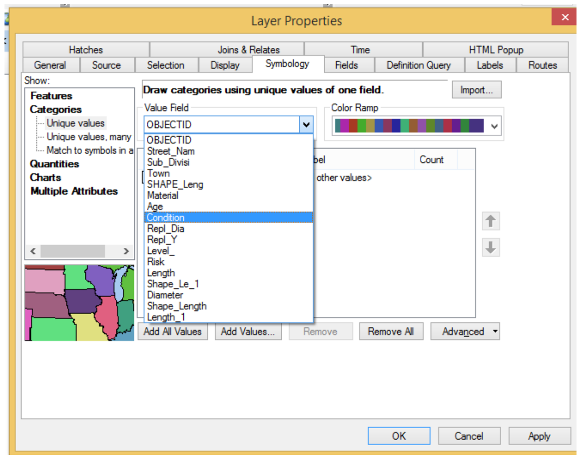


Figure 3.18.Symbology setting for categories

- Then click "add all values tab", set the symbol color & size and click ok as shown in figure 3.19.

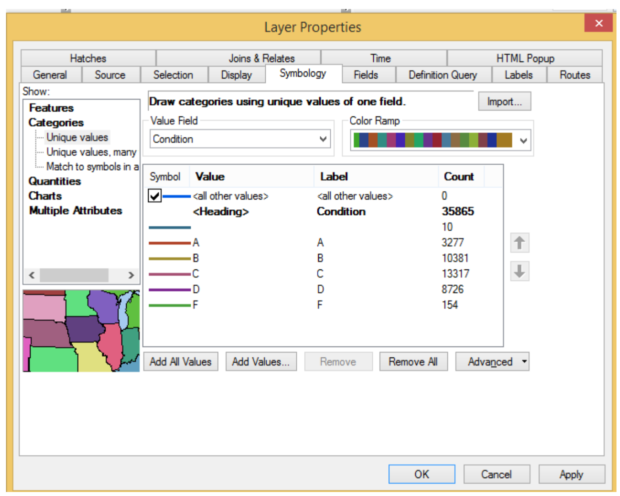


Figure 3.19. After Categorizing

- The final output after categorizing of water supply feature class in ArcMap is shown in figure 3.20.

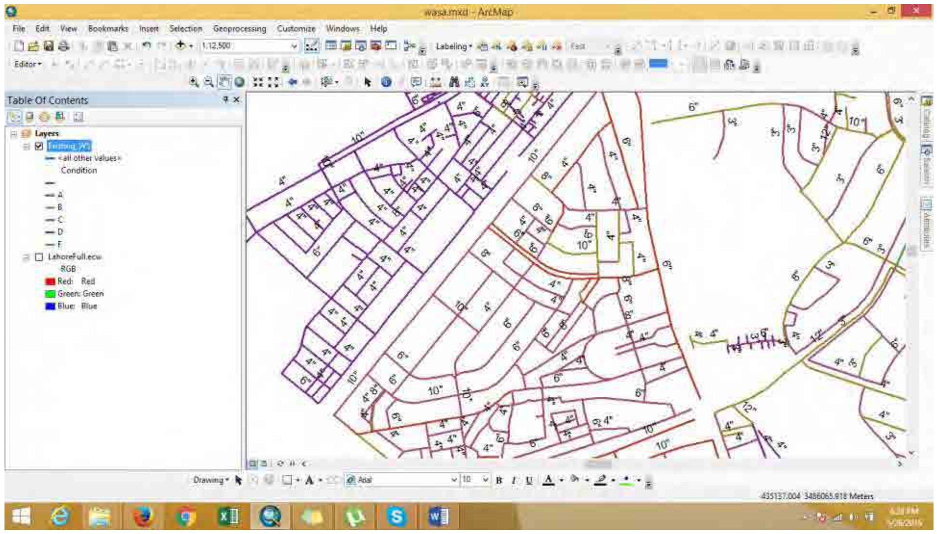


Figure 3.20.Display after Categorizing

The conditon categorizing and labelling of diameter of water supply pipelines is seen in table of contents as well as in data view window of ArcMap

4. Topic Information

Course Title: Asset Management	Course Code: M 4131
Module Title: Use of GIS Application in Asset Management	Module No: 6
Lecture Topics: Editing and updating assets network data according to as build drawings & preparation of Block Maps. • Editing the assets • Making Shapfiles • Digitization • Preparation of Layouts/Block Maps	Lecture Duration: Three Hours

4.1. Editing and updating assets network data according to as build drawings & preparation of Block Maps.

Lecture 4 Editing and updating assets network data according to as build drawings & preparation of Block Maps, covers the sub-topics; editing the assets data, making shapefiles, digitization, preparation of layouts/block maps related to WASA under module 6 "use of GIS applications in assets management". This lecture consists of practical work and practical assignment. The demonstration and practices regarding editing and updating assets network data according to as build drawings & preparation of block maps is covered in the lab activity. The existing GIS data related to assets is edited according the requirement, digitized new pipelines and block maps will be prepared.

Lecture 4 is formulated in strengthening the practical skills to assets data editing and updation, preparation of shapefile for assets data storage in GIS environment and preparation of block level maps of assets for decision making by using ArcGIS to course participants. After completion of lecture 4; the course participant will be familiar about practical skills regarding the assets data editing and updation, preparation of shapefile for assets data storage in GIS environment and preparation of block level maps of assets.

The explanation of the sub-topics are given as;

4.1.1. Editing the assets

ArcGIS 10.2 version is used for the editing the assets vector and attribute data. Editing of assets vector data is required on demand. Editing is done in the existing vector feature class of assets. Creation of new spatial feature, re-editing of existing pipelines and edition of attribute information associated with the spatial feature are done.

➢ **Editing of Attribute Information**

- Right Click on the Menu Bar and select the Editor Toolbar. The editor toolbar will be added to the ArcMap as shown in figure.

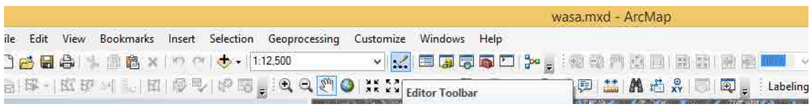


Figure 4.3. Accessing of Editor Toolbar

- Click on the Editor Button on editor toolbar, a drop down menu will be open.

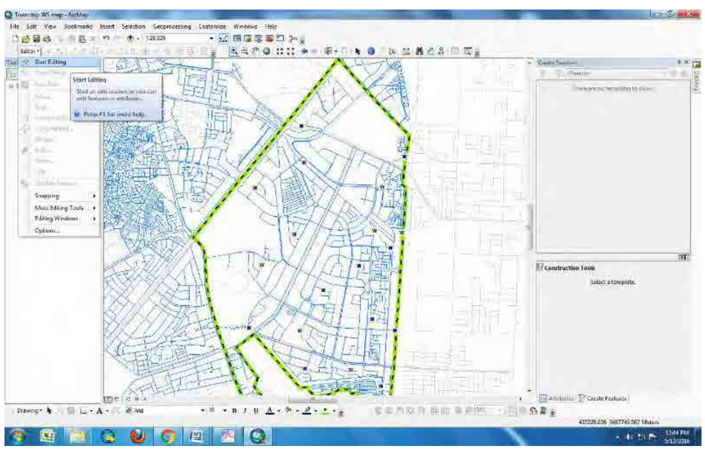


Figure 4.2. Opening of Editor Toolbar

- Select Start Editing and click on the Existing _WS and click Ok.

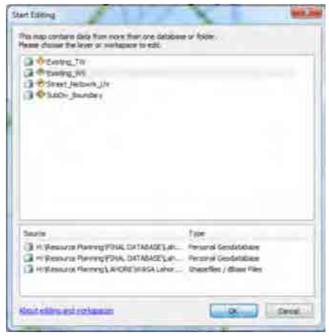


Figure 4.3. Opening Start Editing window

Note that if you have only one feature class in the table of content of ArcMap then software choose the editing target layer automatically, otherwise you have to choose the target feature class in which you want to edit.

- Now select any pipeline by using selection tool and click on Attribute table icon in editing toolbar.
- From attribute table one can edit or modify the information regarding the specific pipeline.

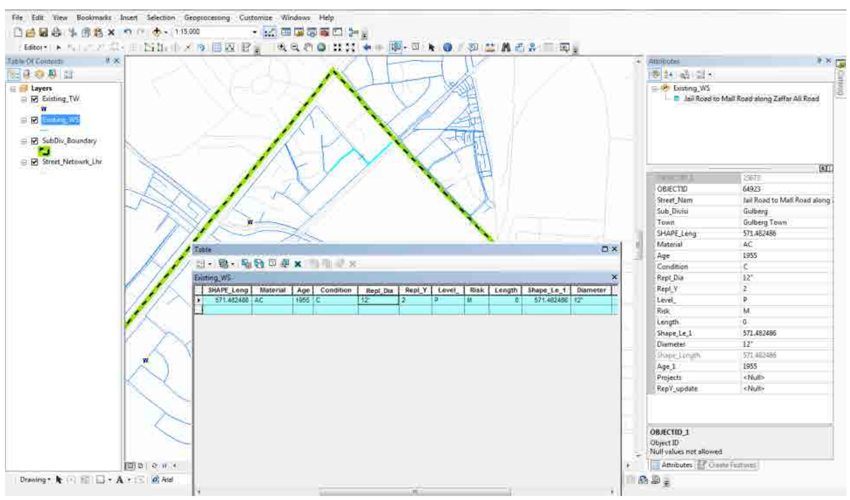


Figure 4.4. Selection of feature

- Click on “Editor” Tab and select “Save Edits” and click “Stop Editing”.

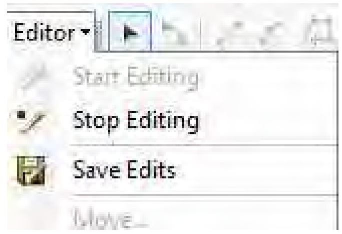


Figure 4.5. Save Editing and stop Editing

If you did not save the edits, you all work done will be discarded and not saved.

➤ **Creation of New Pipeline**

In-order to create a new pipeline in the water supply feature class perform the following steps;

- Right Click on the Menu Bar and select the Editor Toolbar. The editor toolbar will be added to the ArcMap.
- Click on the Editor Button on editor toolbar, a drop down menu will be open.
- Select line from construction tools and trace the pipeline which you want to create, and perform double click by using mouse on where you want to finish the pipeline. The new pipe line will be highlighted as shown in figure.

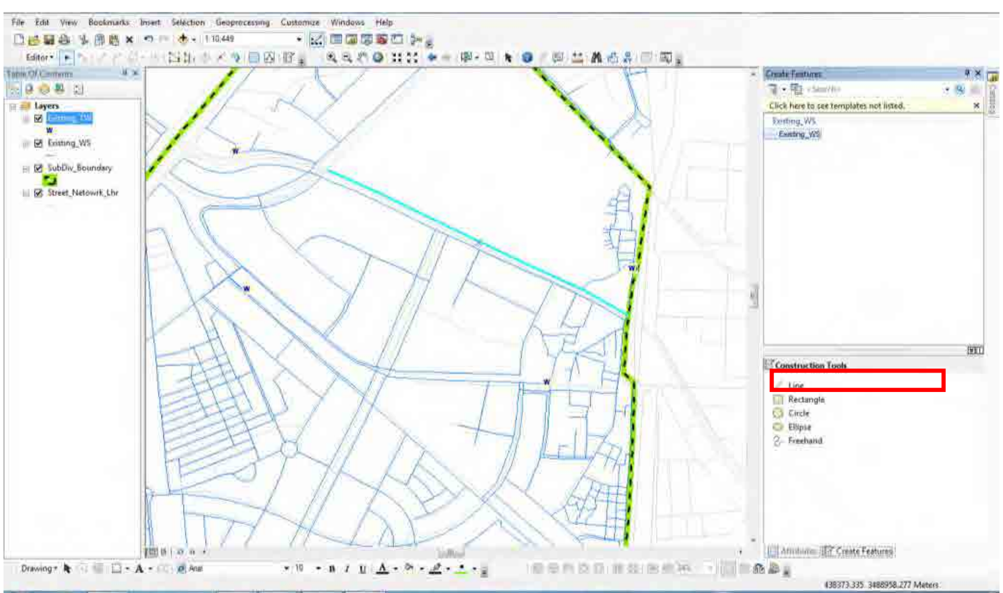


Figure 4.6. ArcMap Window for Editing

- Add the attribute information of new created feature.

- Click on “Editor” Tab and select “Save Edits” and click “Stop Editing”.

4.1.2. Making Shapefile

Shapefile is the dataset of storing of spatial information of assets. ArcMap 10.2 is used for the preparation of shapefile. The ArcCatalog is used for the preparation of shapefile.

In-order to make the shapefile perform the following steps;

- Go to Start>>program>>ArcGIS.
- Open ArcCatalog.
- Navigate to the folder or path where you want make the shapefile.
- Use C:\GIS Training\Make Shapefile path in table of content in ArcCatalog.
- Right click, select new and then select new shapefile as shown in figure.

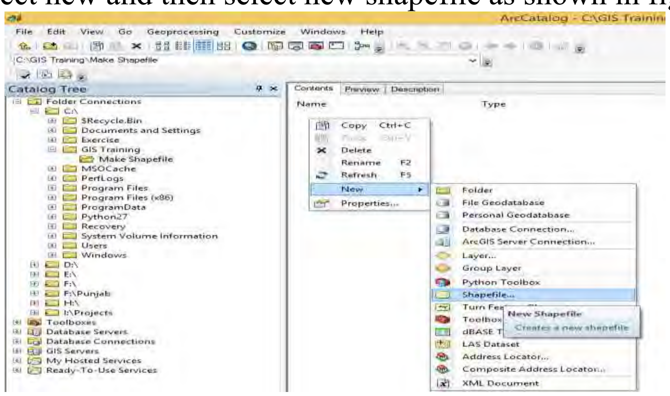


Figure 4.7: Shapefile Tab in ArcCatalog

- Create new shapefile window is opened, type name “Sewerage”, select feature type “Polyline” as shown below.

Figure 4.8. Create New Shapefile window

- Give the spatial references by click edit tab and select import.

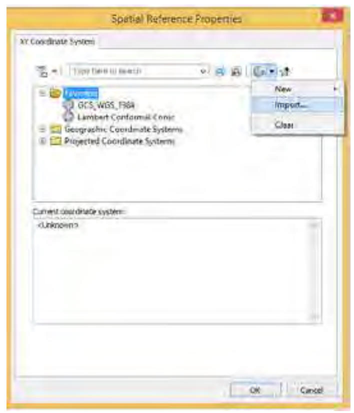


Figure 4.9. Spatial reference properties window

- Select Exiting_WS for the spatial reference and click add button.

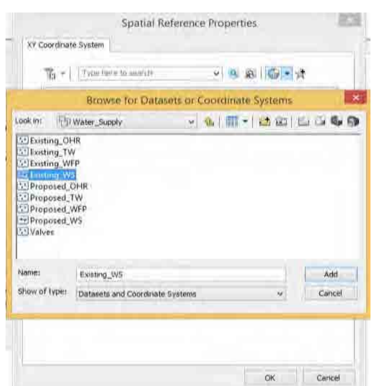


Figure 4.10. Importing of Spatial reference properties

- Spatial reference properties window is appeared which shows the highlighted spatial reference system and click ok.

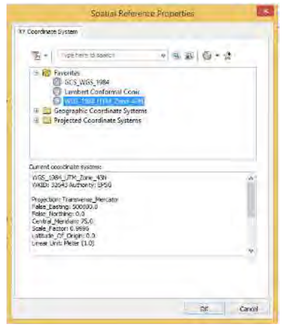


Figure 4.11. After importing Spatial Reference

- That spatial reference information is also appeared in Create New Shapefile window.

Figure 4.12. After setting of spatial reference

- Then click on in create new shapefile window, the new shapefile window is prepared and is ready for digitization.

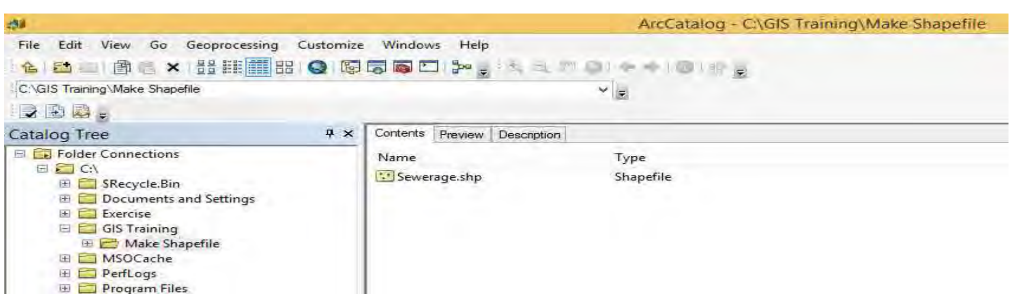


Figure 4.13. New Shapefile prepared in ArcCatalog

The shapefile is ready for the storage of spatial features of sewerage pipelines. Digitize the sewerage information by using ArcMap.

4.1.3. Preparation of Layouts/Block Maps

After the preparation of spatial data related to WASA assets, block level map of water supply replacement plan of Allama Iqbal Town subdivision, Lahore is prepared.

The following methodology is used for the block level mapping.

- Prepare the block boundary/index boundary. So here we use the sub-division boundary as block boundary.

- To open the ArcMap software, click on the "Start" button in "Window Task Bar" then navigate to the ArcMap shortcut.
- Click on "Add Data" button. In the open dialog, navigate to the folder "C\:GIS Training\Exercise" to add the asset GIS data.
- Locate the required vector files from the list of personal database and add them all at once by holding the Ctrl or Shift button while clicking on each selection. Here we add the following data by using the Lahore WASA personel database "WASA-Lhr.mdb";

  - ✓ *The SubDiv_Boundary City of Lahore*
  - ✓ *All Valves in the SubDiv_Boundary*
  - ✓ *Existing_WS*
  - ✓ *Existing _TW*
  - ✓ *Existing _OHR*

- When the data is loaded, all files will be listed in the left pane, called the table of Contents. The geographic features (contents) are displayed in the main data frame window.

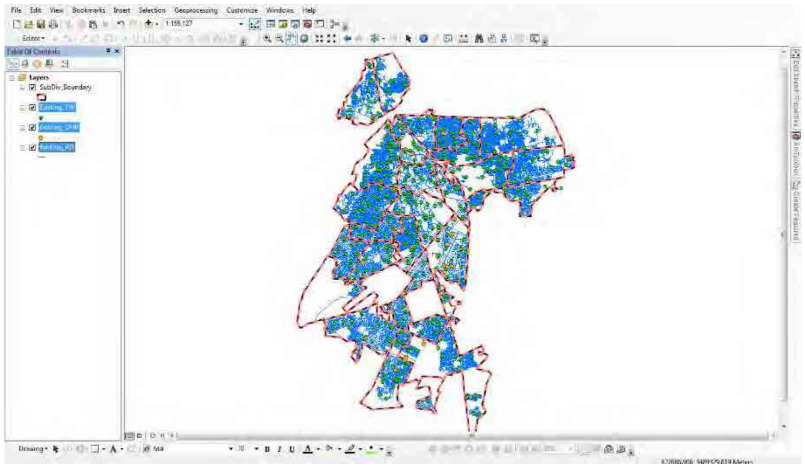


Figure 4.15. After Data added in ArcMap

- In-order to selection of data only Allama Iqbal Town Subdivision, go to layer properties of sub-division boundary and select definition query tab and select write "[Name] = 'Allama Iqbal Town'" in query window.

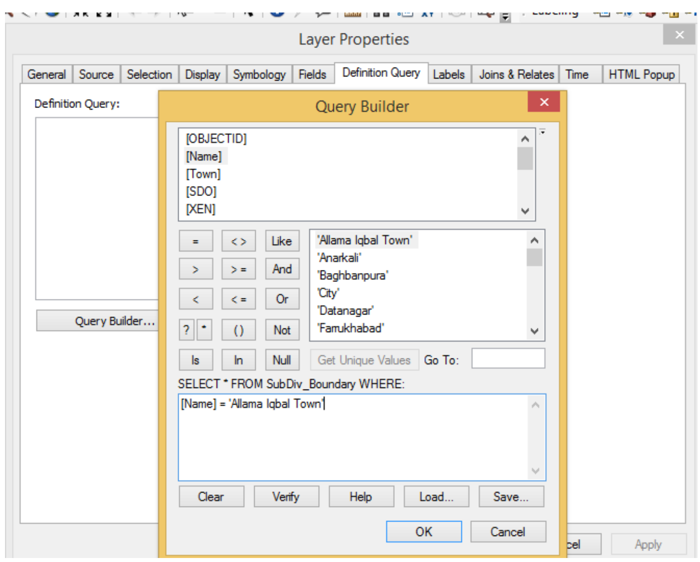


Figure 4.16. Definition Query

- To define the size of map, Click "File" on ArcMap and Click Page and Print setup.

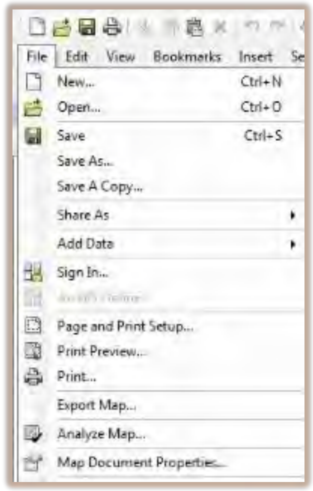


Figure 4.17. Print and page setup

- A page and print setup window is opened and select size A3.
- Click "View" tab on ArcMap   and select layout View.

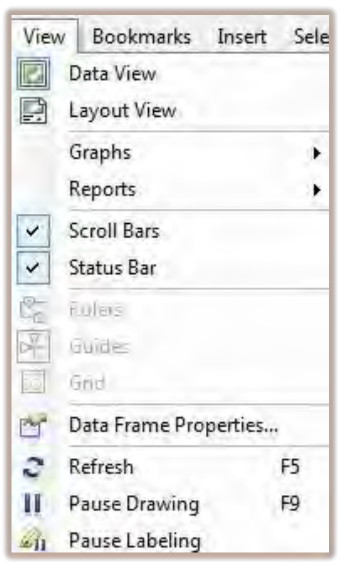


Figure 4.18. Setting Layout View

- Set the map template.
- Set color, size and labeling style of the all the layers and categorize the symbology.

- Click "Insert" option and enter title, North Arrow, Logo, Scale and Legend for map.

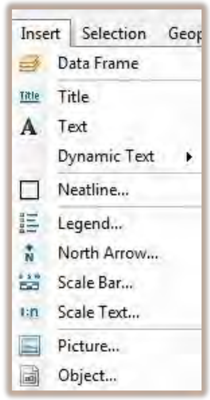


Figure 4.19. Insert Option

- Go to file and select export map.

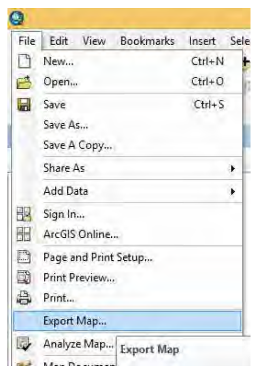


Figure 4.20. Export Map

- Export map window is opened, select path, file name, resolution and format as JPG and then save it.

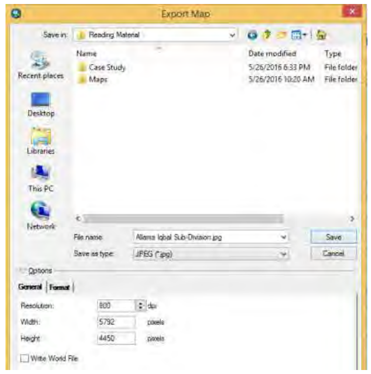


Figure 4.21. Export map window

- The block map of water supply of Allama Iqbal sub-division is ready as shown in figure.

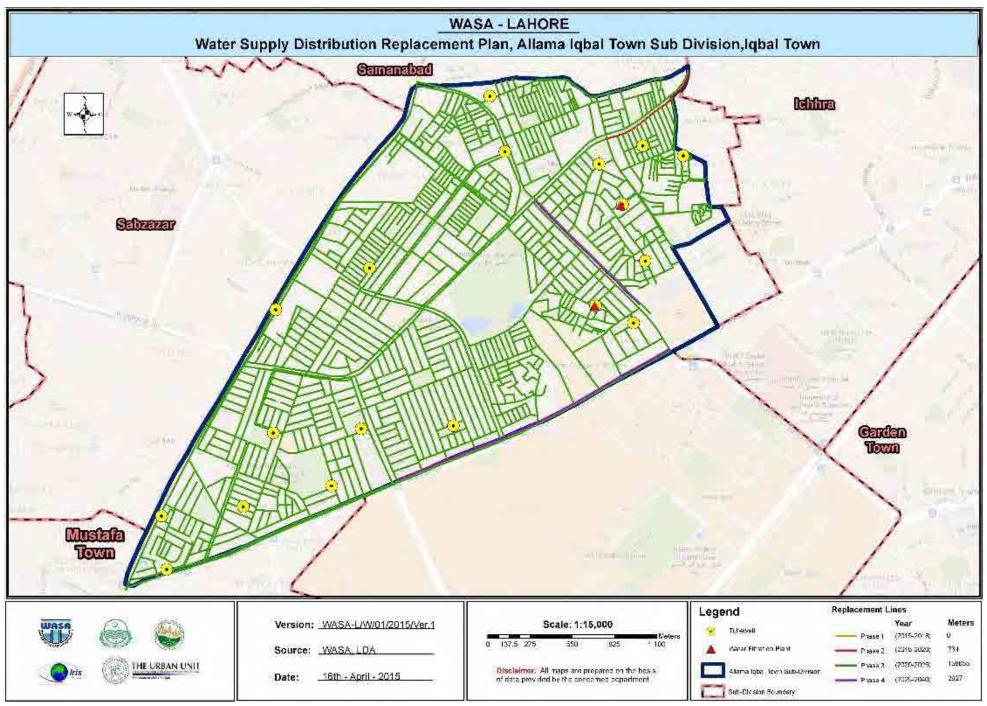


Figure 4.22. Water Supply distribution Block Map

5. Topic Information

Course Title: Asset Management	Course Code: M 4131
Module Title: Use of GIS Application in Asset Management	Module No: 6
Lecture Topics: Pipe Replacement planning • Applying Query Functions • Query the pipelines of your interest (e.g.,with 6 inch diameter) • Calculating Lengths of Pipeline	Lecture Duration: Three Hours

5.1. Pipe Replacement Planning

Lecture 5, pipe replacement planning covers the sub-topics; applying query functions, query the pipelines of your interest and calculating the length of pipelines related to WASA under module 6 “use of GIS applications in assets management”. This lecture consists of practical work and practical assignment. The demonstration and practices pipe replacement planning is covered in the lab activity. The existing GIS data related to assets is access after applying query functions and calculate the length of pipelines.

Lecture 5 is formulated in strengthening the practical skills to asset data is accessed after applying query functions and calculated the length of pipelines. by using ArcGIS to course participants. After completion of lecture 5; the course participant will be familiar about practical skills regarding the query functions, query of pipelines of interest and calculation of length.

The explanation of the sub-topics are given as;

5.1.1. Applying Query Functions

ArcGIS 10.2 version is used for query functions on attribute data associated with spatial feature class of pipelines and calculated length of pipelines.

➢ **Applying Query Functions**

Query is the filtering of information from the exiting spatial feature class in ArcGIS. Query is applied on the assets attribute information associated with the spatial feature class.

❖ **Example-1:**

In-order to select pipelines of your interest on the basis of assets attribute information associated with spatial feature class, query function is applied. Here we want to select "all the pipelines with Diameter 6" following steps is followed.

- Go to Start>>program>>ArcGIS.
- Select ArcMap.
- Locate the required vector files from the list of personal database and add them all at once by holding the Ctrl or Shift button while clicking on each selection. Here we add the following data by using the Lahore WASA personel database "WASA-Lhr.mdb";

  ✓ *The SubDiv_Boundary City of Lahore*
  ✓ *All Valves in the SubDiv_Boundary*
  ✓ *Existing_WS*
  ✓ *Existing _TW*
  ✓ *Existing _OHR*

- When the data is loaded, all files will be listed in the left pane, called the table of Contents. The geographic features (contents) are displayed in the main data frame window.

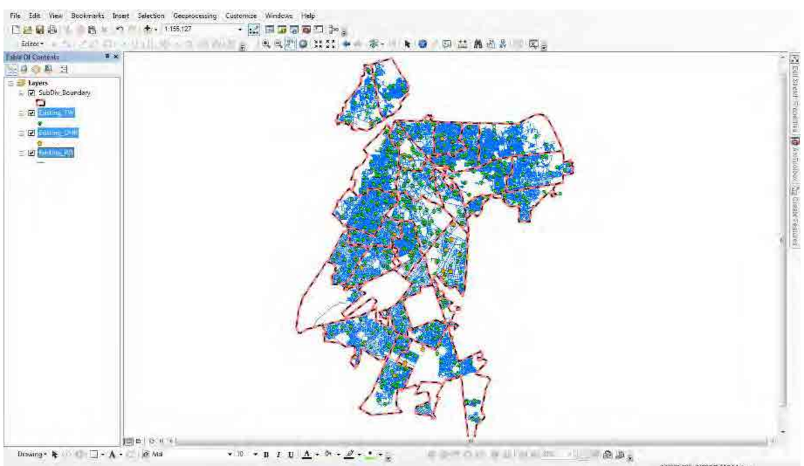


Figure 5.1. After Data added in ArcMap

- Click on Selection Tab and Select by Attribute from the drop down list.

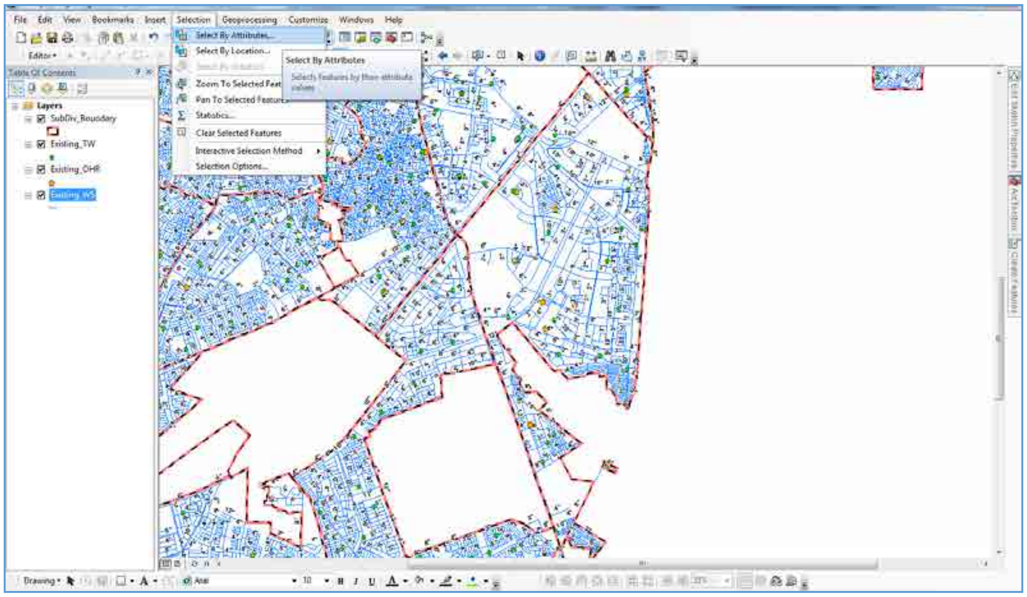


Figure 5.2. Accessing of Select by Attributes in ArcMap

- Select by attributes window is opened.
- Select the “Existing _WS” layer from layer drop down list.
- Select “Diameter” tab after “selection of create new selection” in method dropdown list.
- Select equal “=” sign.
- Click on “Get Unique values” and select <6”>.
- The Query will become as: [Diameter] = '6"‘and visible in Select * from Existing_WS where window.

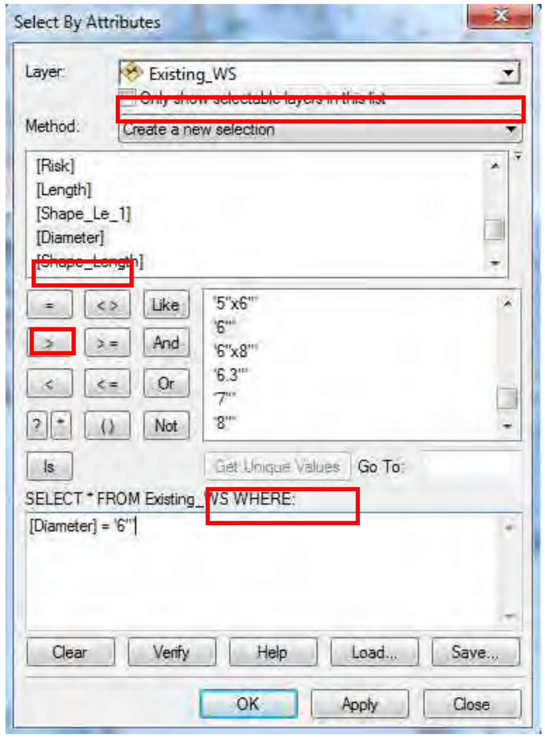


Figure 5.3. Select by Attributes window

- Water supply pipelines of six inches (6”) diameter are selected.
- Open the attribute table to see the selected record.
- The selected records of pipelines with diameter 6 inches is showed in figure.

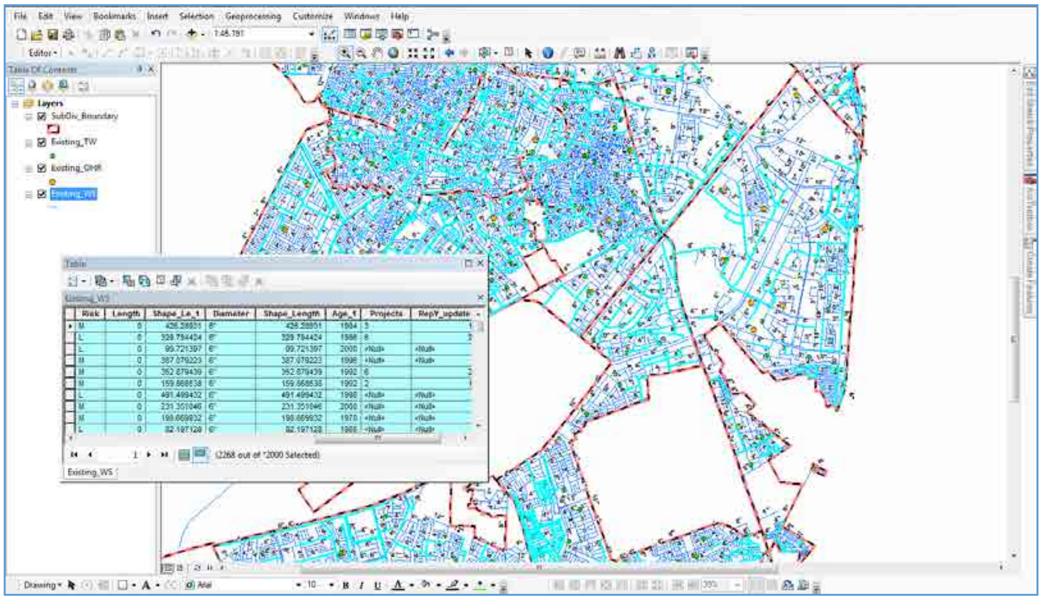


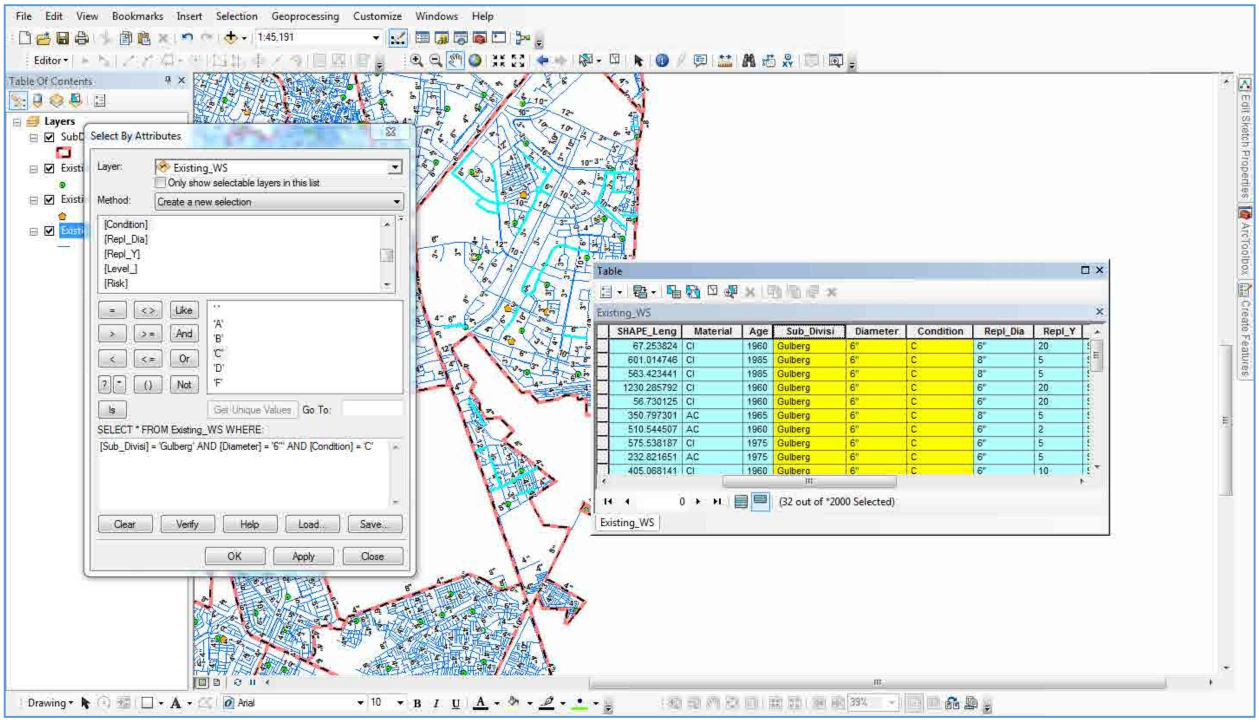
Figure 5.4. Highlighted Water Pipelines with Diameter 6'

❖ **Example-2:**

- In-order to select pipelines in Gulberg subdivision with diameter 6 with condition C on the basis of assets attribute information associated with spatial feature class, following query function is applied.

  [Sub_Divisi] = 'Gulberg' AND [Diameter] = '6"' AND [Condition] = 'C'.

- The result of above query is shown below.



SHAPE_Leng	Material	Age	Sub_Divisi	Diameter	Condition	Repl_Dia	Repl_Y
67.253824	CI	1960	Gulberg	6"	C	6"	20
601.014746	CI	1985	Gulberg	6"	C	8"	5
563.423441	CI	1985	Gulberg	6"	C	8"	5
1230.285792	CI	1960	Gulberg	6"	C	6"	20
56.730125	CI	1960	Gulberg	6"	C	6"	20
350.797301	AC	1965	Gulberg	6"	C	8"	5
510.544507	AC	1960	Gulberg	6"	C	6"	2
575.538187	CI	1975	Gulberg	6"	C	6"	5
232.821651	AC	1975	Gulberg	6"	C	6"	5
405.068141	CI	1960	Gulberg	6"	C	6"	10

Figure 5.5. Highlighted Pipelines with diameter 6 with condition C in Gulberg Sub-Division

5.1.2. Calculating Lengths of Pipelines

For the calculation of length a new field "length" is required in order to calculate the length of selected pipelines with diameter 6 inches in the attribute information.

- In-order to add the attribute data in a new field/column, add a new field to attribute table of Existing_WS feature class.
- Open the attribute table and click on the pull down button in the top left of the table, then click 'add field' as shown in figure.

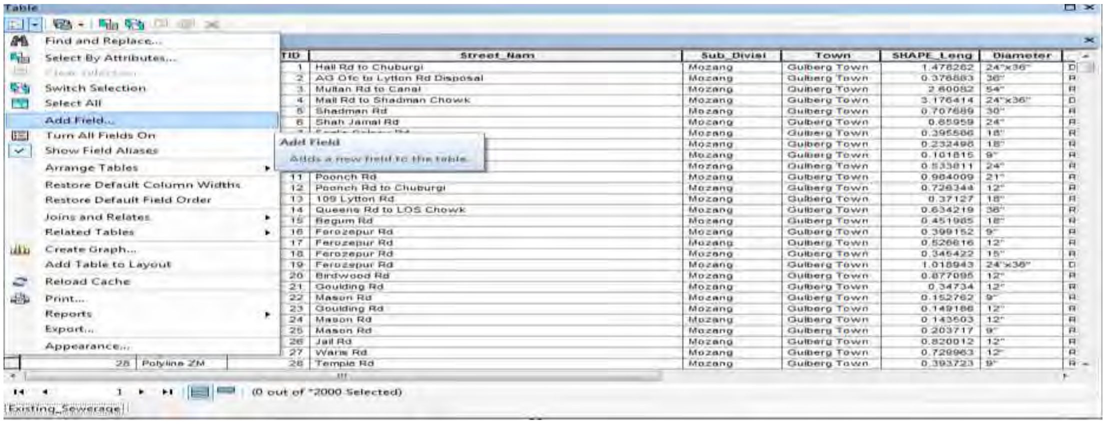


Figure 5.6.Add Field in attribute table

- “Add Field” dialog box is opened as shown in figure 5.6.
- Add the name of the field/column as ‘length’ and select ‘double’ from drown down list of type and click ok as shown in figure 5.7. There are many different data field types and carefully add that type which is most appropriate for your data. Here field type double is selected, because the length contains decimal values for more precision.

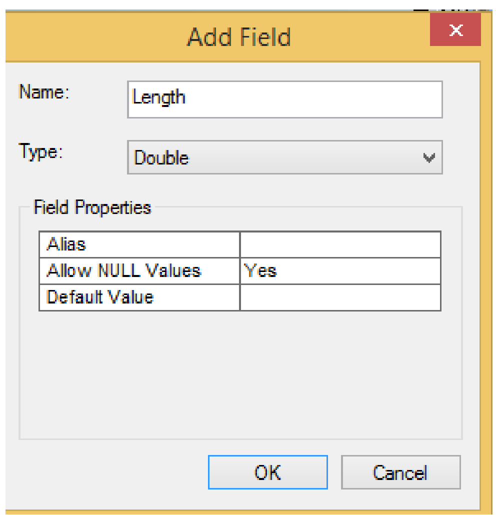


Figure 5.7.Add Field

- The new field is highlighted in the attribute table which contains “Null” values.
- Right click on that length field and click on calculate geometry as shown in figure 5.8.

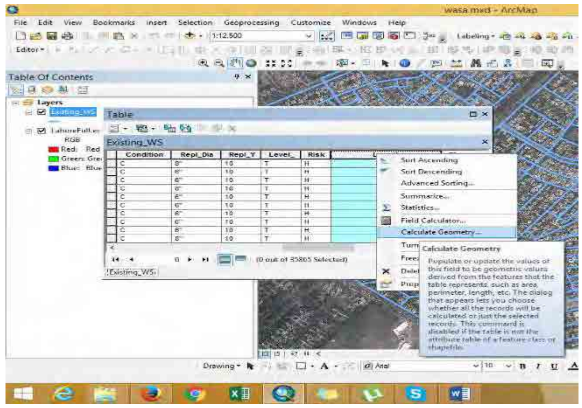


Figure 5.8.Calculate Geometry tab

- Calculate Geometry window is opened as shown in figure 5.9.

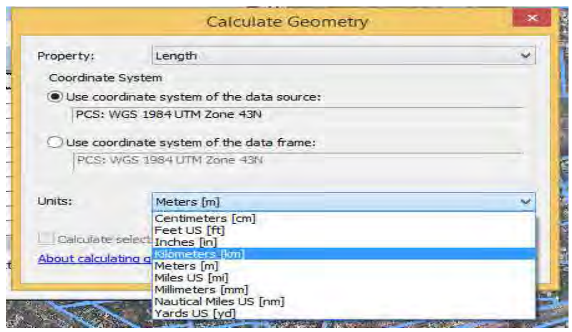
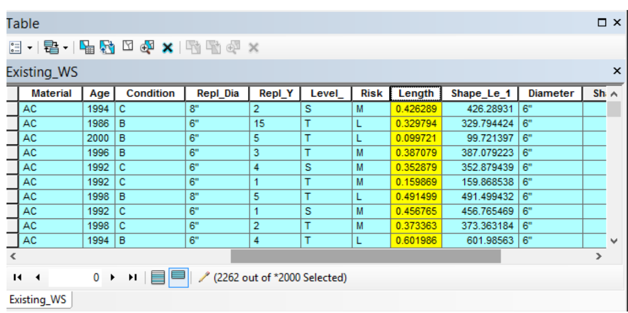


Figure 5.9. Calculate Geometry Window

- Select kilometer (m) from the drop down list of Units and click ok. It takes a few time and the length of water supply is calculated as shown in figure 5.10.



Table

Existing_WS

Material	Age	Condition	Repl_Dia	Repl_Y	Level_	Risk	Length	Shape_Le_1	Diameter	Sh
AC	1994	C	8"	2	S	M	0.426289	426.28931	6"	
AC	1986	B	6"	15	T	L	0.329794	329.794424	6"	
AC	2000	B	6"	5	T	L	0.099721	99.721397	6"	
AC	1996	B	6"	3	T	M	0.387079	387.079223	6"	
AC	1992	C	6"	4	S	M	0.352879	352.879439	6"	
AC	1992	C	6"	1	T	M	0.159869	159.868538	6"	
AC	1998	B	8"	5	T	L	0.491499	491.499432	6"	
AC	1992	C	6"	1	S	M	0.456765	456.765469	6"	
AC	1998	C	6"	2	T	M	0.373363	373.363184	6"	
AC	1994	B	6"	4	T	L	0.601986	601.98563	6"	

(2262 out of *2000 Selected)

Existing_WS

Figure 5.10. After Length Calculation

Note that in order to calculate length or area, the feature class must have projected coordinate system.

Statistics calculate only integer values and not calculate the text values. So be careful about the field entries of spatial feature class. In-order to calculate the statistics right-click the field “length” in attribute table of spatial feature class and click the tab “statistics” as shown in figure 5.11.

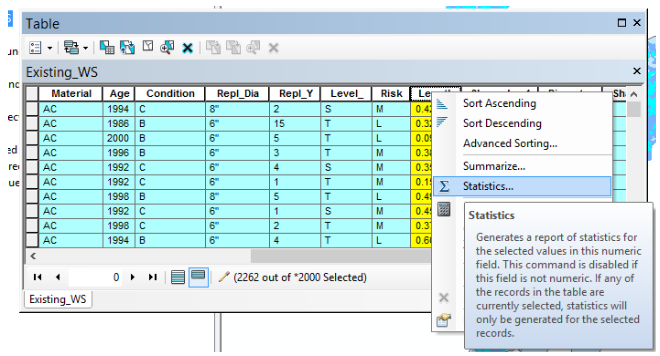


Figure 5.11.Accessing of Statistics tab

- The statistics of water supply Length of Gulberg sub-division is shown in figure 5.12.

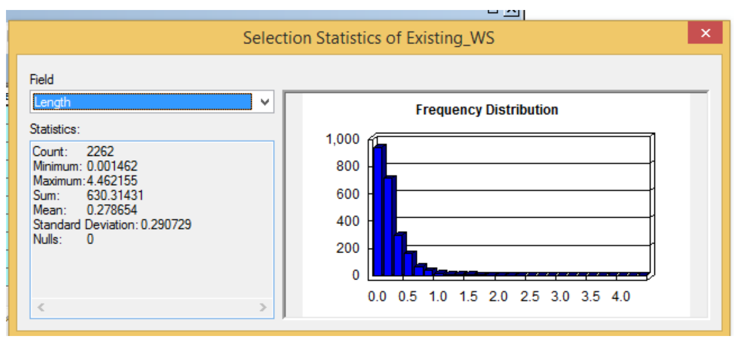


Figure 5.12. Statistics Window

- The statistics window shows the following information;

Selected Field: Length
Count: 2262
Minimum: 0.001462
Maximum: 4.462155
Sum: 630.31431
Mean: 0.278654
Standard Deviation: 0.290729
Nulls: 0

- The frequency distribution bar chart represents the distribution of values graphically is shown in figure 5.12.
- The statistics of other filed can also be calculated by choosing field directly in the statistics window.

6. Topic Information

Course Title: Asset Management	Course Code: M 4131
Module Title: Use of GIS Application in Asset Management	Module No: 6
Lecture Topics: Preparation of water and sewerage network maps with scale 1:500 & 1:1000 • Layout setting • Adding Map essentials • Creating map of water supply system e.g., Gulberg Subdivision • Scale setting • Exporting map • Printing	Lecture Duration: Three Hours

6.1. Preparation of Water and Sewerage Maps with Scale 1:500 & 1:1000

Lecture 6, Preparation of water and sewerage network maps with scale 1:500 & 1:1000 of assets covers the sub-topics; layout setting, adding map essentials, creating map of water supply system, scale setting, exporting map and printing related to WASA under module 6 “use of GIS applications in assets management”. This lecture consists of practical work and practical assignment. The demonstration and practices regarding preparation of water and sewerage network maps with scale 1:500 & 1:1000 are made in the lab activity. The existing GIS data related to assets is used for this activity.

Lecture 6 is formulated in strengthening the practical skills in preparation of water & sewerage maps with different scales by using ArcGIS to course participants. After completion of lecture 6; the course participant will be familiar about practical skills regarding the map preparation of assets with different scales.

Map is the important element of GIS and is the key type of GIS functions. So the decision make use this map and perform decision making. So in-order to map preparation, the audience who will use this map and what should be the information in that map is very important.

The explanation of the sub-topics are given as;

6.1.1. Layout Setting

ArcGIS 10.2 version is used for layout setting regarding map preparation in ArcMap. A page layout (often referred to as a layout) in ArcMap is a collection of map elements organized on a virtual page, designed for map printing. Common map elements that are arranged in the layout include one or more data frames (each containing an ordered set of map layers), a scale bar, north arrow, map title, descriptive text, and a symbol legend.

- To open the ArcMap software, click on the "Start" button in "Window Task Bar" then navigate to the ArcMap shortcut.
- Click on "Add Data" button. In the open dialog, navigate to the folder "C\:GIS Training\Exercise" to add the asset GIS data.
- Locate the required vector files from the list of personal database and add them all at once by holding the Ctrl or Shift button while clicking on each selection. Here we add the following data by using the Lahore WASA personel database "WASA-Lhr.mdb";

  ✓ *The SubDiv_Boundary City of Lahore*
  ✓ *All Valves in the SubDiv_Boundary*
  ✓ *Existing_WS*
  ✓ *Existing _TW*
  ✓ *Existing _OHR*

- When the data is loaded, all files will be listed in the left pane, called the table of Contents. The geographic features (contents) are displayed in the main data frame window.

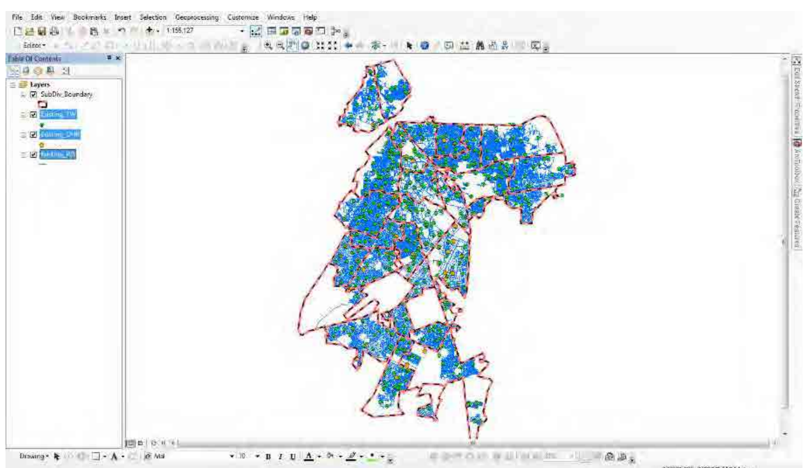


Figure 6.1. After Data added in ArcMap

- In-order to selection of data only Gulberg Subdivision, Lahore, go to layer properties of sub-division boundary and select definition query tab and select write [Name] = 'Gulberg"' in query window.

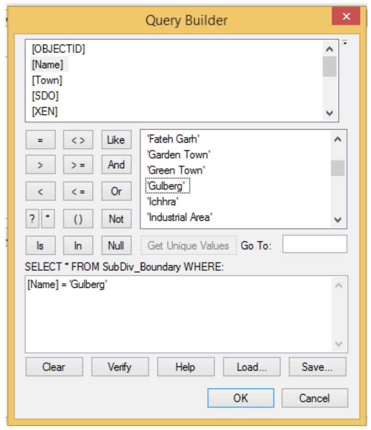


Figure 6.2. Definition Query

- To define the size and scale of map, Click "File" on ArcMap and Click Page and Print setup.

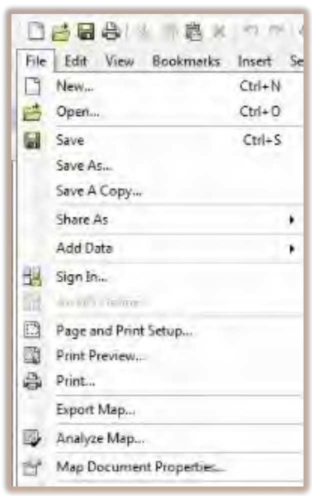


Figure 6.3. Print and page setup

- A page and print setup window is opened and select size A3.

- A land scape layout with printer setting is added to the layout view.
- Click "View" tab on ArcMap   and select layout View.

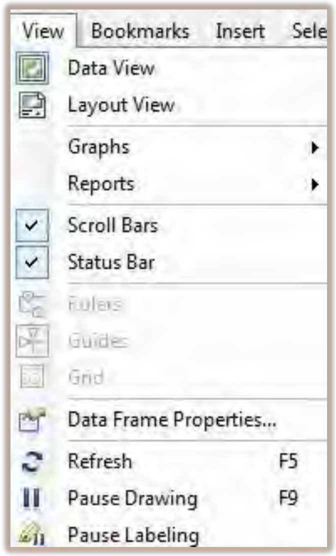


Figure 6.4. Setting Layout View

- Set the map template.
- Set color symbology after categorizing the symbols of assets vector layers and set also size and labeling style of the all the layers.

6.1.2. Adding Map essentials

- Click Insert option and insert map elements (Title, North Arrow, Logo, Scale, Legend, etc.).

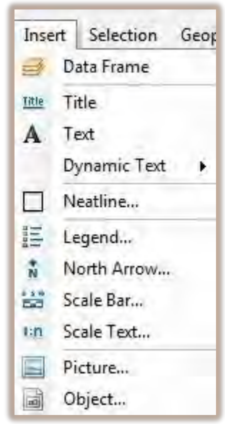


Figure 6.5. Insert Option for map elements

- Double click on the title string.
- Click “Insert” option and enter title after double click on title string.
- A title properties window is opened and write name as Water Supply System Gulberg Subdivision and click ok.

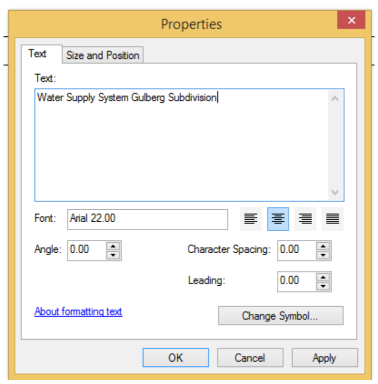


Figure 6.6. Title properties

- Click “Insert” option and select north arrow from “north arrow selector” window.

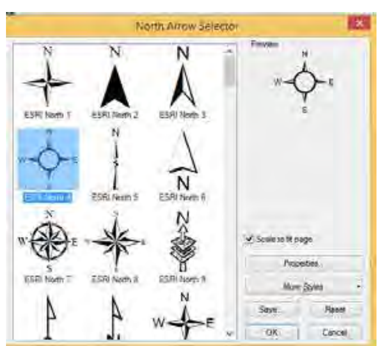


Figure 6.7. North Arrow Selector

6.1.3. Scale Setting

- Click “Insert” option and select scale bar.
- The scale bar is selected from “scale bar selector” window.

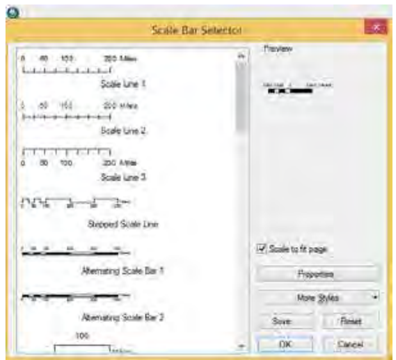


Figure 6.8. Scale Bar Selector

- Click “Insert” option and select scale text from “scale text selector” window. For the preparation of map 1:1000 map a scale is adjusted in scale window in ArcMap.

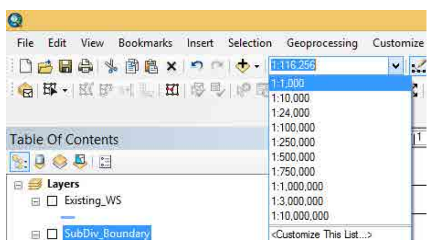


Figure 6.9. Scale Setting

- Zoom in, zoom out and pan tools in layout view tool is also used for adjustment of map elements and scale.

Figure 6.10. Layout Tools

6.1.4. Creating and exporting map of water supply system e.g., Gulberg Subdivision

- Go to file and select export map.

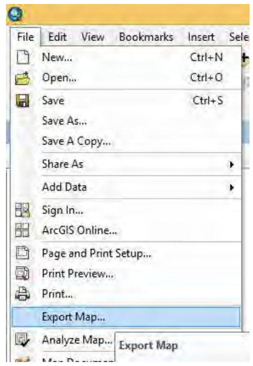


Figure 6.11. Export Map

- Export map window is opened, select path, file name, resolution and format as JPG and then save it.

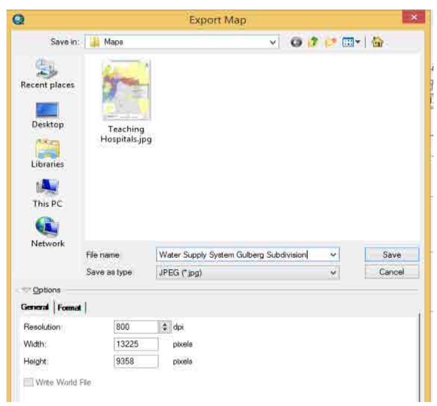


Figure 6.12. Export map windo

- The water supply system Gulberg Subdivision is ready as shown in figure.

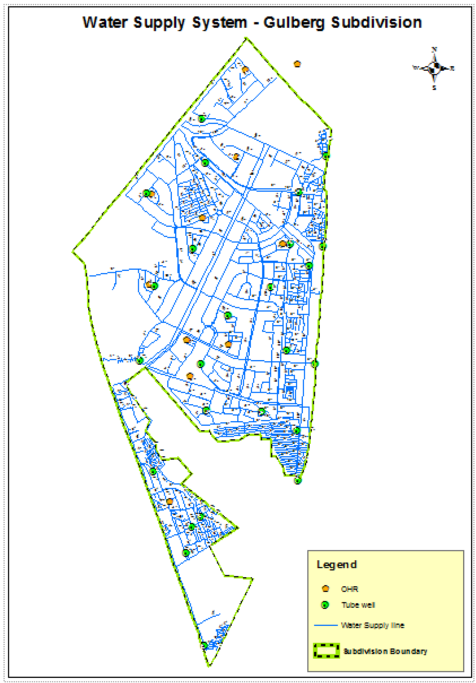


Figure 6.13. Water Supply System Gulberg Subdivision

6.1.5. Printing

The water supply system of Gulberg subdivision is ready for printing and decision maker can use for decison making.

Lecture No. 7

7. Topic Information

Course Title: Asset Management	Course Code: M 4131
Module Title: Use of GIS Application in Asset Management	Module No: 6
Lecture Topics: Field Verification Survey • Introduction to Global Positioning System (GPS) • Use of GPS Device • Assets data collection with GPS • Tracking Pipeline • Synchronization of GPS data with ArcGIS • Map Making	Lecture Duration: Six Hours

7.1. Field Verification Survey

Lecture 7 study of field verification survey, covers the sub-topics; ; introduction to GPS, use of GPS device, assets data collection with GPS, tracking pipelines, synchronization of GPS data with ArcGIS 10.2 and map making related to WASA assets under module 6 "use of GIS applications in assets management". This lecture consists of practical work and practical assignment. The demonstration and practices regarding field verification by using GPS device and ArcGIS is covered in strengthening the practical skills of course participants. The surveyed data is used for the upgradation of existing GIS data of assets, classified on the basis of their attributes associated with spatial features and prepared a map in the lab activity.

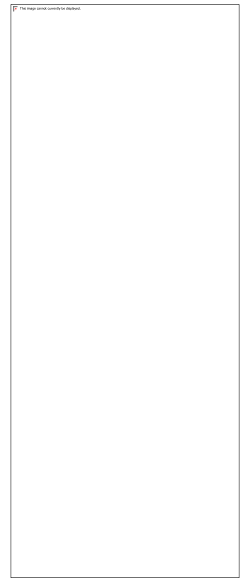
Lecture 7 is formulated in strengthening the practical skills regarding GPS usage, data collection from field survey, synchronization of GPS data with ArcGIS feature classes and map preparation using ArcGIS and GPS receiver to course participants. After completion of lecture 7; the course participant will be familiar about practical skills regarding the field verification survey and modification of existing GIS data of assets.

The explanation of the sub-topics are given as;

7.1.1. Introduction to GPS

GPS is the device which is used as data sources in GIS. It is used for data collection of WASA assets from the field to ascertain the positional accuracy of the ground features and also used for the verification of the assets data.

- Garmin GPS 60 is used for the field verification survey of Gulberg Subdivision as shown in figure 1.



7.1.2. Use of GPS Device

The survey teams are formulated on the basis of that each team consists of two members. GPSs are issued with batteries to all survey teams and areas of interest (AOI) for field survey is allotted to each team.

After the training of survey teams regarding the use of GPS receiver, the teams will be deputed for the data collection of assets in Gulberg subdivision of Lahore.

Figure 7.4.GPS Receiver

Use following steps during the field survey;

- Installed the batteries in the GPS and turn on the GPS by pressing turn on button.

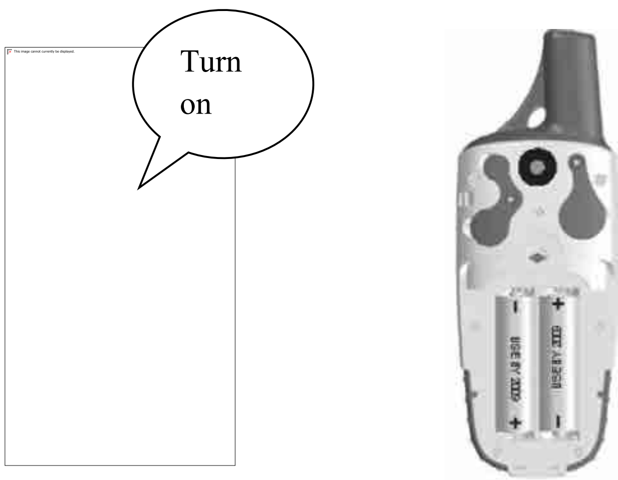


Figure 7.2. Turning on GPS and Installation of Batteries

- After pressing the menu button, the main window of GPS is given as.

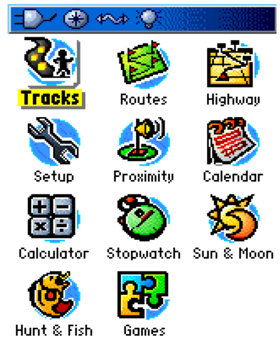


Figure 7.3. Accessing of Menu on GPS

- Set the GPS units as WGS84 by using setup on main window.
- In-order to mark the location of assets check the satellite signal strength for accuracy and mark points when the maximum 4 signal strength is required.

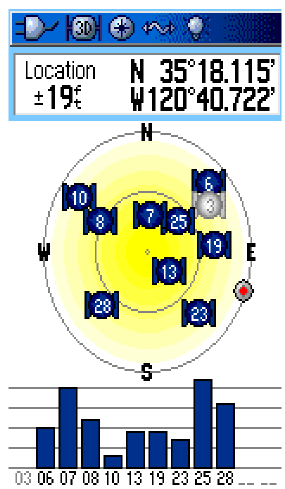


Figure 7.4. GPS Satellites

- Mark Current location of assets by press and hold mark and select mark way points.

Figure 7.5.Marking waypoints

- Note GPS location on the notebook also, because during the field GPS may be damage so your note book will be beneficial in that case.
- Save the location by writing the GPS point name and click ok.

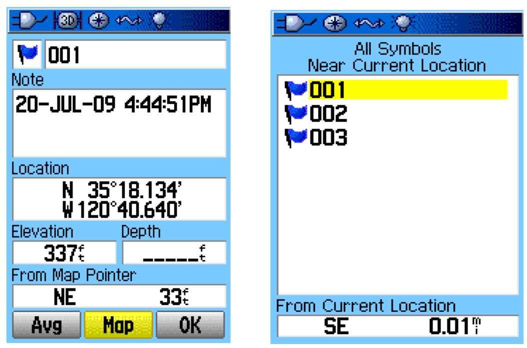


Figure 7.6.Saving of GPS Location

- The GPS saved locations/waypoints can be deleted or edited.
- In order to view saved points go to list where the waypoints saved and go to map window.

Figure 7.8.Map Viewer on GPS

- GPS has the facility to keep track record on GPS during the field survey. So on the GPS track during the field.

7.1.3. Assets data collection with GPS

Survey teams record the location of main holes and sewerage pipe line (start & end location). The survey team also identify the sewerage problems during field survey and highlighted that information on the provided map.

Take at least 10 to 20 GPS locations from the field.

7.1.4. Synchronization of GPS data with ArcGIS

After the field survey the GPS data is downloaded on work station and synchronized the data with existing GIS data of assets.

- GPS is connected with the computer via GPS cable.

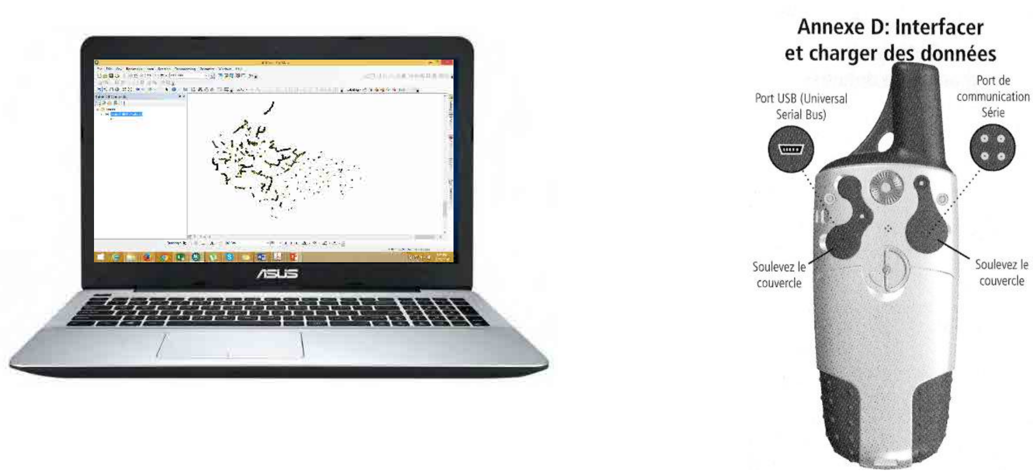


Figure 7.9. GPS connection with Laptop

- Turn on your GPS.
- Start new ArcMap and click ArcToolbox.

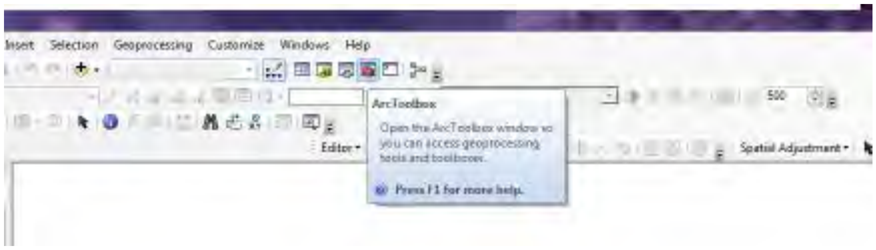


Figure 7.10. Accessing of ArcToolbox

- Go to conversion tools in ArcToolbox, select from GPS and click on GPx to features.

Figure 7.11. Assessing of GPX to features tool

- GPx to features window is opened and GPX file is given in input GPX file and set the path of output fearutes class.

Figure 7.12. GPx to features window

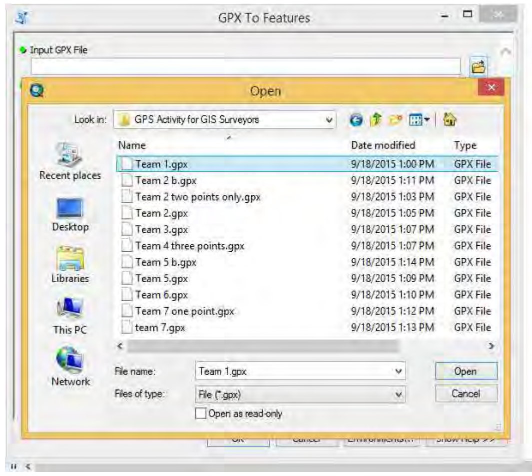


Figure 7.13. Accessing of GPx file

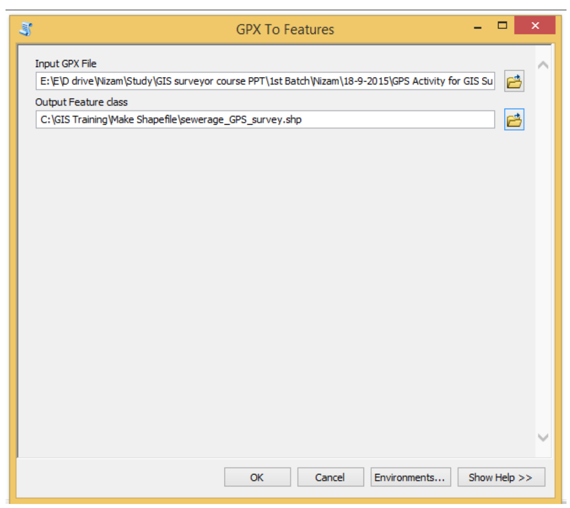


Figure 7.14. Saving the path of feature class

- After few seconds the process runs in ArcMap and convert that GPx file into point feature class.
- Then open that converted feature class in ArcMap esiting document.

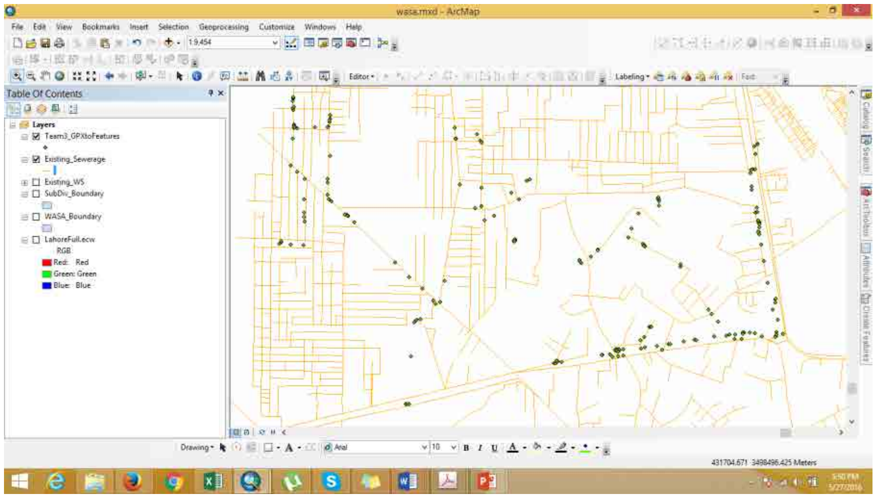


Figure 7.15. Opening of GPS converted data

- Edit the sewerage data as per surveyed data and save the edits.

7.1.5. Map Making

Now the asset data is updated in ArcMap after the field verification and the final map of sewerage system Gulberg subdivision is prepared after adding the map essentials.

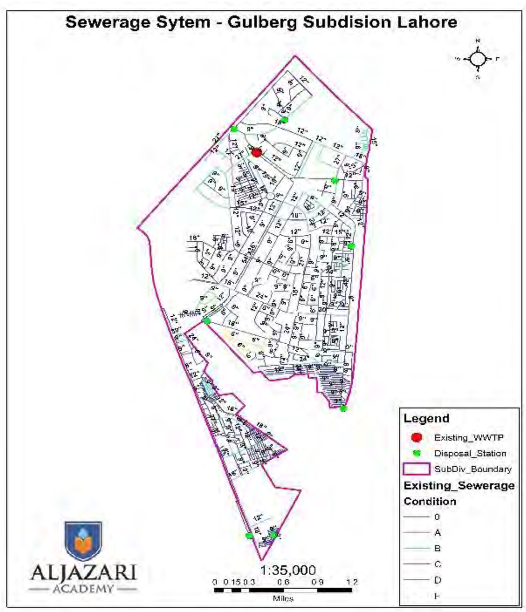


Figure 7.16. Final Map of Sewerage system – Gulberg Subdivision

Introduction to GIS/ArcGIS Software & Data Editing/Assets Data Browsing and Classification

Nizam-ud-Din
Sr. Instructor GIS
Al-Jazari Water & Sanitation Academy
Township, Lahore

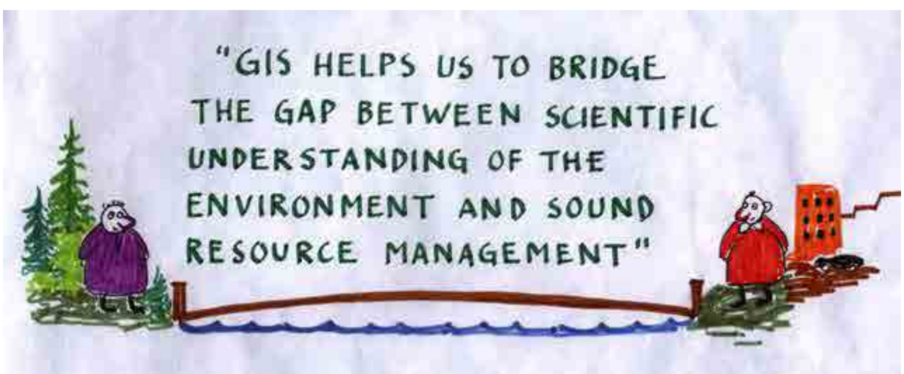
ALJAZARI ACADEMY

Outline

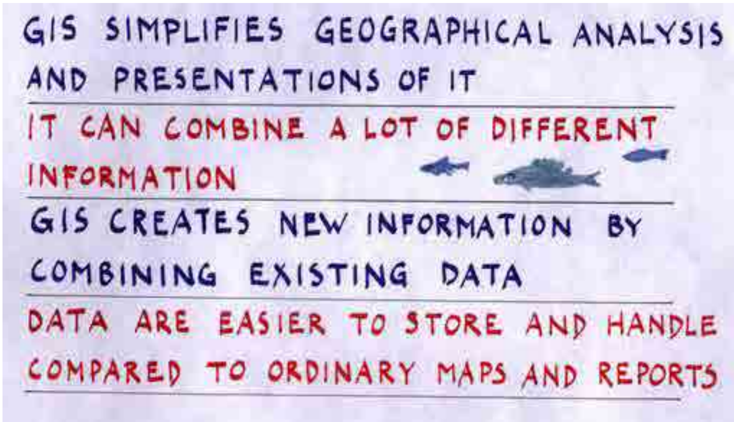
- ❖Introduction to GIS
- ❖GIS Applications in Context to WASA Assets
- ❖Introduction to ArcGIS **(Demonstration)**
- ❖Assets Data Editing **(Demonstration)**
- ❖Assets Data Browsing and Classification **(Demonstration)**

ALJAZARI ACADEMY

GIS



Why GIS?



GIS for Asset Management

- GIS is a tool that can provide information regarding the asset to help answers questions.
- GIS solutions for asset management include the process for storing, managing and accessing spatial data.

Asset Management	Planning & Analysis	Field Mobility	Operational Awareness	Constituent Engagement
Collect, organize & exchange Data	Transform data into actionable information	Get information into & out of the field	Disseminate information where and when it is needed	Get feedback & make informed decision

Complete and Integrated Workflows and Systems

Statistics have shown

Over 80% of information used by government has a spatial component i.e. information about where something is located or where something is happening.

Importance of GIS

GIS is used as tool for the mapping of asset because; it gives answers the following;

- ❖Location: Where specific asset (pipelines, tube well etc.) is?
- ❖Condition: Status of assets (pipelines, tube well etc.)?
- ❖Trends: What has changed since...?
- ❖Patterns: What spatial patterns exist?
- ❖Modeling: What if…?

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GIS-Definitions

- The common ground between information processing and the many fields using spatial analysis techniques. (Tomlinson, 1972)
- A powerful set of tools for collecting, storing, retrieving, transforming, and displaying spatial data from the real world. (Burroughs, 1986)
- A computerized database management system for the capture, storage, retrieval, analysis and display of spatial (locationally defined) data. (NCGIA, 1987)
- A decision support system involving the integration of spatially referenced data in a problem solving environment. (Cowen, 1988)

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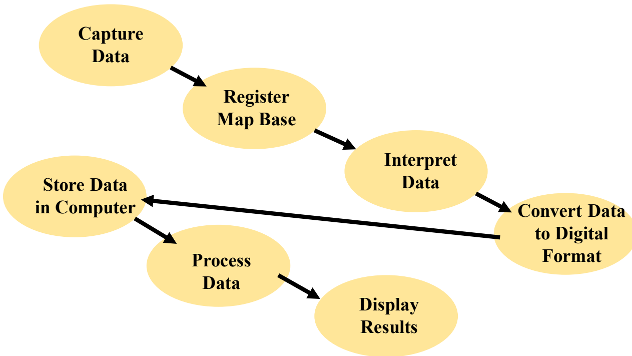
Components of GIS

GIS Process includes a complete exercise



GIS Capabilities

- **Integration of data-** Non-spatial data (statistical, texts data) is integrated with spatial data features.
- **Data capture/input-** by digitizing, scanning, or direct coordinate entry, edition of data, labelling of data in the output map.
- **Management-** Linking of attribute with spatial features, linking of external databases, import and export from other than GIS format.
- **Manipulation-**make maps from different sources compatible so that they can be drawn on top of each other.
- **Spatial analysis-** deals with spatial queries and proximity analysis, geocoding and network operations.
- **Modelling-** identify or predict a process that has created or will create a certain spatial pattern, diffusion (how is the epidemic spreading in the province?), interaction (where do people migrate to?), what if scenarios (if the dam is built, how many people will be displaced?).
- **Display/output-** visualization of pattern and identification anomalies to compare information in map space and data space.

Data vs. Information

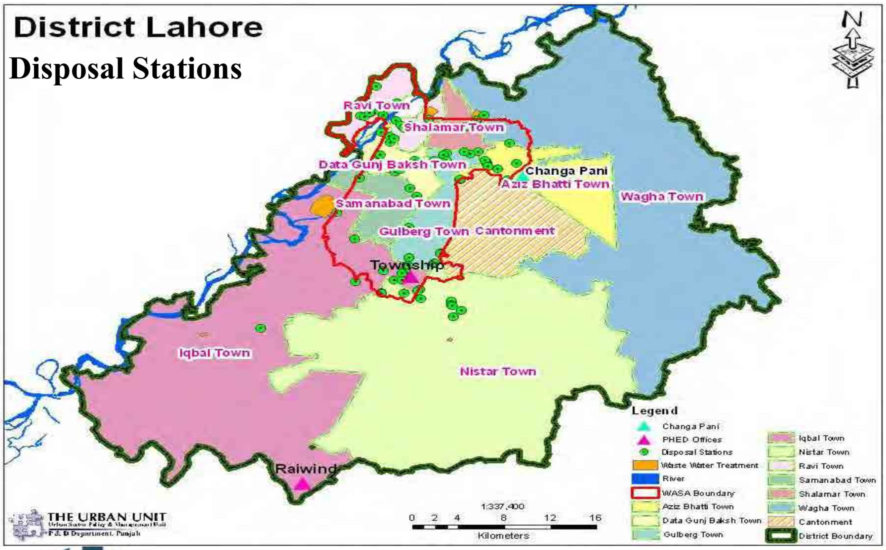
Data, by itself, generally differs from information.

- ❖ **Data** is of little use unless it is transformed into information.
- ❖ **Information** is an answer to a question based on raw data.

GIS Applications in Context to WASA Assets

ALJAZARI ACADEMY

District Lahore
Disposal Stations



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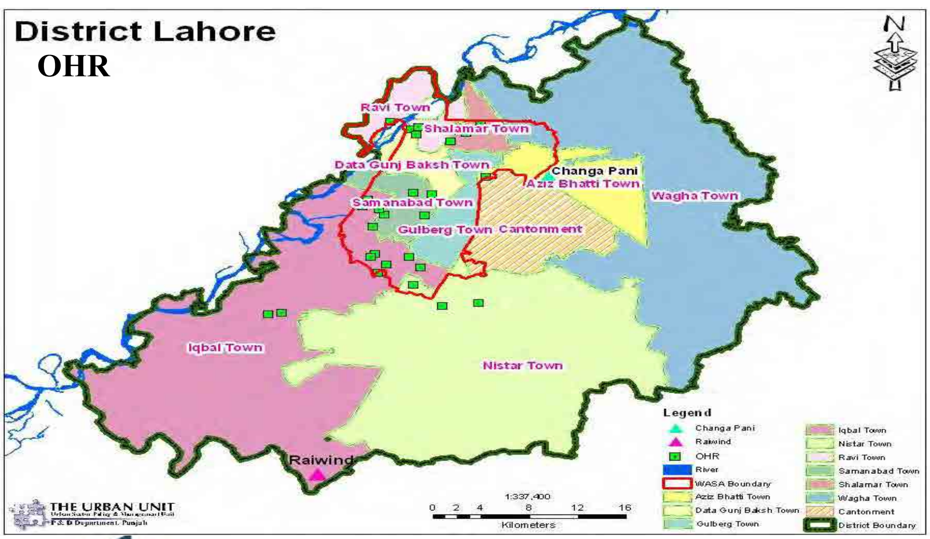
District Lahore
OHR



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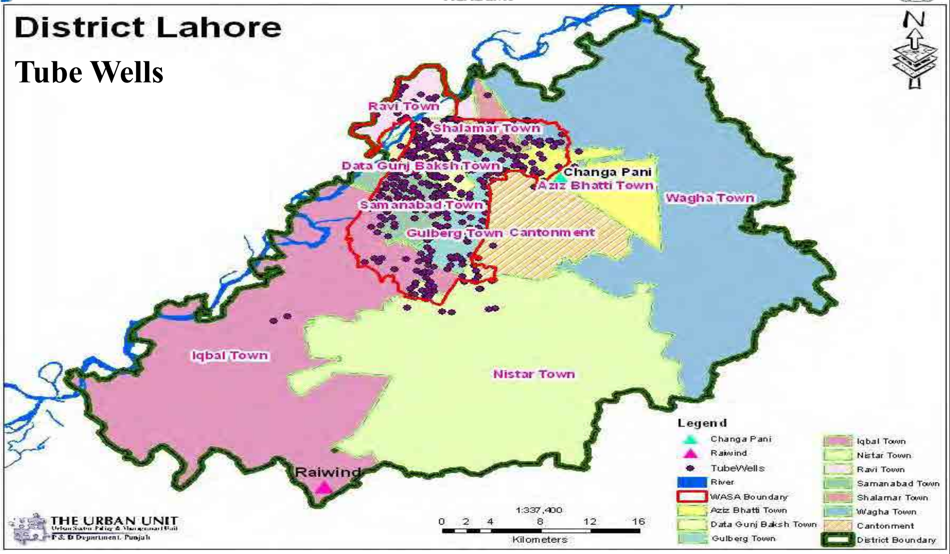

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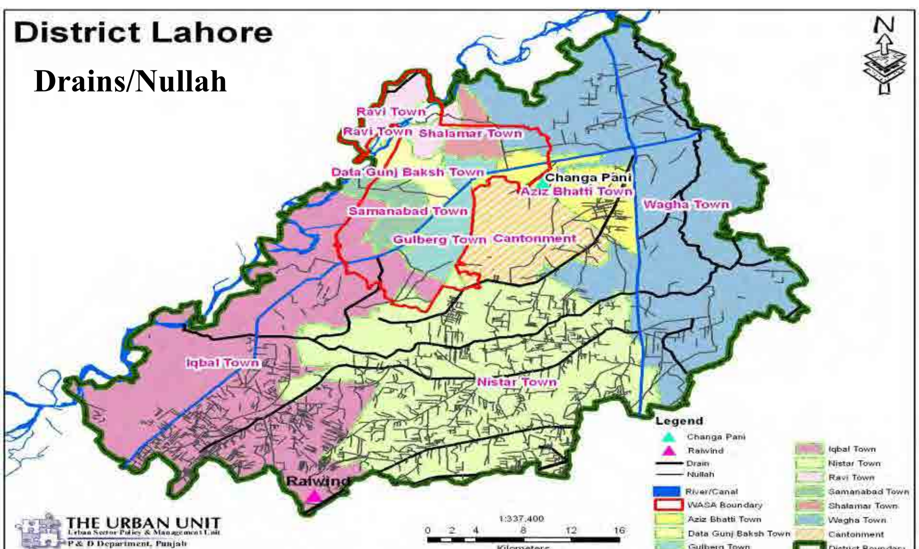
ALJAZARI ACADEMY



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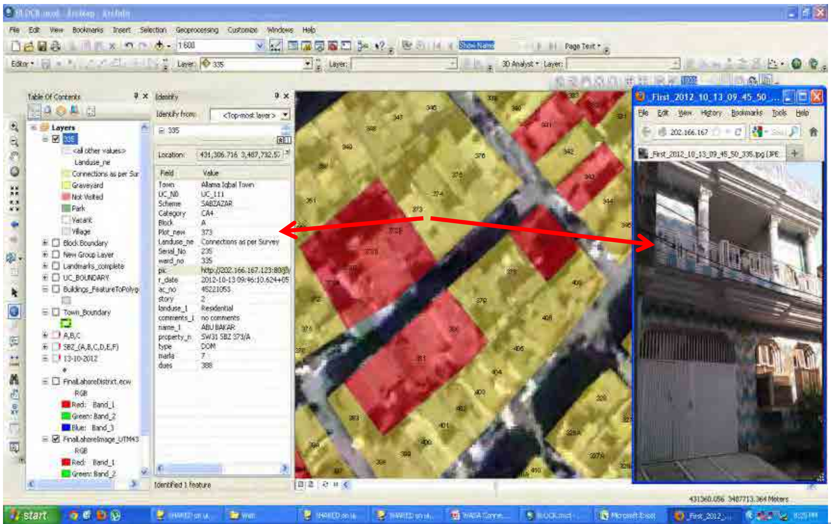


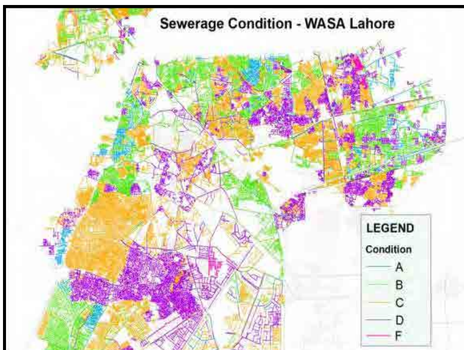
Green Town Office Space Subdivision Lahore

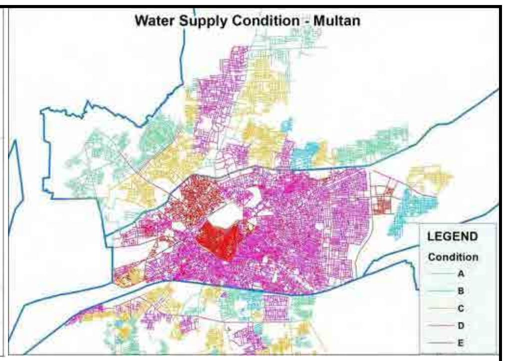
Sr.No.	Type	Area (Sq.ft.)	Area (Marla)
1	Wash Room	225.47	1.00
2	Complaint Center	228.82	1.02
3	Residence	1888.43	8.39
4	Residence	2492.77	11.08
5	Store	320.85	1.43
6	Masjid	602.12	2.68
7	Generator	349.97	1.56
8	Water Tank/Offices	4306.10	19.14
9	Store	68.68	0.31
10	Tube Well (Closed)	45.48	0.20
11	Open Space	59831.30	265.92

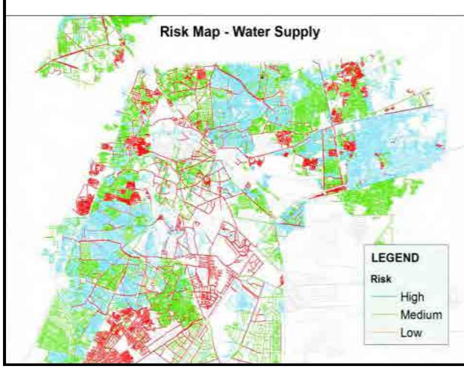
ALJAZARI ACADEMY

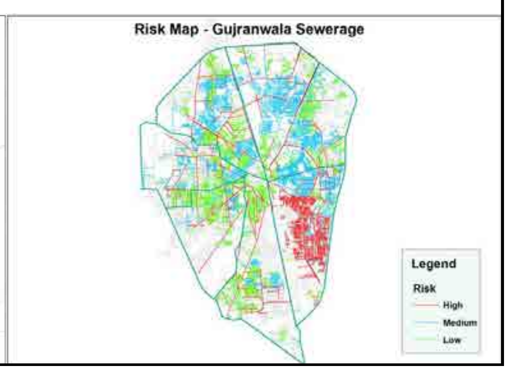
Utility Management WASA Lahore

Water Supply & /Sewerage Distribution Network
Allama Iqbal Sub-Division Lahore

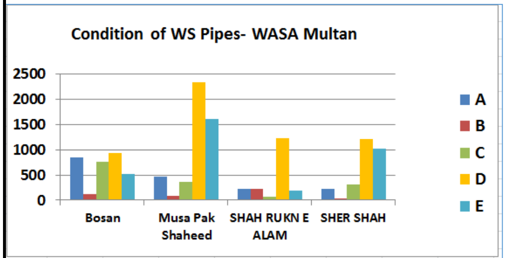


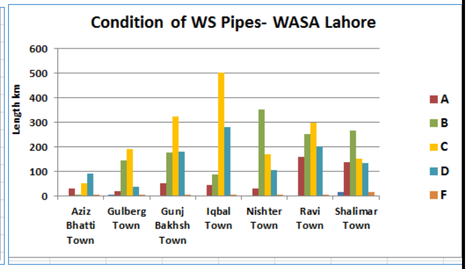


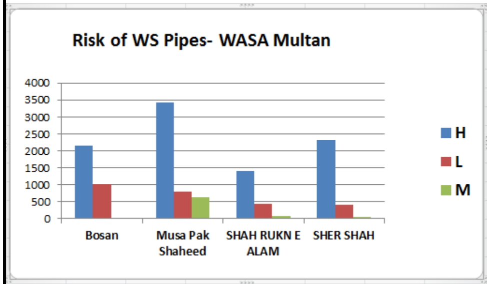


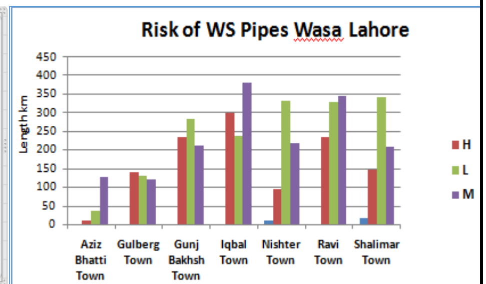


ALJAZARI ACADEMY









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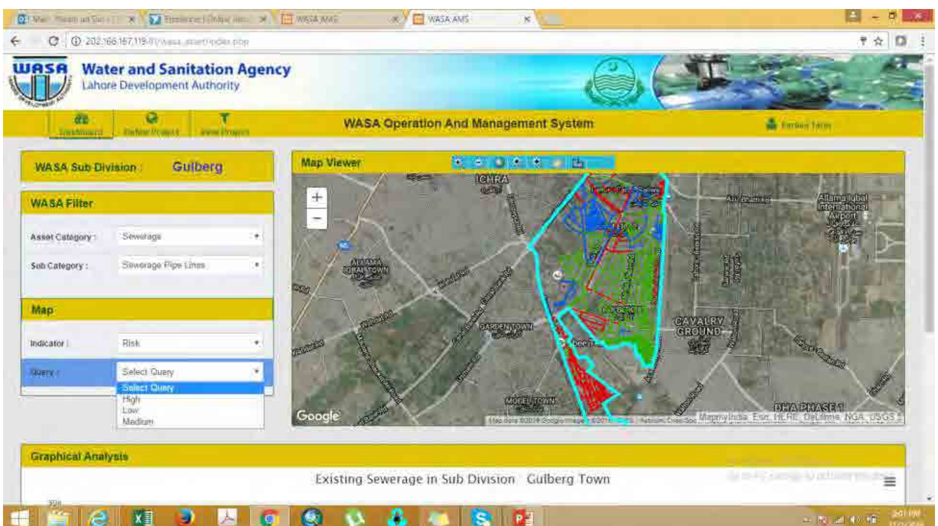
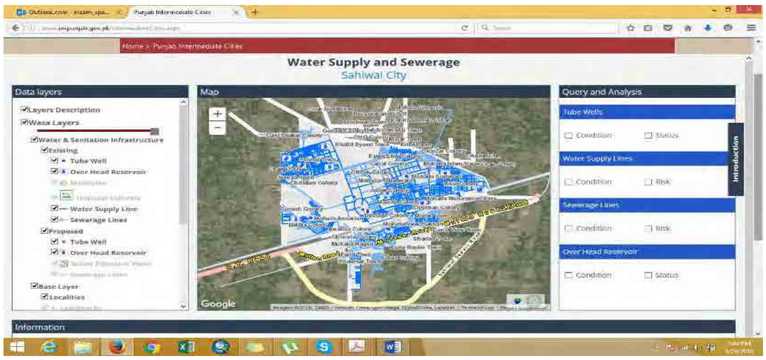


ALJAZARI ACADEMY

ALJAZARI ACADEMY

Water and Sewerage Network
Sialkot & Sahiwal City

http://www.irispunjab.gov.pk/IntermediateCities.aspx



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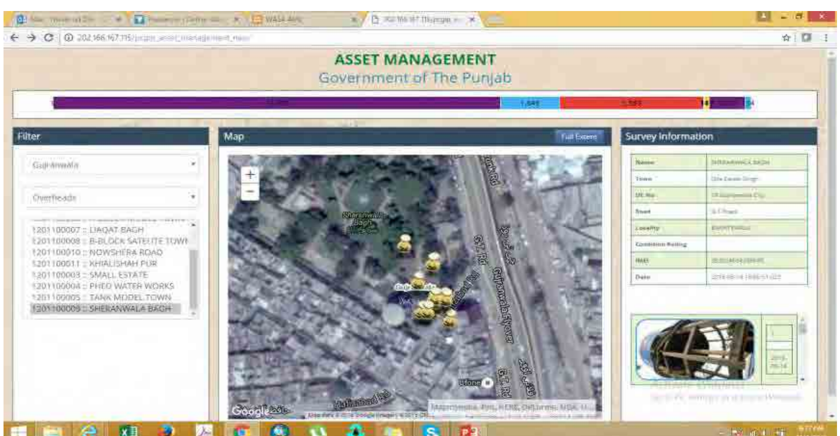
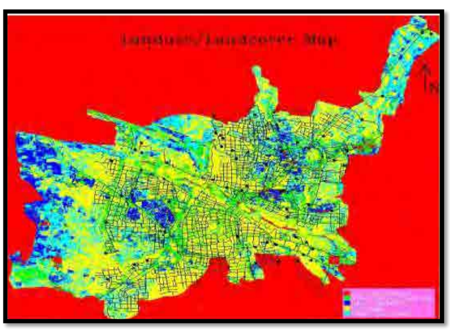
Asset management Information System (AMIS)

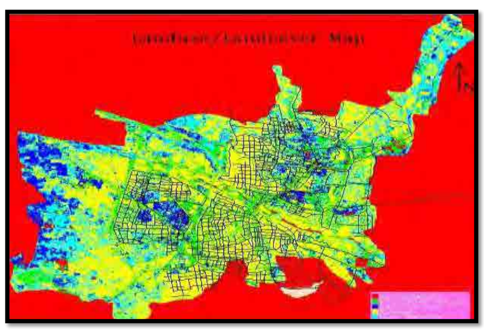
http://202.166.168.184:99/Common/Superadmin
http://202.166.167.115/pcgip_asset_management_new/



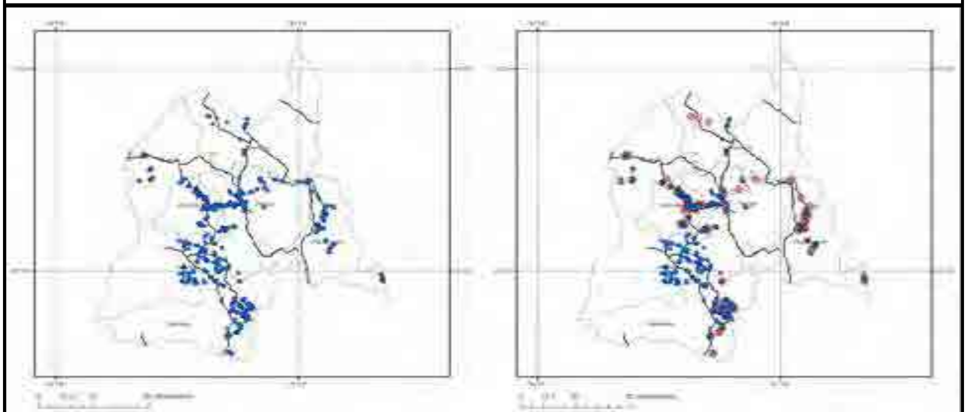
Case Study

Case Study-Water & Sewerage Network For Madurai Region India





Mapping of Water Supply and Sanitation (WSS) in Ethiopia- Concept Paper



- Water Supply Scheme (undivided)

- Developed water supply scheme
- Undeveloped water supply scheme
- No data

Water Supply GIS-Yokuhama Water-Japan Kokusai Kogyo Group

Work Site

About 40 worker

Skilled Person

Meeting

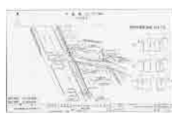
Mapping system

Retrieval & indication

Support for Water stoppage

Data Filling

Data Updating



Construction Map

Tracing

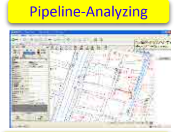
Overlay

Digital Tracing

Final Map

Mapping Sub Systems

Pipeline-Analyzing



Pipeline mapping IS

Construction mapping IS

North Sindh Urban Services Corporation (NSUSC)

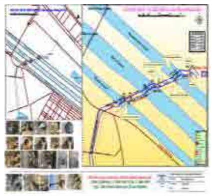
Water Supply- Khairpur

Drainage System-Sukkur

Moon Soon Flood Mapping

Storm Water Map

Drain Network-Khairpur



Repair 24" Dia Map Near Makka Sukkur

Proposed Sewerage Plan Sukkur

Water Supply Variation-mapping

Introduction to ArcGIS Software

(Demonstration)

Assets Data Editing

(Demonstration)

Data Browsing and Classification

(Demonstration)

Day 4

GIS Applications for Asset Management

Aneeqa Azeem
GIS Expert,
The Urban Unit

CONTENTS

- INTRODUCTION TO ARCGIS SOFTWARE
- ASSET DATA BROWSING AND CLASSIFICATION
- EDITING/UPDATING ASSET DATA
- REPLACEMENT PLANNING
- CREATING MAPS
- EXPORTING MAPS

Replacement Planning

- Query
- Prioritize pipelines
- Making Projects
- Costing

[Sub_Divisi] = 'Gulberg' AND [Diameter] = '6"' AND [Condition] = 'C'.

Exercise 1

Prepare a complete water supply system map of one subdivision with following layers:

- Water supply lines, Tubewell ,OHR

- Also add diameter label on lines and
- Names of point features

Exercise 2

Prepare a Sewerage map of one subdivision regarding first three years replacement plan,

a) label diameter

b) calculate lengths for year 1 ,2 and 3

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ACADEMY

Asset Management

Course Code: M4131

Asset Database Analysis
Module 3

Lecture Notes

2017

1. Lecture Information

Course Title: Asset Management	**Course Code**:
Module Title: Asset Database Analysis	**Module No**: 3
Lecture Topic : Asset Condition Analysis, Diameter base Analysis	**Lecture Duration:**4 Hours

2. Data Description

The terms used in the datasets are listed and defined below, for reference by the tutor as well as the CPs.

Asset condition

Asset condition explains the state of the asset in term of its physical, functional and performance based ranking. For example:

Rank	**Condition**	**Description**
A	Excellent	No noticeable defects. Some aging or wear may be visible.
B	Good	Only minor deterioration or defects are evident.
C	Fair	Some deterioration or defects are evident, but function is not significantly affected.
D	Poor	Serious deterioration in at least some portion of the structure. Function is inadequate.
F	Failed	No longer functional. General failure or complete failure of a major structural component.

Asset Risk

Risk is the probability of failure of the asset and is defined in term of High, Medium and Low:

H → High, M → Medium, L → low

Level

Level is classified in three classes; Primary level, secondary level and tertiary level. In the attribute table they will be shown as:

P → Primary, S → Secondary, T →Tertiary

Replacement Year

Replacement year indicates the remaining life of an asset and provide information on when an asset should be replaced. This is usually determined by the manufacturer and lead engineer, based in part on the service life and run time.

Replacement diameter

Replacement diameter means when a pipe has to be replaced, what should be its future diameter and also diameter reveals the information that whether it should be changed or should remain same.

3. Inventory of WASA Lahore Assets

Summary of WASA assets with help of pivot tables.

	Lahore	Gujranwala	Faisalabad	Multan	Rawalpindi
Tube wells	519	53	85	104	400
Water Pipelines (km)	4500	507	1436	1290	714
Disposal stations	99	22	22	20	-
Sewerage Pipeline (km)	3957	808	1760	1382	134

4. What is Pivot Table

Pivot tables are one of Excel's most powerful features.

A pivot table allows you to extract, summarize and explore data interactively from detailed data set. Building a pivot table is the process of answering questions you have about the data e.g.:

- ✓ What is total length of Pipes by Subdivision?
- ✓ What is the length of pipelines with 6" diameter?
- ✓ Once you create a pivot table, you can quickly transform huge numbers of rows and columns into a meaningful, nicely formatted report.

Different type of analysis related to assets can be performed using pivot tables. The following exercises will explain its functionality and benefits. First we'll perform analysis regarding assets condition.

Exercise 1: Condition Analysis

The following table shows Water supply pipes of Lahore. Please conduct your database analysis in a table and graph, using Pivot Table in the Excel.

1	Street_Name	Sub_Division	Town	Diameter	Material	Intallation	Conditi	placement_Dia	Replacement_Y	Level	Risk	hape_Length
2	main pecco road	Township	Nishter Town	10"	AC	2000	B	10"	11	P	M	1896.653919
3	Main pecco road	Township	Nishter Town	10"	AC	2011	B	10"	25	P	L	1915.949432
5		Township	Nishter Town	8"	AC	2000	B	8"	12	S	L	600.8450439
7		Township	Nishter Town	10"	AC	2010	B	10"	20	S	L	213.4052574
9	model town link road	Township	Nishter Town	8"	AC	2009	B	8"	20	S	L	444.5776576
10	R Block Model town	Township	Nishter Town	4"	AC	1994	B	4"	12	S	L	97.24220231
11	Karma_wala Bazar	Township	Nishter Town	6"	AC	1986	B	6"	15	T	L	329.7944242
15		Township	Nishter Town	12"	AC	1987	B	12"	15	T	L	478.8977818
16		Township	Nishter Town	8"	AC	1987	B	8"	15	P	L	1943.078345
17	extention	Township	Nishter Town	12"	AC	1987	B	12"	15	S	L	139.3136498
19	Extention	Township	Nishter Town	8"	AC	2000	B	8"	20	T	L	253.9458667
20	Extention	Township	Nishter Town	4"	AC	1992	B	4"	12	T	L	123.0487501
21	KHADAM PARK	Township	Nishter Town	4"	AC	1992	B	4"	12	T	L	110.4098695
22	R Block Model Town Extention	Township	Nishter Town	4"	PVC	1992	B	4"	12	T	L	199.2874524
23	R Block Model Town Extention	Township	Nishter Town	4"	AC	1992	B	4"	12	T	L	282.9811107
24	R Block Model Town Extention	Township	Nishter Town	4"	AC	1992	B	4"	12	T	L	105.9039282
25	R Block Model Town Extention	Township	Nishter Town	4"	AC	1992	B	4"	12	T	L	66.6975641
26	R Block Model Town Extention	Township	Nishter Town	4"	PVC	1992	B	4"	12	T	L	107.4636598
27	Khadam Park near Itefaq Cricket Ground	Township	Nishter Town	8"	AC	2000	B	8"	16	P	L	277.9007928
28	R Block Model Town Extention	Township	Nishter Town	4"	AC	1992	B	4"	12	T	L	73.52308128
31	Q Block Model Colony	Township	Nishter Town	4"	AC	1987	B	4"	20	T	L	245.8719307
32	Q Block Model Colony	Township	Nishter Town	4"	AC	1974	B	4"	20	T	L	102.1487785
33	Q Block Model Colony	Township	Nishter Town	4"	AC	1974	B	4"	20	T	L	213.0720068
34	Q Block Model Colony	Township	Nishter Town	4"	AC	1974	B	4"	20	T	L	240.9920837
35	Q Block Model Colony	Township	Nishter Town	4"	AC	1974	B	4"	20	T	L	116.8837562
36	Q Block Model Colony	Township	Nishter Town	4"	AC	1974	B	4"	20	T	L	210.3503903
37	Q Block Model Colony	Township	Nishter Town	4"	AC	1974	B	4"	20	T	L	210.8930082
38	Q Block Model Colony	Township	Nishter Town	4"	AC	1974	B	4"	20	T	L	71.49516675

Figure 1: Water supply pipes data of Lahore

For Creating pivot tables do the following steps:

1. Select the data you want to analyze,
2. Then go to Insert and click on "Pivot Table"
3. Choose "New Work Sheet" for the Pivot table to be placed

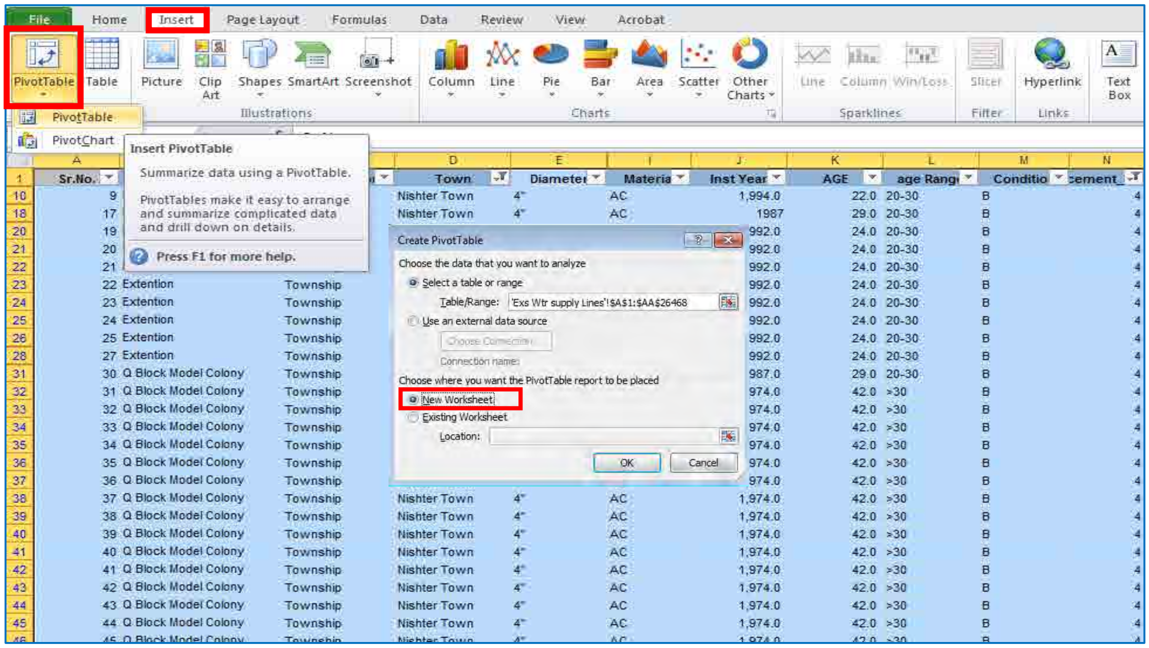
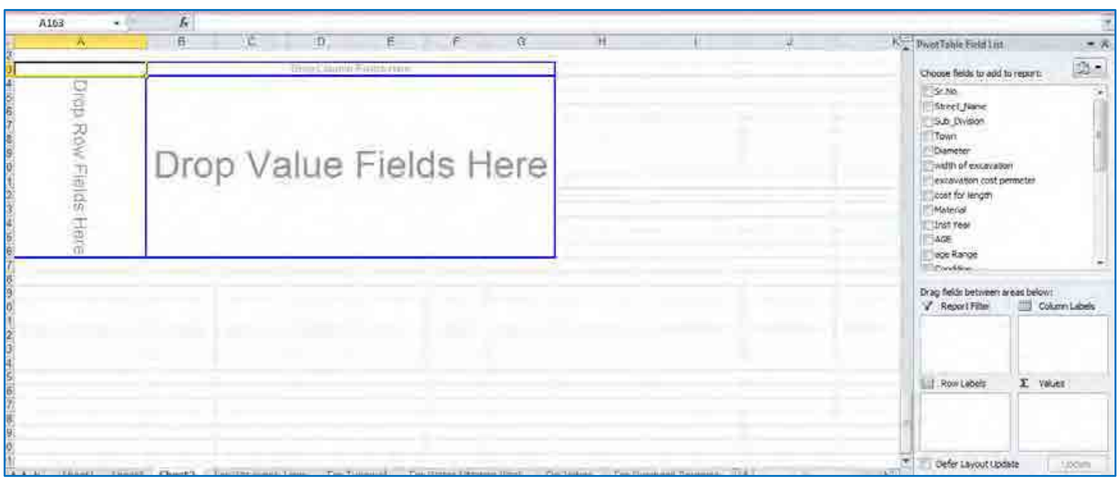


Figure 2: Creating Pivot Table



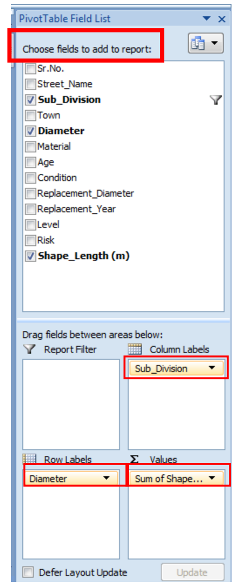
Exercise1-1: Condition of Pipelines (m) on town level

For creating the condition of pipeline table on town level follows the steps in “Pivot table Filed List”

1. Drag the Sub_division field and drop to “**Column labels**”
2. Drag the diameter field and drop to “**Row Labels**”
3. Drag and drop the length field to **“∑ Values”**

Town	A	B	C	D	F	Grand Total
Aziz Bhatti Town	28063	4601	50987	90828	190	174669
Gulberg Town	19464	142638	190013	38620	3113	394237
Gunj Bakhsh Town	50247	176774	322865	180271	22	730178
Iqbal Town	44302	88379	501957	277390	2828	914856
Nishter Town	30690	350795	169589	104291	2415	657779
Ravi Town	157818	250400	299473	201094	2637	911422
Shalimar Town	137574	265308	150241	133932	15492	718371
Grand Total	468158	1278895	1685124	1026427	26696	4501514

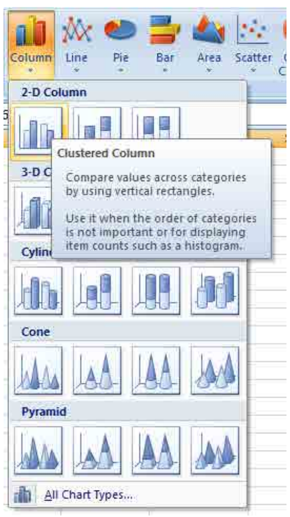
Figure 3: Pipes Condition on Town level

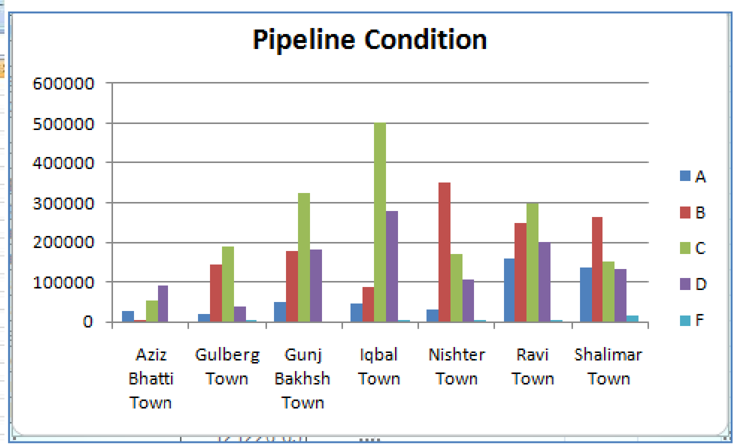


For making graph from the table:

1. Select the table created
2. Go to **Insert** and Click on **"Column"**

You will get the following graph

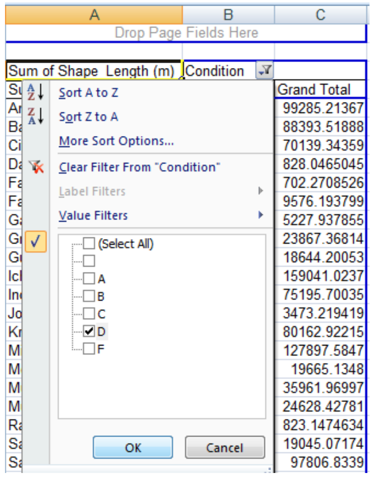


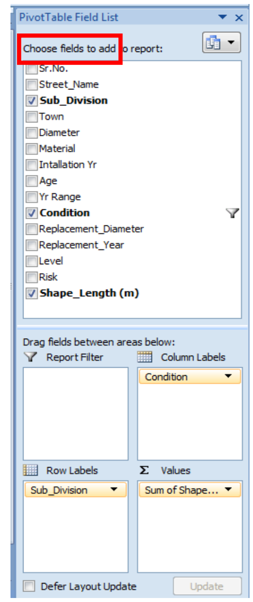


Exercise 1-2: Comparison of Poor pipes on Subdivision level

If you want to find out which subdivision has more poor condition pipeline,follow the steps:

1. Drag the Sub_division field and drop to "**Row Lables**"
2. Drag the Condition field and drop to "**Column Labels**"
3. Drag and drop the length field to "∑ **Values**"
4. Filter the Condition column for D (poor) condition, "Check D" only





You will get the following graph

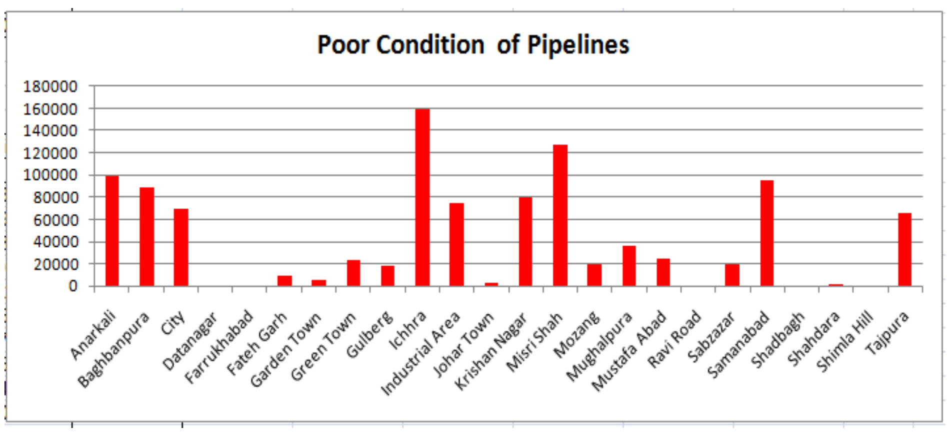


Figure 4: Poor Condition of Pipes

The Graph shows that water supply pipes of Ichra subdivision are in poor condition.

Exercise: 1-3 Percentages of pipeline lengths in terms of condition

Filter garden town subdivision and assess the percentage of pipeline lengths in terms of condition.

1. Drag and drop the Condition Column to "**Row Lables**"
2. Drag and drop the length field to "∑ **Values**
3. Use the function **"**=B118*100/B124" (**"**=Length*100/Total Length") to get value sin %age. You will get 0.36 % for 1st row.
4. Then Drag this 1st cell upto rest of the rows

Condition	Length (m)	% Length
	16213.50	0.36
A	468157.53	10.40
B	1278894.94	28.40
C	1685124.37	37.42
D	1028403.21	22.84
F	26696.20	0.59
Grand Total	4503489.75	100.00

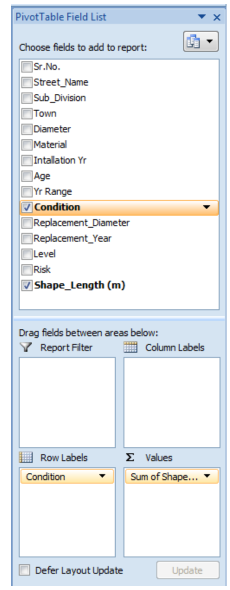
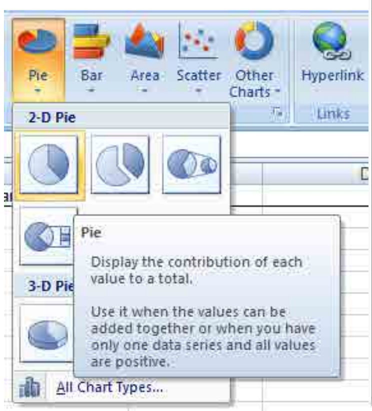


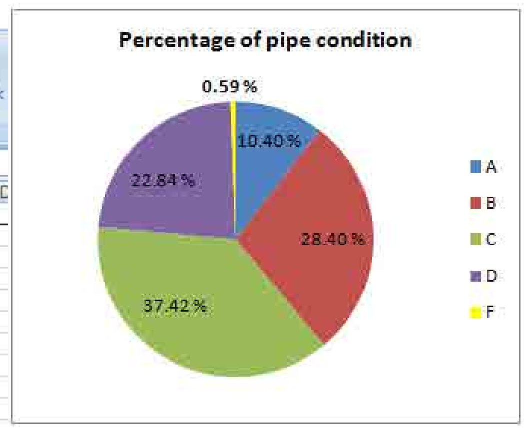
Figure 5: Percentages of pipeline lengths in terms of condition

Pie Chart of the above table will help in better understanding.

To make a pie chart from the table:

1. Select the "Condition" and "% Length" Column
2. Go to Inset and click on "Pie"





The following table shows tube wells in Lahore. Please conduct your database analysis in a table and graph, using Pivot Table in the Excel.

Sr. No.	Name	Installation Year	Status	Town	Generator	Design Capacity	Actual Capacity	Condition	Replaceme	Motor_Size	Sub_Divisi
1	Chenab Block	2009	Functional	Iqbal Town	NILL	4 CFS	4 CFS	C	8	150 HP	Allama Iqbal Town
2	Pak Block	1986	Functional	Iqbal Town	YES	4 CFS	1.75 CFS	D	4	150 HP	Allama Iqbal Town
3	Asif Block	2014	Functional	Iqbal Town	NILL	4 CFS	4 CFS	A	14	150 HP	Allama Iqbal Town
4	Clifton Colony	2014	Functional	Iqbal Town	NILL	4 CFS	4 CFS	A	14	150 HP	Allama Iqbal Town
5	Neelum Block	2008	Functional	Iqbal Town	NILL	4 CFS	2 CFS	D	5	150 HP	Allama Iqbal Town
6	Hunza Block	2008	Functional	Iqbal Town	YES	2 CFS	2 CFS	C	7	80 HP	Allama Iqbal Town
7	College Block	1993	Functional	Iqbal Town	NILL	4 CFS	2 CFS	C	7	150 HP	Allama Iqbal Town
8	Raza Block	2009	Functional	Iqbal Town	NILL	4 CFS	4 CFS	C	9	150 HP	Allama Iqbal Town
9	Kareem Block	1996	Functional	Iqbal Town	NILL	4 CFS	1.75 CFS	D	4	150 HP	Allama Iqbal Town
10	Kareem Block Graveyard	2004	Functional	Iqbal Town	YES	2 CFS	2 CFS	C	8	80 HP	Allama Iqbal Town
11	Nishter Block	2009	Functional	Iqbal Town	NILL	2 CFS	1.90 CFS	D	6	80 HP	Allama Iqbal Town
12	F&V Market 2 Wadhat Road Multan Chungi	2009	Functional	Iqbal Town	NILL	4 CFS	4 CFS	B	8	150 HP	Allama Iqbal Town
13	F&V Market 1 Main Multan Road	2010	Functional	Iqbal Town	NILL	4 CFS	3.75 CFS	C	10	150 HP	Allama Iqbal Town
14	Ravi Block	2011	Functional	Iqbal Town	NILL	4 CFS	3.90 CFS	C	12	150 HP	Allama Iqbal Town
15	Nargis Block	2008	Functional	Iqbal Town	NILL	4 CFS	4 CFS	C	7	150 HP	Allama Iqbal Town
16	Huma Block	1999	Functional	Iqbal Town	NILL	4 CFS	3.25 CFS	C	8	150 HP	Allama Iqbal Town
17	Jahanzaib Block	1986	Functional	Iqbal Town	NILL	4 CFS	2 CFS	D	2	150 HP	Allama Iqbal Town
18	Kmaran Block	2010	Functional	Iqbal Town	NILL	4 CFS	3.75 CFS	C	10	150 HP	Allama Iqbal Town

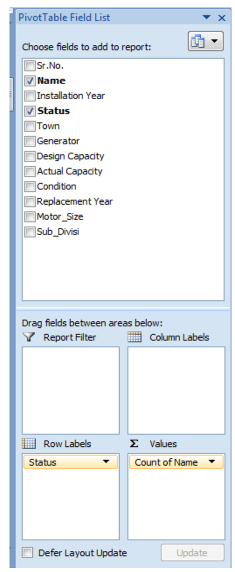
Figure 6: Tube Wells data -WASA Lahore

You are required to conduct the database analysis with Pivot tables in excel.

Exercise 1-4: Status of Tube wells

If you want to find out status of tube wells follow the steps below:

1. Drag the status field and drop to “**Axis field**”
2. Drag and drop the Name field to “∑ **Values**”



Status	Total
Abandoned	3
Functional	491
Not Functional	25
Grand Total	519

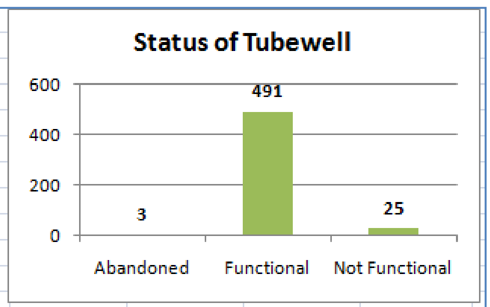


Figure 7: Tube well Status table and graph

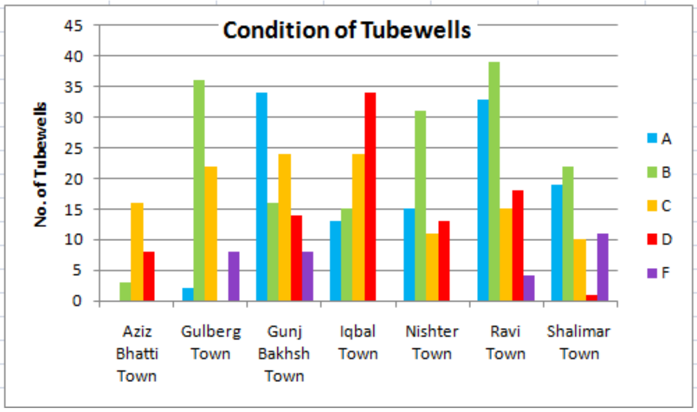
Exercise 1-5: Condition of Tube wells on town level

On town level tube wells with different conditions can be assessed. You will follow the steps described below;

1. Drag and drop the Town field to **“Row Labels**”
2. Drag and drop the Condition Column to **“Column Labels”**
3. Drag and drop the Name field to **“∑ Values”.**

It will sum up the no. of tube well according to condition

Count of Name	Condition					
Town	A	B	C	D	F	Grand Total
Aziz Bhatti Town		3	16	8		27
Gulberg Town	2	36	22		8	68
Gunj Bakhsh Town	34	16	24	14	8	96
Iqbal Town	13	15	24	34		86
Nishter Town	15	31	11	13		70
Ravi Town	33	39	15	18	4	109
Shalimar Town	19	22	10	1	11	63
Grand Total	116	162	122	88	31	519



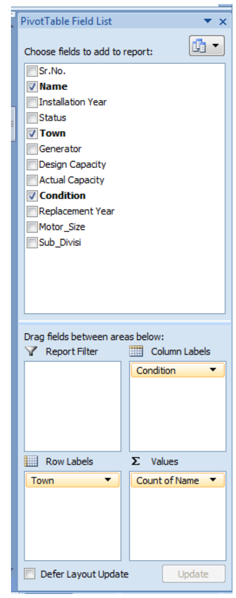


Figure 8: Condition of Tube wells on town level

The above graph shows that in Iqbal town there is maximum no. of poor (D) condition tube wells. And most of the tube wells in Ravi town are in A(Excellent) or B(Good) condition.

Similarly various analysis based on pipe diameter can also be carried out. Examples of these analysis are shown in the following exercises.

Exercise 2: Diameter based Analysis

Exercise 2-1: Diameter wise Length (m) of pipeline (Township)

1. Drag and drop the Diameter field to "**Row Labels**"
2. Drag and drop the Sub_Division field to **"Report Filter"** and filter the township subdivision
3. Drag and drop the Length field to "∑ **Values.**

Diameter	Length (m)
10"	7989.93
12"	1118.21
3"	3466.31
4"	70528.08
5"	297.04
6"	8824.87
8"	8418.66
Grand Total	100643.10

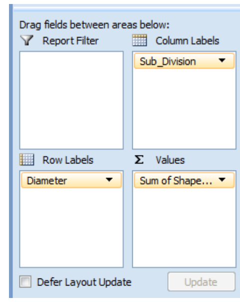
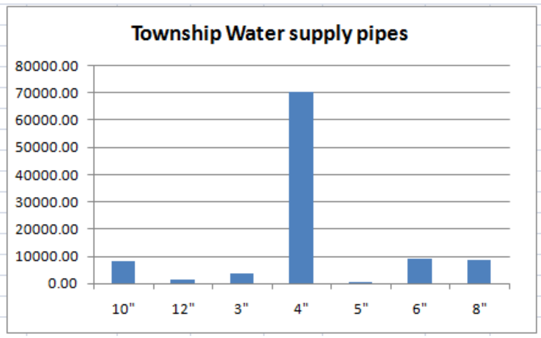


Figure 9: Diameter wise Length (m) of pipeline



The Y axis of the graph can also be changed into km units by right clicking on the axis and then click on "Format Axis". From here you can change the Display Units to thousands to show the length in kilometers.

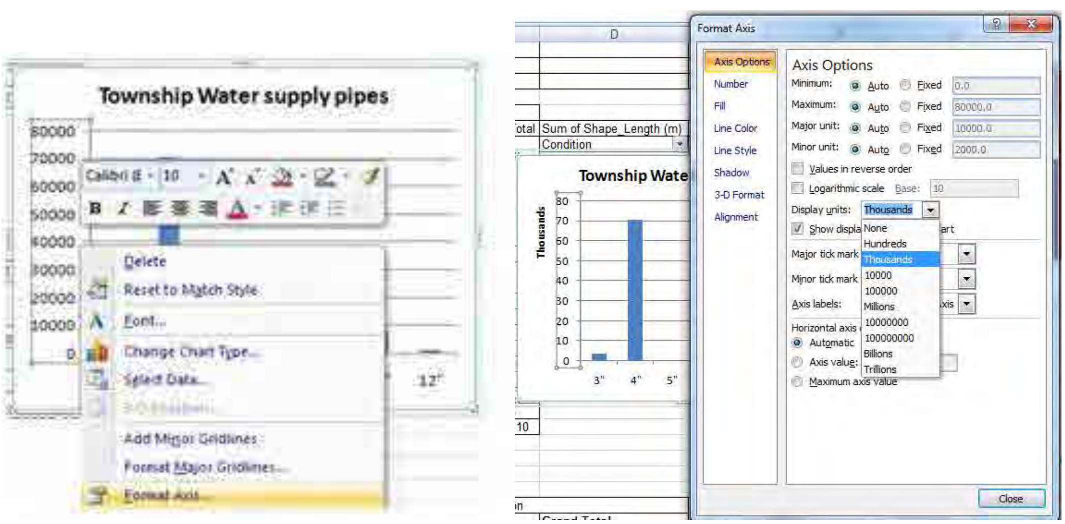


Figure 10: Changing Length in Kilometers

You can rearrange or sort the diameter column by taking the cursor to the row and drag it down or up as per requirement.

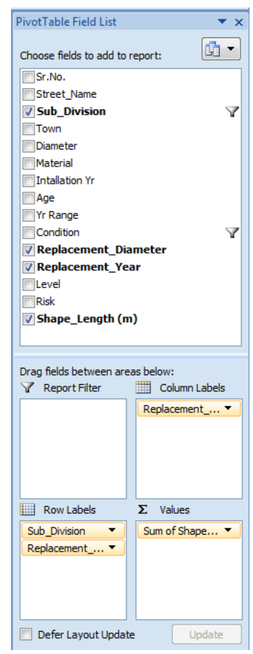
14	Sum of Shape_	Sub_Division	
15	Diameter	Length	Grand Total
16	10"	7989.93	7989.93
17	12"	1118.21	1118.21
18	3"	3466.31	3466.31
19	4"	70528.08	70528.08
20	5"	297.04	297.04
21	6"	8824.87	8824.87
22	8"	8418.66	8418.66
23	Grand Total	100643.10	100643.10

Sum of Shape_Length (r	Sub_Division
Diameter	Length
3"	3466.31
4"	70528.08
5"	297.04
6"	8824.87
8"	8418.66
10"	7989.93
12"	1118.21
Grand Total	100643.10

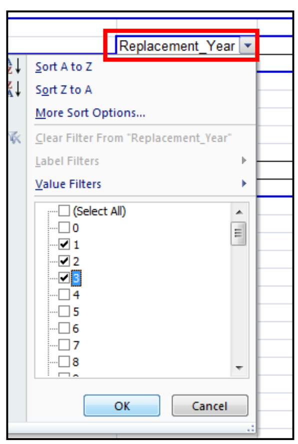
Figure 11: Rearranging the Rows

Above graphs depict that in township most of water supply pipes are of 4inch diameter

Exercise 2-2: Diameter, Replacement Year and Replacement Length



1. Drag and drop the Sub_division and Replacement_Dia field to to "**Row lables**"
2. Drag and drop the Replacment_Year field to "**Column Labels**"
3. Drag and drop Length Field to **"∑Values"**
4. Filter the replacement_year to only for Year 1,2 and 3, uncheck the rest of the years



You will get the following table and graph.

Sum_Length (m)		Replacement			
Sub_Division	Rep_Dia	1	2	3	Grand Total
Township	4		2615	3942	6557
	6	2573	3254	4738	10565
	8	2425	426		2852
	10		43	588	631
	12			267	267
Township Total		4998	6338	9535	20871
Grand Total		4998	6338	9535	20871

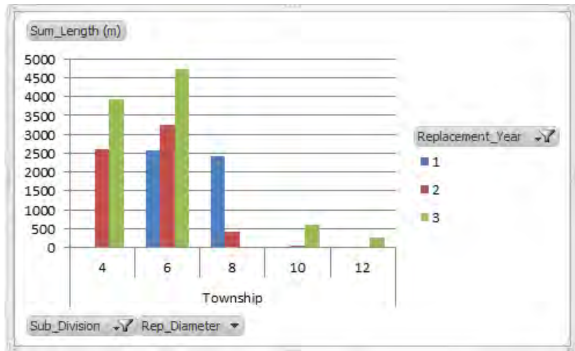


Figure 12: Pipes Lengths with Replacement Year

You can also have the figure in percentage.

1. Select the table
2. go to show values as and
3. then click on "% of Grand Total"

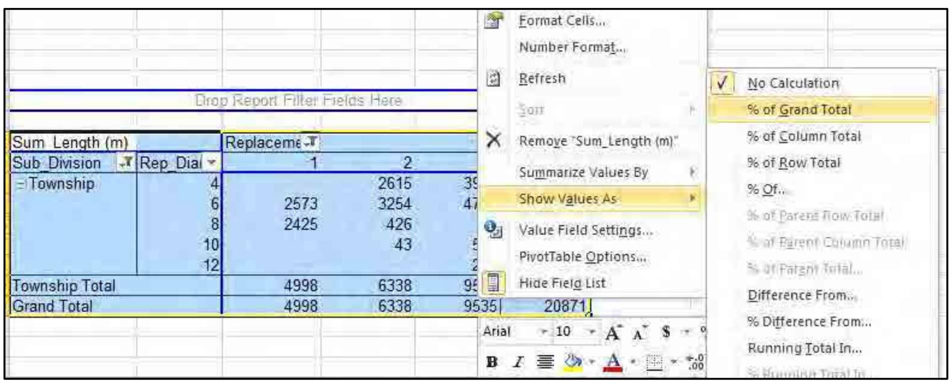


Figure 13: Changing the Numbers into Percentages

You will get the following table and graph.

Sum_Length (m)		Replacement			
Sub_Division	Rep_Dia	1	2	3	Grand Total
Township	4	0.00%	12.53%	18.89%	31.42%
	6	12.33%	15.59%	22.70%	50.62%
	8	11.62%	2.04%	0.00%	13.66%
	10	0.00%	0.20%	2.82%	3.02%
	12	0.00%	0.00%	1.28%	1.28%
Township Total		23.95%	30.37%	45.68%	100.00%
Grand Total		23.95%	30.37%	45.68%	100.00%

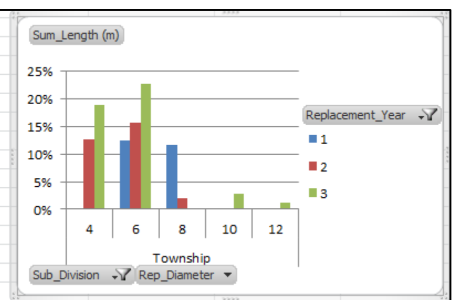


Figure 14: %age of Pipe Lengths with Replacement Year

This shows that 6” and 8” pipes are about 24% of the total pipes that need attention in year 1.

Exercise 2-3: Pipeline Replacement Plan – Township

Pipelines which need replacements in year 1 and so on upto year 25 can be categorized as follows:

1. Drag and drop the Sub_Division field to **“Report Filter**” and filter the township subdivision
2. Drag and drop the Rep_Year field to “**Row Labels**”
3. Drag and drop the Diameter field to “**Column Labels**”
4. Drag and drop the Length field to “∑ **Values.**

Rep_Year	10"	12"	3"	4"	6"	8"	Grand Total
1			1996.89	2276.56	2294.26	2128.37	8696.07
2	42.63			4156.05	2125.56		6324.23
3	588.11	266.73		7591.10	1233.59		9679.53
4				335.24	1031.56		1366.80
5			226.86	16208.62	1106.41	820.05	18361.94
6					860.51		860.51
8	124.67			719.39			844.06
9	9.68						9.68
10	2490.45		2235.22	12602.05	748.75	464.16	18540.63
11	1896.65						1896.65
12	74.19		1497.61	4489.01	197.15	936.62	7194.58
13				2138.86			2138.86
15	177.09	618.21	20.07	4255.30	967.48	2419.43	8457.58
16				172.10		682.50	854.60
17		233.27	158.85	1814.43			2206.55
20	2030.65			16173.56		1251.56	19455.76
22	5.28					4.58	9.85
25	1915.95			579.90			2495.85
Grand Total	9355.34	1118.21	6135.50	73512.17	10565.27	8707.26	109393.74

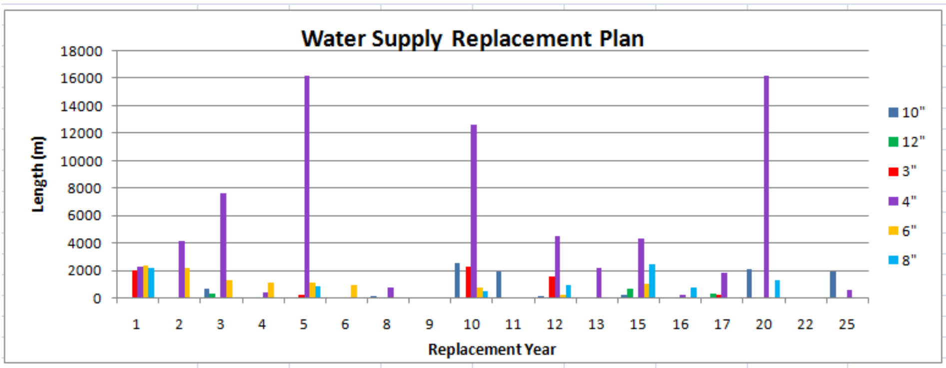


Figure 15: Pipeline Replacement Plan - Township

1. Lecture Information

Course Title: Asset Management	**Course Code**:
Module Title: Asset Database Analysis	**Module No**: 3
Lecture Topic : Asset Age Analysis, Cost Calculation for Replacement	**Lecture Duration:**4 Hours

Other important parameters of the assets can be analyzed which include assets age profiling, asset replacement cost calculation and prioritization of assets for replacement planning. Exercises for asset age analysis are described below.

Exercise 1: Asset Age Analysis

For doing these analysis we need to calculate the age of the asset from its Installation Year. So insert new column by right clicking on the "installation year" go to "insert", then click on "Insert column to Right". Name it as "Age". Now add Age information in this column with the help of year of installation e.g. how old an asset is. For this please input a formula "=2016- installation year" to get how many years from installation.

Then If you can input "=IF(D2>39,">40",IF(D2>29,"30-40",IF(D2>19,"20-30",IF(D2>9,"10-20","0-9")))) "to get a range of years (Age).

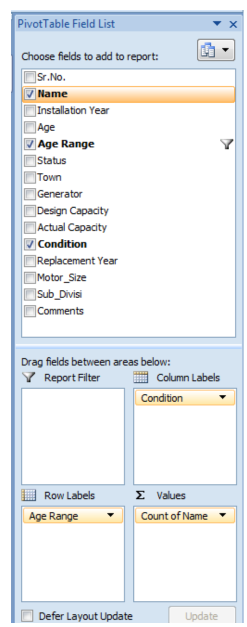
=IF(D2>39,">40",IF(D2>29,"30-40",IF(D2>19,"20-30",IF(D2>9,"10-20","0-9"))))

	A	B	C	D	E	F	G	H
1	Sr.No.	Name	Installation Year	Age	Age Range	Status	Town	Generato
2	1	Chenab Block	2009	7	0-9	Functional	Iqbal Town	NILL
3	2	Pak Block	1986	30	30-40	Functional	Iqbal Town	YES
4	3	Asif Block	2014	2	0-9	Functional	Iqbal Town	NILL
5	4	Clifton Colony	2014	2	0-9	Functional	Iqbal Town	NILL
6	5	Neelum Block	2008	8	0-9	Functional	Iqbal Town	NILL
7	6	Hunza Block	2008	8	0-9	Functional	Iqbal Town	YES
8	7	College Block	1993	23	20-30	Functional	Iqbal Town	NILL
9	8	Raza Block	2009	7	0-9	Functional	Iqbal Town	NILL
10	9	Kareem Block	1996	20	20-30	Functional	Iqbal Town	NILL
11	10	Kareem Block Graveyard	2004	12	10-20	Functional	Iqbal Town	YES
12	11	Nishter Block	2009	7	0-9	Functional	Iqbal Town	NILL
13	12	F&V Market 2 Wadhat Road Multan Chungi	2009	7	0-9	Functional	Iqbal Town	NILL
14	13	F&V Market 1 Main Multan Road	2010	6	0-9	Functional	Iqbal Town	NILL
15	14	Ravi Block	2011	5	0-9	Functional	Iqbal Town	NILL
16	15	Nargis Block	2008	8	0-9	Functional	Iqbal Town	NILL
17	16	Huma Block	1999	17	10-20	Functional	Iqbal Town	NILL
18	17	Jahanzaib Block	1986	30	30-40	Functional	Iqbal Town	NILL
19	18	Kmaran Block	2010	6	0-9	Functional	Iqbal Town	NILL
20	19	Usmania Colony	2009	7	0-9	Functional	Gunj Bakhsh Town	NILL
21	20	Mela Ram Park	1990	26	20-30	Functional	Gunj Bakhsh Town	200 KVA
22	21	Mozang Road	2015	1	0-9	Functional	Gunj Bakhsh Town	NILL
23	22	Nisar Scheme	1995	21	20-30	Functional	Gunj Bakhsh Town	NILL
24	23	Mohallah Gawalian	1993	23	20-30	Functional	Gunj Bakhsh Town	NILL
25	24	Nasir Bagh	1985	31	30-40	Functional	Gunj Bakhsh Town	NILL
26	25	Patial Ground	2015	1	0-9	Not Functional	Gunj Bakhsh Town	NILL
27	26	Shimla Hill	2015	1	0-9	Not Functional	Gunj Bakhsh Town	NILL
28	27	Dhobi mandi	1970	46	>40	Not Functional	Gunj Bakhsh Town	NILL
29	28	Cattle Park	2010	6	0-9	Functional	Gunj Bakhsh Town	NILL
30	29	Lady Mclegon	2009	7	0-9	Functional	Gunj Bakhsh Town	NILL

Figure 16: Calculating Pipe line Age from Installation Year

Exercise1-1: Age Range, Condition and No. of Tube wells

1. Drag and drop the Age Range field to "**Row Labels**"
2. Drag and drop the Condition field to "**Column Labels**"
3. Drag and drop the Name field to "∑ **Values.**



Count of Name	Condition					
Age Range	A	B	C	D	F	Grand Total
>40					2	2
0-9	111	107	30	14	2	264
10-20	5	47	67	32	13	164
20-30		7	24	27	11	69
30-40		1	1	15	1	18
Grand Total	116	162	122	88	29	517

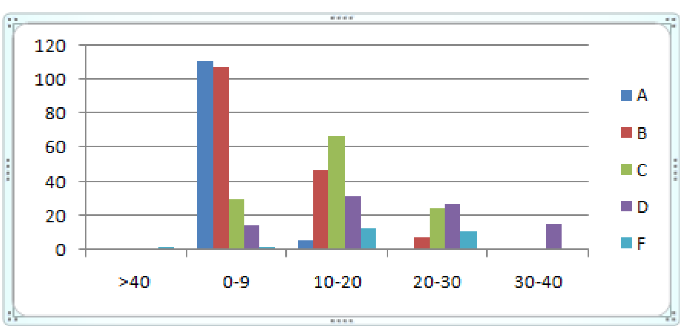
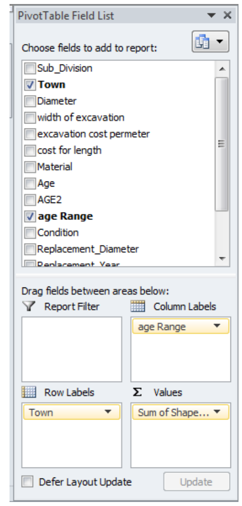


Figure 17: Tube wells Age and Condition

Exercise 1-3: Pipeline age range in each town of Lahore (table)

Do the same age profile analysis on pipes data using pivot table and making graph

1. Drag and drop the Age Range field to "**Column Labels**"
2. Drag and drop the Town field to "**Row Labels**"
3. Drag and drop the Length field to "∑ **Values.**



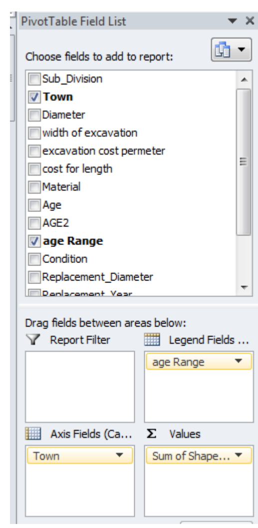
Sum of Shape_Length (m)	age Range				
Town	0-9	10-20	20-30	>30	Grand Total
Aziz Bhatti Town	35061	32167	37646	69796	174669
Gulberg Town	38252	75959	93183	186843	394237
Gunj Bakhsh Town	42559	111796	308083	267741	730178
Iqbal Town	98422	116945	393923	307542	916832
Nishter Town	59666	152896	413136	32081	657779
Ravi Town	160020	223999	304603	222800	911422
Shalimar Town	184900	249459	165867	118146	718371
Grand Total	618880	963221	1716440	1204949	4503490

Figure 18: Age Profile of Pipelines

Exercise 1-4: Pipeline age range in each town of (graph)

For making the graph

1. Drag and drop the Age Range field to **"Legend Fields"**
2. Drag and drop the Town field to "**Axis Field**"
3. Drag and drop the Length field to "∑ **Values.**



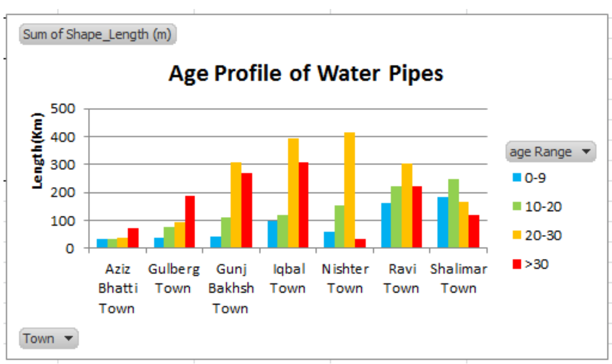


Figure 19: Age Profile of Pipelines (Graph)

Exercise 2: Replacement Cost Calculation

Cost for replacing a pipeline can be calculated using length of the pipes and standard MRS rates.Inser a column for entering unit cost. Enter the unit cost of pipe according to diameter one by one.By applying filter for each diamter you can enter the unit cost at once. For example from filter check diameter 4. The records for 4” diameter pipeline will be shown only. Now one can enter its rate which is 351.64 according to MRS rates for district Lahore, and drag it to all records. Similarly enter the unit cost of other diameters of pipes.

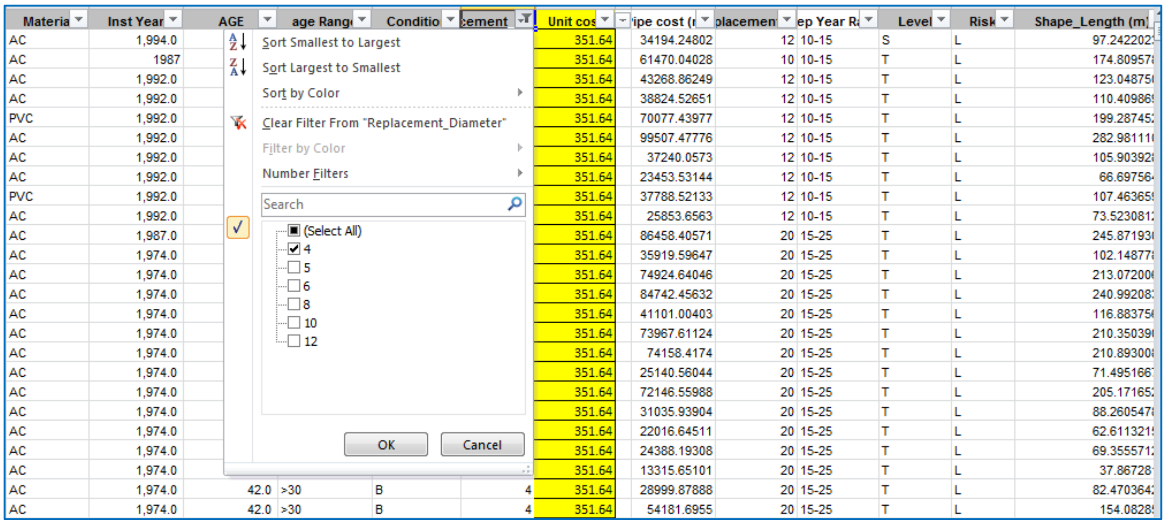


Figure 20: Entering Unit Cost

Now add a column for rep year range. Then If you can input “=IF(W2>24,">25",IF(W2>14,"15-25",IF(W2>9,"10-15",IF(W2>4,"5-10","1-5"))))”.

X1 | Rep Year Range

I	J	K	L	M	N	T	U	V	W	X	Y	Z	AA
Materia	Inst Year	AGE	age Rang	Conditio	cement_	Unit cos		ipe cost (r	placemen	ep Year R	Level	Risk	Shape_Length (m)
AC	2,000.0	16.0	10-20	B	10	1057.8	#	2006280.515	11	10-15	P	M	1896.653919
AC	2,011.0	5.0	0-9	B	10	1057.8		2026691.309	25	>25	P	L	1915.949432
AC	2000	16.0	10-20	C	8	703.28		407517.4585	1	1-5	T	H	579.4526483
AC	2,000.0	16.0	10-20	B	8	703.28		422562.3025	12	10-15	S	L	600.8450439
AC	1994	22.0	20-30	C	8	703.28		299800.7457	2	1-5	S	M	426.2893096
AC	2,010.0	6.0	0-9	B	10	1057.8		225740.0812	20	15-25	S	L	213.4052574
AC	1995	21.0	20-30	B	8	703.28		645813.891	1	1-5	S	L	918.2884357
AC	2,009.0	7.0	0-9	B	8	703.28		312662.5751	20	15-25	S	L	444.5776576
AC	1,994.0	22.0	20-30	B	4	351.64		34194.24802	12	10-15	S	L	97.24220231
AC	1,986.0	30.0	>30	B	6	485.04		159963.4875	15	15-25	T	L	329.7944242
AC	1994	22.0	20-30	B	10	1057.8		953804.0657	10	10-15	T	M	901.6865813
AC	1994	22.0	20-30	B	10	1057.8		1080537.158	10	10-15	T	M	1021.494761
AC	2000	16.0	10-20	B	10	1057.8		685183.5878	5	5-10	P	M	647.7439854
AC	1,987.0	29.0	20-30	B	12	1701.1		814653.0167	15	15-25	T	L	478.8977818
AC	1,987.0	29.0	20-30	B	8	703.28		1366528.138	15	15-25	P	L	1943.078345
AC	1,987.0	29.0	20-30	B	12	1701.1		236986.4497	15	15-25	S	L	139.3136498
AC	1987	29.0	20-30	B	4	351.64		61470.04028	10	10-15	T	L	174.8095788
AC	2,000.0	16.0	10-20	B	8	703.28		178595.0491	20	15-25	T	L	253.9458667
AC	1,992.0	24.0	20-30	B	4	351.64		43268.86249	12	10-15	T	L	123.0487501
AC	1,992.0	24.0	20-30	B	4	351.64		38824.52651	12	10-15	T	L	110.4098695
PVC	1,992.0	24.0	20-30	B	4	351.64		70077.43977	12	10-15	T	L	199.2874524
AC	1,992.0	24.0	20-30	B	4	351.64		99507.47776	12	10-15	T	L	282.9811107
AC	1,992.0	24.0	20-30	B	4	351.64		37240.0573	12	10-15	T	L	105.9039282
AC	1,992.0	24.0	20-30	B	4	351.64		23453.53144	12	10-15	T	L	66.6975641

Figure 21: Making Replacement Year Range

You will get a range of replacement years.

Now if you multiply the length with unit cost (T*AA) you will get an estimate of pipe cost.

Inst Year	AGE	age Rang	Conditio	cement_	Unit cos	ipe cost (r	placemen	ep Year R	Level	Risk	Length (r
1,994.0	22.0	20-30	B	4	351.64	34194.24802	12	10-15	S	L	97.24220231
1987	29.0	20-30	B	4	351.64	61470.04028	10	10-15	T	L	174.8095788
1,992.0	24.0	20-30	B	4	351.64	43268.86249	12	10-15	T	L	123.0487501
1,992.0	24.0	20-30	B	4	351.64	38824.52651	12	10-15	T	L	110.4098695
1,992.0	24.0	20-30	B	4	351.64	70077.43977	12	10-15	T	L	199.2874524
1,992.0	24.0	20-30	B	4	351.64	99507.47776	12	10-15	T	L	282.9811107
1,992.0	24.0	20-30	B	4	351.64	37240.0573	12	10-15	T	L	105.9039282
1,992.0	24.0	20-30	B	4	351.64	23453.53144	12	10-15	T	L	66.6975641
1,992.0	24.0	20-30	B	4	351.64	37788.52133	12	10-15	T	L	107.4636598
1,992.0	24.0	20-30	B	4	351.64	25853.6563	12	10-15	T	L	73.52308128
1,987.0	29.0	20-30	B	4	351.64	86458.40571	20	15-25	T	L	245.8719307
1,974.0	42.0	>30	B	4	351.64	35919.59647	20	15-25	T	L	102.1487785
1,974.0	42.0	>30	B	4	351.64	74924.64046	20	15-25	T	L	213.0720068
1,974.0	42.0	>30	B	4	351.64	84742.45632	20	15-25	T	L	240.9920837
1,974.0	42.0	>30	B	4	351.64	41101.00403	20	15-25	T	L	116.8837562
1,974.0	42.0	>30	B	4	351.64	73967.61124	20	15-25	T	L	210.3503903
1,974.0	42.0	>30	B	4	351.64	74158.4174	20	15-25	T	L	210.8930082
1,974.0	42.0	>30	B	4	351.64	25140.56044	20	15-25	T	L	71.49516675
1,974.0	42.0	>30	B	4	351.64	72146.55988	20	15-25	T	L	205.1716525
1,974.0	42.0	>30	B	4	351.64	31035.93904	20	15-25	T	L	88.26054783
1,974.0	42.0	>30	B	4	351.64	22016.64511	20	15-25	T	L	62.61132155
1,974.0	42.0	>30	B	4	351.64	24388.19308	20	15-25	T	L	69.35557126
1,974.0	42.0	>30	B	4	351.64	13315.65101	20	15-25	T	L	37.8672819
1,974.0	42.0	>30	B	4	351.64	28999.87888	20	15-25	T	L	82.47036424
1,974.0	42.0	>30	B	4	351.64	54181.6955	20	15-25	T	L	154.082856
1,974.0	42.0	>30	B	4	351.64	31867.65818	20	15-25	T	L	90.62580532
1,986.0	30.0	>30	B	4	351.64	50926.96208	15	15-25	T	L	144.8269881
2,010.0	6.0	0-9	B	4	351.64	131209.5183	20	15-25	T	L	373.1359296
2,010.0	6.0	0-9	B	4	351.64	100985.6016	20	15-25	T	L	287.1846252

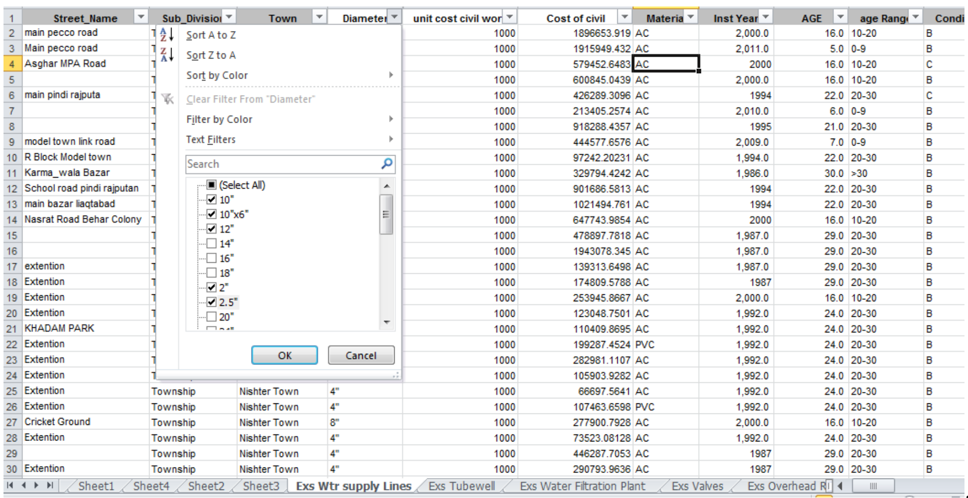
Figure 22: Pipe Cost Calculation

The tabe shows the cost of each pipe to be replaced.

For calculating civil work cost, insert new coulum as “Civil work cost”. CW Cost depends on pipe diameter and excavation width. Assumed unit cost for civil works according to diameter is described in below table:

Diameter	Excavation width	Unit cost Civil Work
<12	7 ft	1000
12-24	8 ft	2000
24-36	9 ft	3000

Click on filter of diameter coulum and check diameters upto 12” diameter and type 1000 in unit cost of civil works and drag it,simlarly enter diameter for 12-24 inch diameters and for 24-36 inch diameter and type 2000 and 3000 unit cost for civil works respectively



Now add a coulum “Civil work cost” multiply unit cost of civil work with length (=I2*AC2). You will get Cost of Civil Works.

1	Sub_Divisio	Town	Diameter	unit cost civil wor	Cost of civil Work	Total cost	Materia	Inst Year	AGE	age Rang	Conditio
2	Township	Nishter Town	10"	1000	1896653.919	3902934.434	AC	2,000.0	16.0	10-20	B
3	Township	Nishter Town	10"	1000	1915949.432	3942640.742	AC	2,011.0	5.0	0-9	B
4	Township	Nishter Town	8"	1000	579452.6483	986970.1068	AC	2000	16.0	10-20	C
5	Township	Nishter Town	8"	1000	600845.0439	1023407.346	AC	2,000.0	16.0	10-20	B
6	Township	Nishter Town	6"	1000	426289.3096	726090.0553	AC	1994	22.0	20-30	C
7	Township	Nishter Town	10"	1000	213405.2574	439145.3386	AC	2,010.0	6.0	0-9	B
8	Township	Nishter Town	8"	1000	918288.4357	1564102.327	AC	1995	21.0	20-30	B
9	Township	Nishter Town	8"	1000	444577.6576	757240.2327	AC	2,009.0	7.0	0-9	B
10	Township	Nishter Town	4"	1000	97242.20231	131436.4503	AC	1,994.0	22.0	20-30	B
11	Township	Nishter Town	6"	1000	329794.4242	489757.9118	AC	1,986.0	30.0	>30	B
12	Township	Nishter Town	10"	1000	901686.5813	1855490.647	AC	1994	22.0	20-30	B
13	Township	Nishter Town	10"	1000	1021494.761	2102031.92	AC	1994	22.0	20-30	B
14	Township	Nishter Town	8"	1000	647743.9854	1332927.573	AC	2000	16.0	10-20	B
15	Township	Nishter Town	12"	1000	478897.7818	1293550.799	AC	1,987.0	29.0	20-30	B
16	Township	Nishter Town	8"	1000	1943078.345	3309606.483	AC	1,987.0	29.0	20-30	B
17	Township	Nishter Town	12"	1000	139313.6498	376300.0995	AC	1,987.0	29.0	20-30	B
18	Township	Nishter Town	4"	1000	174809.5788	236279.6191	AC	1987	29.0	20-30	B
19	Township	Nishter Town	8"	1000	253945.8667	432540.9158	AC	2,000.0	16.0	10-20	B
20	Township	Nishter Town	4"	1000	123048.7501	166317.6126	AC	1,992.0	24.0	20-30	B
21	Township	Nishter Town	4"	1000	110409.8695	149234.396	AC	1,992.0	24.0	20-30	B
22	Township	Nishter Town	4"	1000	199287.4524	269364.8922	PVC	1,992.0	24.0	20-30	B
23	Township	Nishter Town	4"	1000	282981.1107	382488.5885	AC	1,992.0	24.0	20-30	B
24	Township	Nishter Town	4"	1000	105903.9282	143143.9855	AC	1,992.0	24.0	20-30	B
25	Township	Nishter Town	4"	1000	66697.5641	90151.09554	AC	1,992.0	24.0	20-30	B
26	Township	Nishter Town	4"	1000	107463.6598	145252.1811	PVC	1,992.0	24.0	20-30	B
27	Township	Nishter Town	8"	1000	277900.7928	473342.8624	AC	2,000.0	16.0	10-20	B
28	Township	Nishter Town	4"	1000	73523.08128	99376.73758	AC	1,992.0	24.0	20-30	B
29	Township	Nishter Town	4"	1000	446287.7053	662755.0939	AC	1987	29.0	20-30	B
30	Township	Nishter Town	4"	1000	290793.9636	431840.6677	AC	1987	29.0	20-30	B

Sheet1 | Sheet4 | Sheet2 | Sheet3 | **Exs Wtr supply Lines** | Exs Tubewell | Exs Water Filtration Plant | Exs Valves | Exs Overhead Resorvoir | Pro Wtr Supply Line

Figure 23: Civil Work Cost

Total cost of replacement can be estimated by summing up the pipe cost and civil work cost. Inset new column as total cost and type =J2+Y2.

=J2+Y2

	C	D	E	I	J	K	L	M	N	O	
1	Sub_Divisio	Town	Diameter	unit cost civil wor	Cost of civil	Total cost	Materia	Inst Year	AGE	age Rang	
2	Township	Nishter Town	10"	1000	1896653.919	3902934.434	AC	2,000.0	16.0	10-20	B
3	Township	Nishter Town	10"	1000	1915949.432	3942640.742	AC	2,011.0	5.0	0-9	B
4	Township	Nishter Town	8"	1000	579452.6483	986970.1068	AC	2000	16.0	10-20	C
5	Township	Nishter Town	8"	1000	600845.0439	1023407.346	AC	2,000.0	16.0	10-20	B
6	Township	Nishter Town	6"	1000	426289.3096	726090.0553	AC	1994	22.0	20-30	C
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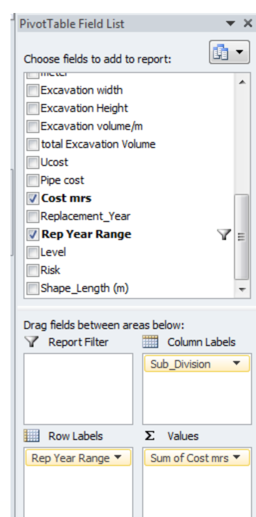
9	Township	Nishter Town	8"	1000	444577.6576	757240.2327	AC	2,009.0	7.0	0-9	B
10	Township	Nishter Town	4"	1000	97242.20231	131436.4503	AC	1,994.0	22.0	20-30	B
11	Township	Nishter Town	6"	1000	329794.4242	489757.9118	AC	1,986.0	30.0	>30	B
12	Township	Nishter Town	10"	1000	901686.5813	1855490.647	AC	1994	22.0	20-30	B
13	Township	Nishter Town	10"	1000	1021494.761	2102031.92	AC	1994	22.0	20-30	B
14	Township	Nishter Town	8"	1000	647743.9854	1332927.573	AC	2000	16.0	10-20	B
15	Township	Nishter Town	12"	1000	478897.7818	1293550.799	AC	1,987.0	29.0	20-30	B
16	Township	Nishter Town	8"	1000	1943078.345	3309606.483	AC	1,987.0	29.0	20-30	B
17	Township	Nishter Town	12"	1000	139313.6498	376300.0995	AC	1,987.0	29.0	20-30	B
18	Township	Nishter Town	4"	1000	174809.5788	236279.6191	AC	1987	29.0	20-30	B
19	Township	Nishter Town	8"	1000	253945.8667	432540.9158	AC	2,000.0	16.0	10-20	B
20	Township	Nishter Town	4"	1000	123048.7501	166317.6126	AC	1,992.0	24.0	20-30	B
21	Township	Nishter Town	4"	1000	110409.8695	149234.396	AC	1,992.0	24.0	20-30	B
22	Township	Nishter Town	4"	1000	199287.4524	269364.8922	PVC	1,992.0	24.0	20-30	B
23	Township	Nishter Town	4"	1000	282981.1107	382488.5885	AC	1,992.0	24.0	20-30	B
24	Township	Nishter Town	4"	1000	105903.9282	143143.9855	AC	1,992.0	24.0	20-30	B
25	Township	Nishter Town	4"	1000	66697.5641	90151.09554	AC	1,992.0	24.0	20-30	B
26	Township	Nishter Town	4"	1000	107463.6598	145252.1811	PVC	1,992.0	24.0	20-30	B
27	Township	Nishter Town	8"	1000	277900.7928	473342.8624	AC	2,000.0	16.0	10-20	B
28	Township	Nishter Town	4"	1000	73523.08128	99376.73758	AC	1,992.0	24.0	20-30	B
29	Township	Nishter Town	4"	1000	446287.7053	662755.0939	AC	1987	29.0	20-30	B
30	Township	Nishter Town	4"	1000	290793.9636	431840.6677	AC	1987	29.0	20-30	B

Sheet1 | Sheet4 | Sheet2 | Sheet3 | **Exs Wtr supply Lines** | Exs Tubewell | Exs Water Filtration Plant | Exs Valves | Exs Overhead R

Figure 24: Total Replacement Cost

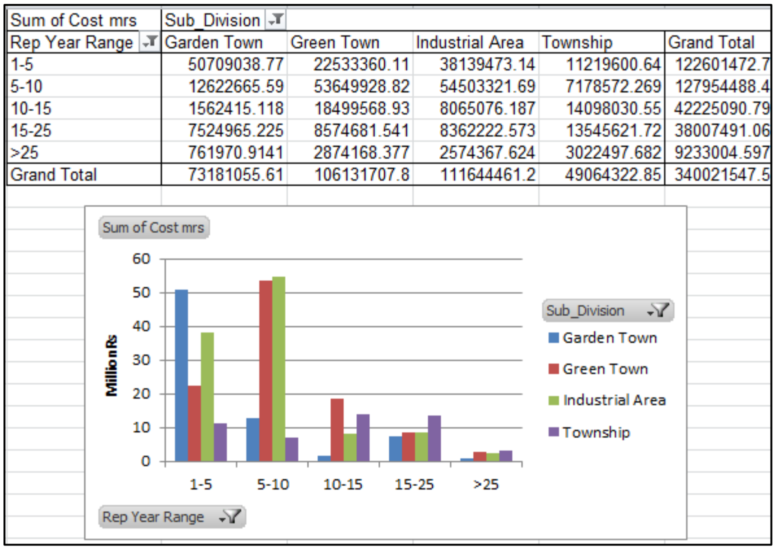
Exercise 1-1 : Replacement Cost Calculation in Phased Manner

Using the replacemet cost and replacement year range you can plot a pivot table and its graph for town level plan



1. Drag and drop the “Rep Year Range” field to “**Row Labels**”
2. Drag and drop the Sun_Division field to “**Column Labels**”

3. Drag and drop the Length field to "∑ **Values.**



Sum of Cost mrs	Sub_Division				
Rep Year Range	Garden Town	Green Town	Industrial Area	Township	Grand Total
1-5	50709038.77	22533360.11	38139473.14	11219600.64	122601472.7
5-10	12622665.59	53649928.82	54503321.69	7178572.269	127954488.4
10-15	1562415.118	18499568.93	8065076.187	14098030.55	42225090.79
15-25	7524965.225	8574681.541	8362222.573	13545621.72	38007491.06
>25	761970.9141	2874168.377	2574367.624	3022497.682	9233004.597
Grand Total	73181055.61	106131707.8	111644461.2	49064322.85	340021547.5

Figure 25: Replacement Cost calculation in phased manner

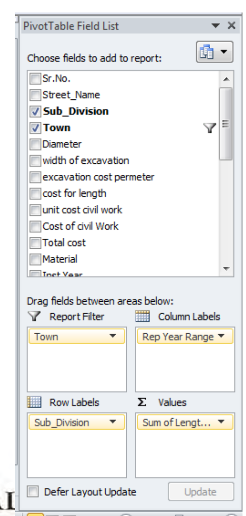
The above example is on the replacement plan of Nishter town subdivisions. From the chart it is evident that in first phase (1-5 year) most of the cost is involved in industrial area subdivision.

Exercise 3: Prioritization for Replacement planning

Successful asset management enables a drinking water or wastewater system to maintain a desired level of service in the most cost-effective manner. Generally, this allows utility managers to proactively rehabilitate or replace system components on a continual basis rather than disruptive to system operations.

Therefore for replacing assets (e.g. pipelines) utility managers have to prioritize their assets based on useful remaining life. Prioritization here means ranking system's assets for replacement. Following exercises will demonstrate how pivot table can help in prioritizing the pipelines for replacement in Lahore.

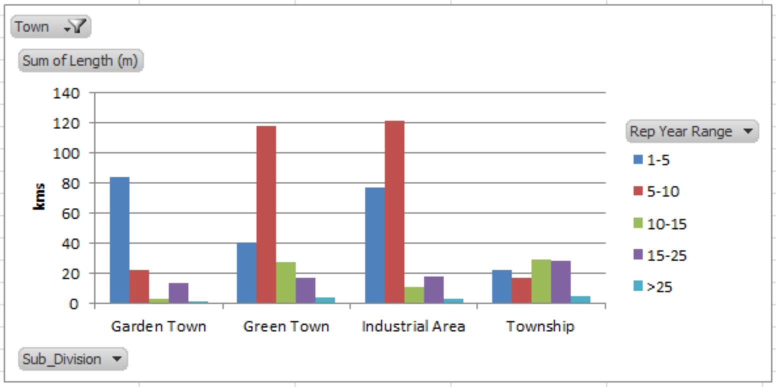
Exercise 3: Replacement Year, for Nishter Town subdivisions



1. Drag and drop the "Town" field to "**Report Filters**"
2. Drag and drop the **Sub_Division** field to **Row Lables**""
3. Drag and drop the "Rep Year Range**"** to Coulum Labels.
4. Drag and drop Length to ""∑ **Values.**

Town: Nishter Town

Sum of Length (m)	Rep Year Range					
Sub_Division	1-5	5-10	10-15	15-25	>25	Grand Total
Garden Town	83776	21635	2696	13248	1196	122551
Green Town	40116	118082	27314	16349	3787	205648
Industrial Area	77124	121078	10263	17646	2434	228544
Township	22238	16698	28841	28512	4748	101036
Grand Total	223254	277493	69114	75755	12164	657779



Exercise3-1: Replacement Cost, Age Range for Nishter Town

1. Drag and drop the “Town” field to “**Row Labels**”
2. Drag and drop the Age Range field to “**Column Labels**”
3. Drag and drop the Cost field to “∑ **Values.**

Sum of Cost mrs	age Range				
Town	0-9	10-20	20-30	>30	Grand Total
Nishter Town	34488780.2	73010265.52	217687464.5	14835037.27	340021547.5
Grand Total	34488780.2	73010265.52	217687464.5	14835037.27	340021547.5

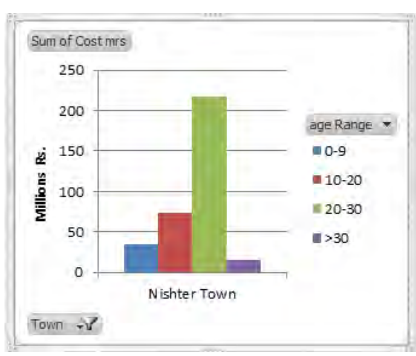


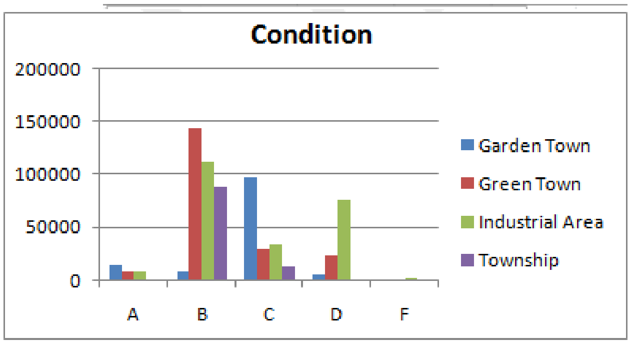
Figure 26: Pipe Replacement Cost and Age Profile - Nishter Town

Exercise 3-2: Pipes Condition of Nishter Town

First we will analyze which subdivision needs more attention. For this pipeline condition table of Nishter Town will be prepared to see which subdivision is in poor condition

1. Drag and drop the "Condition" field to "**Row Labels**"
2. Drag and drop the Sub_Division field to "**Column Labels**"
3. Drag and drop the Length field to "∑ **Values.**

Sum of Shape	Sub_Divisio				
Condition	Garden Town	Green Town	Industrial Area	Township	Grand Total
A	13829.53366	8817.264938	7611.581447	431.76921	30690.149
B	7855.905457	143415.3926	111487.9577	88035.357	350794.61
C	95637.89295	28792.70571	32588.87072	12569.187	169588.66
D	5227.937855	23867.36814	75195.70035		104291.01
F		755.0804177	1659.743127		2414.8235
Grand Total	122551.2699	205647.8118	228543.8534	101036.31	657779.25



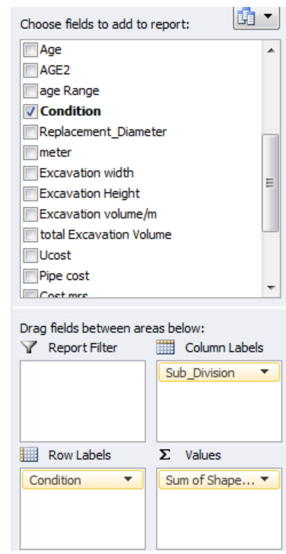


Figure 27: Pipes Condition -Nishter Town

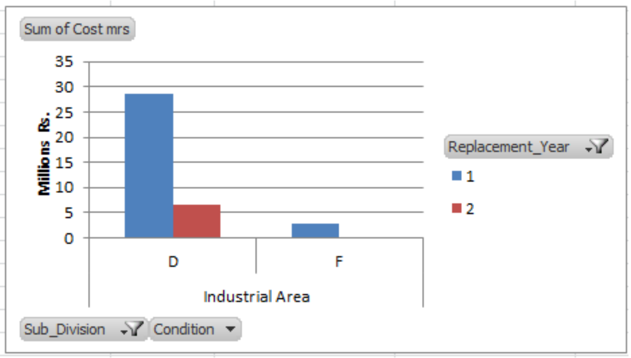
It is clear from the chart that Industrial area has more D and F condition Pipes.

Exercise 3-3 : Condition, Replacemet Year, Replacement Cost of Industrial area

Pipes can be priortized further on the basis of condition

1. Drag and drop the Sub_Division field to "**Report Filter**"
2. Drag and drop the "Condition" field to "**Row Labels**"
3. Drag and drop the "Replacement_Year" field to "**Column Labels**"
4. Drag and drop the Cost field to "∑ **Values.**

Sum of Cost mrs	Replacement_Year		
Condition	1	2	Grand Total
D	28711411	6474433	35185843
F	2823389		2823389
Grand Total	31534800	6474433	38009232



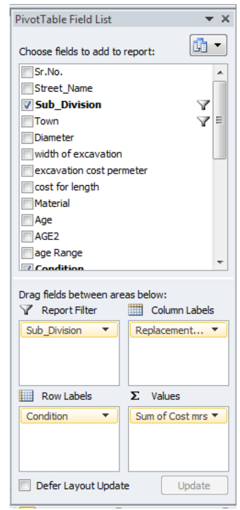


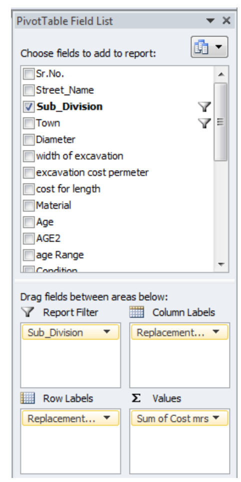
Figure 28: Cost for Replacing Poor Condition Pipes

The graph shows the cost involved for replacing poor condition pipes in first and second year.

Exercise3-4: Replacement diameter, Replacement year, Cost

You can priortize the asset for replacement based on diameter and cost

1. Drag and drop the Sub_Division field to "**Report Filter**"
2. Drag and drop the "Replacement_Year" field to "**Column Labels**"
3. Drag and drop the "Replacement_Diameter" field to "**Row Labels**"
4. Drag and drop the Cost field to "∑ **Values.**



Sub_Division	Industrial Area		
Sum of Cost mrs	Replacement_Year		
Replacement_Diameter	1	2	Grand Total
4	13753492.66	6316527.94	20070020.6
6	3613461.476	157904.7682	3771366.245
8	837179.4923		837179.4923
10	8329165.427		8329165.427
12	5001500.719		5001500.719
Grand Total	31534799.77	6474432.708	38009232.48

Figure 29: Prioritizing Pipes for Replacement – Industrial Area

The above chart you may take up pipes with 10 and 12 inch diameter first, then 6 and 8 inch, then 4 inch pipe for replacement purpose according to available budget**.**

This is one of the approaches of prioritizing the assets.

ALJAZARI
ACADEMY

Asset Management

Course Code: M4131

Asset Replacement Plan
Module 4

Lecture Notes

2017

Introduction of the Asset Management Course:

This course is about asset management related to water utilities. It focuses on assets, its attributes, determining their condition, risk, life cycle of an asset, monitoring of existing assets, accounting treatment of assets and preparing asset replacement plan. This course is especially beneficial for officers of grade 17 and 18 who are directly or indirectly involved in planning and routine management of assets.

Course Participants (CPs) will develop knowledge and skills about asset, its life cycle and carry out asset condition survey. They will be able to develop and use asset data base for asset replacement planning. This course will also help the CPs in understanding application of the concepts related to Asset Replacement Plan, Asset Operational Plan and its monitoring. The CPs will learn through OJT, how to use the Asset Management Information System, GIS and other tools.

Upon the completion of this course the CPs will be in a better position to apply their learning in their routine jobs and prepare an Integrated Development & Asset Management Plan (IDAMP) to provide better water supply and sewerage services to their consumers.

Asset Replacement Module:

The module includes key concepts related to current asset monitoring, repair, and replacement practices at WASAs. The module also outlines cost comparison of repair and replacement of assets. Finally, it also provides guidance on preparing short / medium/ long term replacement plans.

Lecture 1

1. Lecture Information

Topics: 1) Current Asset monitoring and Procurement at WASA Lahore 2) Repair or Replacement based on monitoring results 3) Inspection and payment to suppliers	
Lecture Duration: 2 Hours	

Day 1

Introduction of Topic

Prior Knowledge/Brainstorming **(20 Minutes)**

Lecturer will evaluate course participants' prior knowledge related to "current practices of monitoring" through brainstorming. The Lecturer will put a question to class: What are current practices of monitoring of existing WASA assets ? The expected responses are presented below:

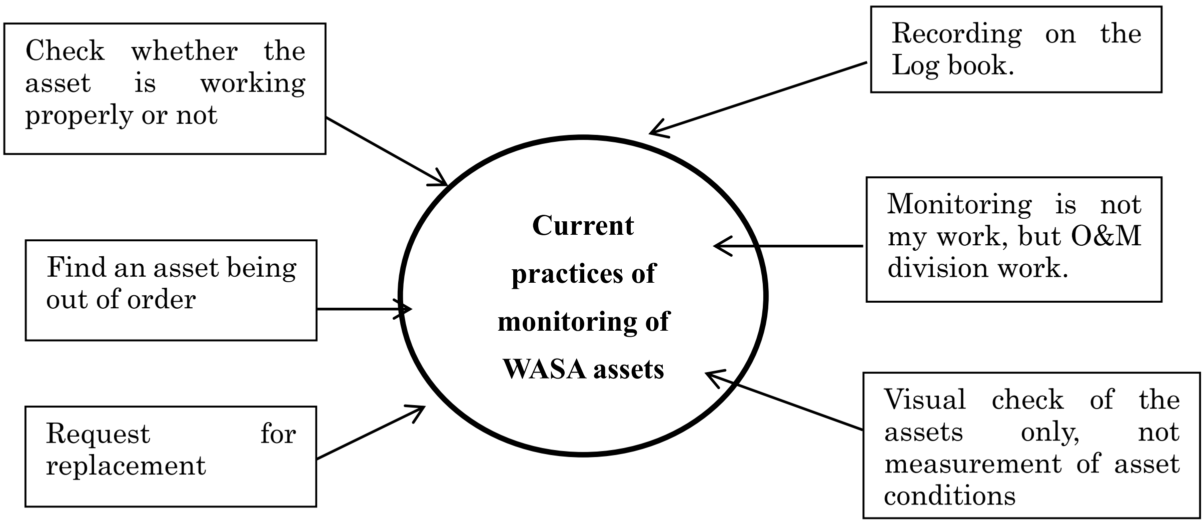


Figure 1: Expected responses to the question "what is monitoring?"

The lecturer will conclude the brainstorming through discussion and clarifications of "monitoring" and will emphasize an importance of preventive maintenance and short/ medium/ long term asset replacement planning.

Motivation Activity **(20 Minutes)**

The lecturer will first emphasize an importance of asset replacement with an example of a prestigious shrine, Ise shrine in Japan. The Ise shrine has conducted replacement of a main building every twenty (20) years for more than one (1) thousand years. The replacement needs three requirements: first **human resources** who are able to plan and rebuild a wholly building with high skills, second **good materials**, wood for the building which are grown in the shrine forest and third **a fund** for the construction work. The asset replacement in WASAs needs staffs with high expertise, materials/ equipment/ facility of good quality and budget to proceed with asset replacement and preventive maintenance.

Lecture 1 Case study: Current Asset monitoring and Procurement at WASA Lahore

(40 Minutes)

Relevance of case study

The lecturer will explain current monitoring practices at Lahore WASA to share relevant experiences with participants. Because Lahore WASA has substantial assets and its management practices would be a good reference for the other WASAs. In addition, GIS unit there collects/ inputs asset data, having expertise in digital manner of asset management.

Overview of Lahore WASA assets

Water production: 435 million gallons per day
Tube wells: 519
Pipelines: 4,500 kilometers
Water purification plants: 150

Valves: 8,500
Overhead reservoirs: 50
Water connections: 636,338
Disposal stations: 12 (2,299cfs)
Lift stations: 93 (826cfs)
Drainage network: 461km
Drainage stations: 4 (663cfs)
Offices
Land

The lecture will contain following topics:

1. 1. Monitoring of the existing assets (60 minutes)

Logbooks of machinery/ equipment maintenance recording are maintained by mechanical engineers, sub engineers, pipe fitters, mechanical helpers, mechanical supervisors, electricians, operators of the Operation and Maintenance department (O & M) on daily basis: date, timing, operating time, meter reading, operating load, electricity shutdown, diesel consumption and others.

When they find a failure or insufficient function, reporting is done to Executive engineers to be immediately repaired by a maker or contractor. In case of replacement, the O & M would request for Procurement & Store Department (P&S) to purchase a new one.

Table1: Current monitoring and repair/ replacement process at Lahore WASA

	Monitoring of the existing assets	Keeping records of the monitoring results	if they find a breakdown	Repair/ replacement	Request for replacement
Departments in charge	O &M department implements a everyday monitoring of the assets (according to SOP).	O &M department keeps records of the monitoring results in their log books.	O &M department staffs report to their executive engineers.	O &M department makes a decision: repair/ replacement	(repair) O &M department requests for suppliers to repair. (replacement) O &M department requests for Procurement and Store Dep. (P&S) to procure a new one.
Staff in charge	mechanical engineers, sub engineers, pipe fitters, mechanical helpers, mechanical supervisors, electricians, operators			executive engineers	

1.2. Demarcation of departments requesting for procurement and those in charge of procurement

Procurement process in WASA is done by PEPRA rules prepared by government. The Procurement & Store Department (P&S) is in charge of routine and non-routine purchase requested by other departments and prepares estimates. Non-development-budget is prepared by them as well.

On the other hand, the Planning and Design division (P&D) is in charge of on-site survey, design, cost estimation, scheduling and procurement in their PC1s to formulate the development budget. Due to staff shortage, however, those works are actually handled by Construction 1, 2 and Waste Water Treatment (WWT) Departments. Only procurement of machine is implemented by P & S.

The P&S/ P&D could, thus, reduce unit purchasing cost with consolidation of many purchase requests. In addition, the WASA could proceed with competition among suppliers, transparency of procurement, as well as avoid corruption.

1.3. Repair/ replacement based on monitoring results

The P&S/ P&D would estimate the procurement costs to obtain an approval from DMD. If the estimation cost is less than Rs.100,000, P&S/ P&D would obtain cost offers from more than three (3) suppliers, then placing an order to the supplier which offers the best one. The suppliers would deliver the products within one (1) week from the award if they have a stock. It would take three (3) to four (4) weeks from the date of procurement request for P&S/ P&D to the delivery.

At the estimation cost of Rs.100,000- 2 million, P&S/ P&D make a bid announcement on PPRA web site, thereby conducting a tender. At more than Rs. 2 million, P&S/ P&D make a bid announcement on newspaper as well as on PPRA web site. Then, P&S/ P&D obtain quotations from more than three (3) suppliers. Those suppliers put their offers in the “Quotation Box”. P&S/ P&D, Finance department, departments requesting for the procurement would jointly formulate an “Appraisal Committee”, to evaluate those quotations, thereby placing an order to a bidder offering the best one.

It would take 45- 60 days from the date of procurement request for the P&S to the product delivery, including the bid announcement period on newspaper.

Table 2: Procurement and its finance source (budget) at Lahore WASA

Departments in charge	Actual works	Finance source (budget)	Actual expenditures	Process of procurement
Procurement and Store division (P&S) is in charge of routine/ non-routine purchases requested by various departments.	Cost estimation, tender, selection of bidders, awarding, inspection upon delivery, request for payment to Finance Division.	"Repair & maintenance", non-development budget (formulated by P&S, every year May 15- June 15)	Repair & maintenance (Million Rs.) (year 2012-13) 785 (year 2013-14) 615 (year 2014-15) 1,146	(estimation costs: less than Rs. 100,000) Obtaining offers more than three (3) companies (estimation costs: Rs. 100,000- 2 million) Bid announcement on PPRA website
Planning and Design division (P&D)	on-site survey, design, cost estimation, scheduling and procurement	development budget (formulated by P&D, every year May 15- June 15)	Annual dev. program (year 2012-13) 701 (year 2013-14) 1,745 (year 2014-15) 6,918	(estimation costs: more than Rs. 2 million) Bid announcement on PPRA website and newspaper The estimations shall be authorized upon DMD

Note: Procurement process in WASA shall be done by PEPRA rules prepared by government.

1.4. Inspection and payment to suppliers

P&S/ P&D conduct an inspection upon delivery, examining whether the product quality meets the requirement. Upon acceptance of the product, Departments in charge would request for the Finance department for payment of the contract amount. The Finance department would issue a check which would be converted into cash in a bank by the supplier.

Table 3: Procurement process at Lahore WASA

Cost estimation	Selection of bidders	Order placement	Inspection upon delivery	Payment to suppliers
P&S/ P&D The cost estimations shall be authorized upon DMD approval	Appraisal committee including Finance department	P&S/ P&D	P&S/ P&D	Finance department upon request by the P&S/ P&D

Summing up the previous discussion, the whole process of monitoring and procurement would be described in the following graph.

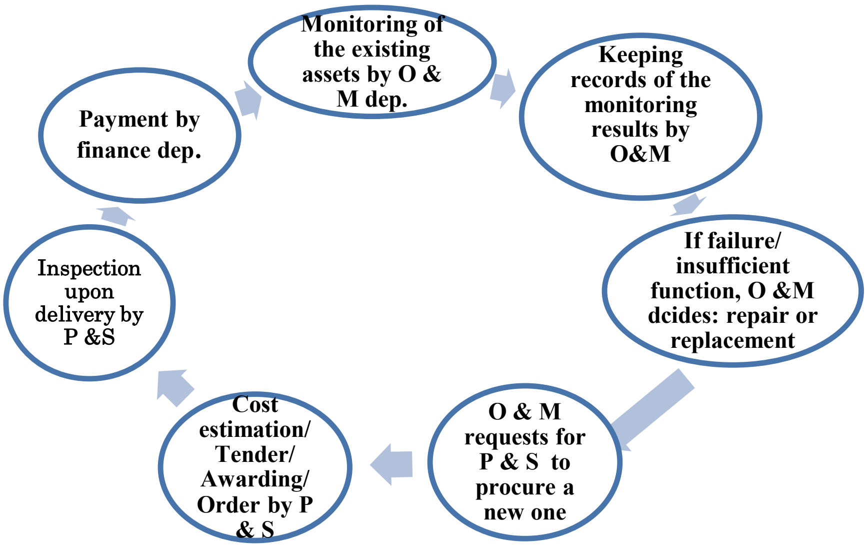


Figure 2: Whole process of monitoring and procurement at Lahore WASA

Lecture 2

1. Lecture Information

Topics: 1) Financial Report and budget formulation
Lecture Duration: 80 Minutes

2. Introduction of Topic

1.1. Financial report and Budget formulation (20 minutes)

Lecture 2 will be related to values of fixed assets, budgeting, and GIS at Lahore and other WASAs.

1.2. Values of fixed assets and budgeting

The lecture will highlight that it is difficult to know current asset values of Lahore or other WASAs.

On the other hand, P&S/ P&D formulate a new fiscal year budget of procurement from May 15 to June 15.

1.3. Fixed asset list

The WASAs have prepared fixed asset lists with support of the Urban Unit, however, current use of the lists is limited. The Asset management course will assist WASAs to more efficiently take advantage of those lists.

1.4. GIS

The GIS unit was established in 2013 and has currently three (3) assistant directors and one (1) CAD operator. They conduct a data input of tube wells, disposal stations, water supply/ sewerage pipe line network in GIS. The unit has completed those works in five (5) sub divisions of Lahore WASA. The work in remaining 27 sub divisions is on-going.

If other information is required to be input, it is necessary for the Unit to obtain a DGPS (Differential Global Position System) and others. The Unit recommended that Lahore WASA establish a MIS (Management Information System) section in charge of programing for data input and reporting with information from various departments, for example:

1) Fixed asset location and its values including tube wells, pipelines and others

2) Consumer address, tariff, payment situation, illegal connections

3) Water production and distribution

Group Discussion and Presentation (60 Minutes)

Group 1/2 will discuss 1) when the assets should be inspected, 2) how inspection should be conducted, 3) how asset condition should be measured, and 4) what actions should be taken based on the inspection. 4) Who would input data of new assets in the asset list.

They will present their findings/ suggestions to the whole class.

Group 3/4 will discuss: how to share the asset monitoring results with GIS department.

Lecture 3

1. Lecture Information

Topics: 1) Cost comparison of repair/ replacement
Lecture Duration: 1 Hours

2. Introduction of Topic

2.1. Cost comparison of repair/ replacement (30 minutes)

When failure or insufficient function is found in an asset, managers at the O & M department would make a decision: repair or replacement. The repair would reduce an initial cost of the recovery while maintenance costs afterward might be increasing. By contrast, the initial purchasing cost of a substitute one would be much higher than that of repair, while maintenance costs afterward might be less than those of the repair. The quantitative manner of cost comparison in described below might help the managers to appraise the options.

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total costs
Repair	130	40	40	40	40	40	330
replacement	250	10	10	10	10	10	300

Conclusion **(20 Minutes)**

The lecturer will conclude day 1 by reviewing current monitoring practices and will invite questions from course participants for further clarifications. Lastly it will be highlighted that WASA staff could prepare replacement plans to incorporate these plans in an annual non-development/ development budgets, as well as recognize the importance of daily monitoring and its recording.

Review Questions

1) If you find a generator out of order, which do you recommend, repair or replacement?
2) How do you judge?

3) If you have a budget limitation in your replacement plan, which do you give a priority to, business area or school area?

Lecture 4

1. Lecture Information

Topics: 1) Pipeline replacement of Yokohama Water 2) asset database analysis and presentation by the participants	
Lecture Duration: 4 Hours	

2. Introduction of Topic

Review of day 1 **(10 minutes)**

The lecturer reviews the day 1 sessions: current asset monitoring/ replacement practices, emphasizing an importance of checklist preparation. The lecturer suggests a quantitative manner of evaluation would be necessary to procure a new asset.

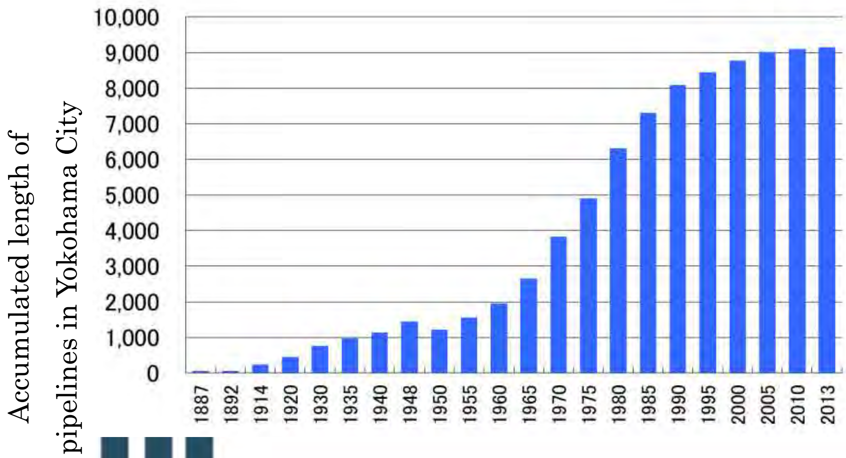
Reflection of day 1 **(10 minutes)**

The lecturer promotes each participant to present what he/ she learned in day 1.

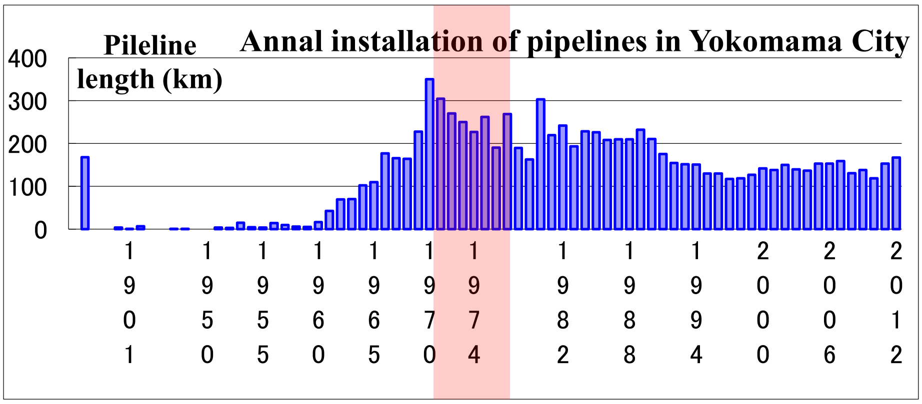
Lecture 1 (case study): Pipeline replacement of Yokohama Water **(20 minutes)**

In recent one (1) hundred years, Government of Japan has implemented a huge investment to increase water resources, water purification plants, pipelines to cope with growing demand. The policy is: supply enough (quantity) and safe (quality) water at reasonably lower prices. Yokohama city government is one of such typical local governments, as described below.

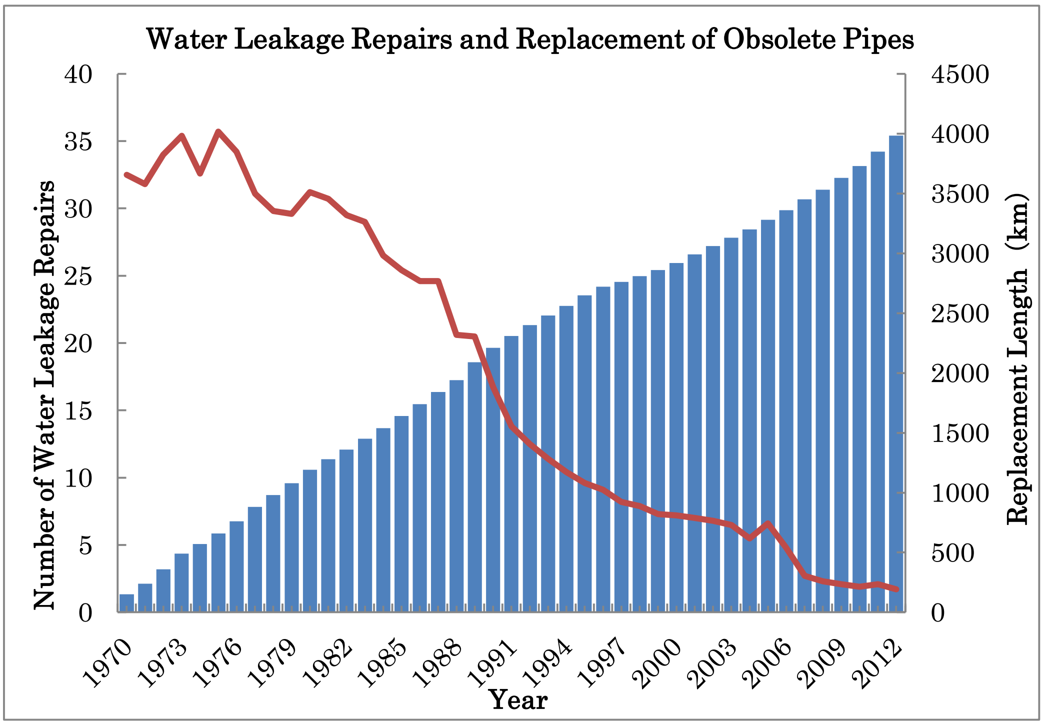
Yokohama Water Works was established in the year 1887. The Yokohama city population then was 140 thousand, and increased to 1 million in 1942, 2 million in 1968, 3 million in 1985, and 3.7 million now. Yokohama water works was merged in Yokohama city government to become "Yokohama Water Works Bureau (YWWB)". The YWWB has implemented a new pipeline installation every year to meet the increasing demand. Current length of the pipeline has reached to 9,100 km.



The following graph shows annual installation of new pipelines in Yokohama City. In Japan, life span of pipelines stipulated by law is forty (40) years. Japan used to achieve a rapid economic growth in 1960's and early 1970's until 1972, so called "Nixon shock". Annual installation then was 350 km, accumulating to 2,400 km. in this era, 1/4 of the total length, 9100 km.



Many water leakages were found in old pipes installed in early era of Yokohama Water Works. The City has, thus, implemented a replacement of old pipes since the year 1970, reaching to 3,900 km. The replacement has reduced numbers of leakage, from 30,000 in 1970 to 2,000 in 2011 and ratio of leakage from 20% to 5 %.



Group discussion **(20 minutes)**

YWWB has achieved 24-hour water supply, daily water quality analysis to meet consumers' demand. On the other hand, Lahore WASA carries out limited time of water supply. It might not meet growing demand of Lahore residents, as well as might generate a contamination of water. Participants will talk about what good practices of YWWB could be implemented in their WASA and how?

Asset database analysis exercise 1: **(40minutes)**

The following table shows tube wells in Iqbal Town of Lahore. Please conduct your database analysis in a table and graph, using Pivot Table in the Excel.

Some WASA staffs might conduct the database analysis with Pivot tables in excel.

Sr. No.	Name	Installation Year	Status	Town	Generator	Design Capacity	Actual Capacity	Condition	Replaceme	Motor_Size	Sub_Divisi
1	Chenab Block	2009	Functional	Iqbal Town	NILL	4 CFS	4 CFS	C	8	150 HP	Allama Iqbal Town
2	Pak Block	1986	Functional	Iqbal Town	YES	4 CFS	1.75 CFS	D	4	150 HP	Allama Iqbal Town
3	Asif Block	2014	Functional	Iqbal Town	NILL	4 CFS	4 CFS	A	14	150 HP	Allama Iqbal Town
4	Clifton Colony	2014	Functional	Iqbal Town	NILL	4 CFS	4 CFS	A	14	150 HP	Allama Iqbal Town
5	Neelum Block	2008	Functional	Iqbal Town	NILL	4 CFS	2 CFS	D	5	150 HP	Allama Iqbal Town
6	Hunza Block	2008	Functional	Iqbal Town	YES	2 CFS	2 CFS	C	7	80 HP	Allama Iqbal Town
7	College Block	1993	Functional	Iqbal Town	NILL	4 CFS	2 CFS	C	7	150 HP	Allama Iqbal Town
8	Raza Block	2009	Functional	Iqbal Town	NILL	4 CFS	4 CFS	C	9	150 HP	Allama Iqbal Town
9	Kareem Block	1996	Functional	Iqbal Town	NILL	4 CFS	1.75 CFS	D	4	150 HP	Allama Iqbal Town
10	Kareem Block Graveyard	2004	Functional	Iqbal Town	YES	2 CFS	2 CFS	C	8	80 HP	Allama Iqbal Town
11	Nishter Block	2009	Functional	Iqbal Town	NILL	2 CFS	1.90 CFS	D	6	80 HP	Allama Iqbal Town
12	F&V Market 2 Wadhat Road Multan Chungi	2009	Functional	Iqbal Town	NILL	4 CFS	4 CFS	B	8	150 HP	Allama Iqbal Town
13	F&V Market 1 Main Multan Road	2010	Functional	Iqbal Town	NILL	4 CFS	3.75 CFS	C	10	150 HP	Allama Iqbal Town
14	Ravi Block	2011	Functional	Iqbal Town	NILL	4 CFS	3.90 CFS	C	12	150 HP	Allama Iqbal Town
15	Nargis Block	2008	Functional	Iqbal Town	NILL	4 CFS	4 CFS	C	7	150 HP	Allama Iqbal Town
16	Huma Block	1999	Functional	Iqbal Town	NILL	4 CFS	3.25 CFS	C	8	150 HP	Allama Iqbal Town
17	Jahanzaib Block	1986	Functional	Iqbal Town	NILL	4 CFS	2 CFS	D	2	150 HP	Allama Iqbal Town
18	Kmaran Block	2010	Functional	Iqbal Town	NILL	4 CFS	3.75 CFS	C	10	150 HP	Allama Iqbal Town

Example 1-1: Installation year and actual capacity of tube wells

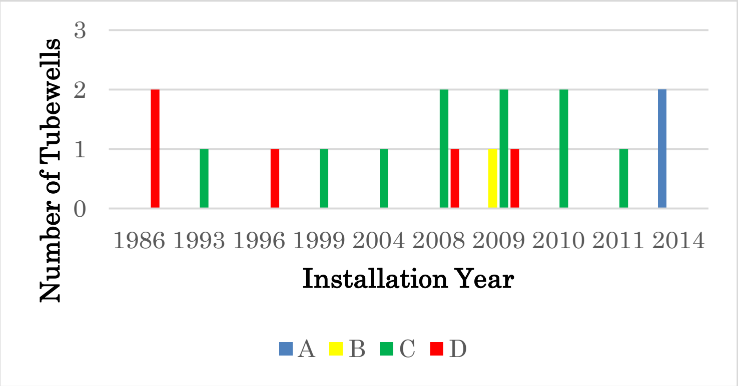
Installation Y	1.75 CFS	1.90 CFS	2 CFS	3.25 CFS	3.75 CFS	3.90 CFS	4 CFS	Total
1986	1		1					2
1993			1					1
1996	1							1
1999				1				1
2004			1					1
2008			2				1	3
2009		1					3	4
2010					2			2
2011						1		1
2014							2	2
Total	2	1	5	1	2	1	6	18

Example 1-2: Installation year and conditions (A, B, C, D) of tube wells (table)

Installation Y	A	B	C	D	Total
1986				2	2
1993			1		1
1996				1	1
1999			1		1
2004			1		1
2008			2	1	3
2009		1	2	1	4
2010			2		2
2011			1		1
2014	2				2
Total	2	1	10	5	18

The above table shows half of the tube wells in Iqbal Town are in C condition. The following graph might help visual understanding.

Example 1-3: Installation year and conditions (A, B, C, D) of tube wells (graph)



Even tube wells installed in the year 2009/ 2010 are now in C condition. It is important to clarify the reasons to implement countermeasures.

Presentation of asset database analysis by participants (40 minutes)

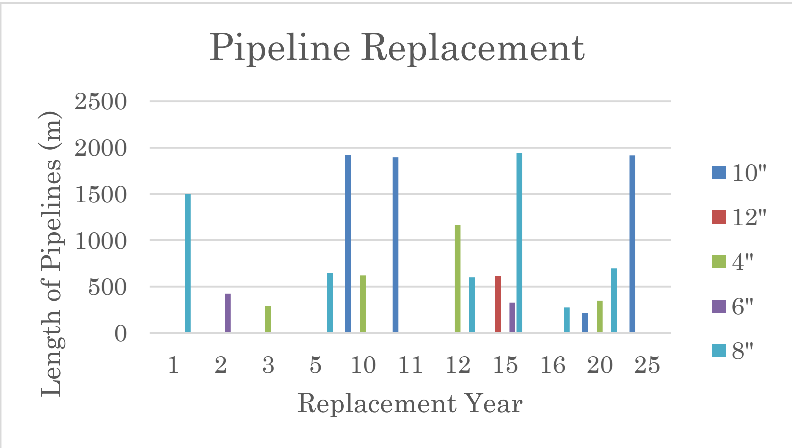
Each participant will present his/ her own database analysis results in the class, explaining observations with tables/ graphs. Some might say a large difference is found between design and actual capacity of many tube wells. Others might insist AC pipes should be replaced because many water leakages have been found in these pipes in Lahore.

Exercises 2 **(40 minutes)**

The following table shows a part of pipelines in Lahore. Please conduct your database analysis in a table and graph, using Pivot Table in the Excel.

Sr.No.	Street_Name	Sub_Division	Town	Diameter	Material	Installation year	Condition	Replacement_Diameter	Replacement_Year	Level	Risk	Shape_Length (m)
1	main pecco road	Township	Nishter Town	10"	AC	2,000.0	B	10"	11	P	M	1897
2	Main pecco road	Township	Nishter Town	10"	AC	2,011.0	B	10"	25	P	L	1916
3	Asghar MPA Road	Township	Nishter Town	8"	AC	2000	C	8"	1	T	H	579
4		Township	Nishter Town	8"	AC	2,000.0	B	8"	12	S	L	601
5	main pindi rajputa	Township	Nishter Town	6"	AC	1994	C	8"	2	S	M	426
6		Township	Nishter Town	10"	AC	2,010.0	B	10"	20	S	L	213
7		Township	Nishter Town	8"	AC	1995	B	8"	1	S	L	918
8	model town link road	Township	Nishter Town	8"	AC	2,009.0	B	8"	20	S	L	445
9	R Block Model town	Township	Nishter Town	4"	AC	1,994.0	B	4"	12	S	L	97
10	Karma_wala Bazar	Township	Nishter Town	6"	AC	1,986.0	B	6"	15	T	L	330
11	School road pindi rajputan	Township	Nishter Town	10"	AC	1994	B	10"	10	T	M	902
12	main bazar liaqtabad	Township	Nishter Town	10"	AC	1994	B	10"	10	T	M	1021
13	Nasrat Road Behar Colony	Township	Nishter Town	8"	AC	2000	B	10"	5	P	M	648
14		Township	Nishter Town	12"	AC	1,987.0	B	12"	15	T	L	479
15		Township	Nishter Town	8"	AC	1,987.0	B	8"	15	P	L	1943
16	extention	Township	Nishter Town	12"	AC	1,987.0	B	12"	15	S	L	139
17	Extention	Township	Nishter Town	4"	AC	1987	B	4"	10	T	L	175
18	Extention	Township	Nishter Town	8"	AC	2,000.0	B	8"	20	T	L	254
19	Extention	Township	Nishter Town	4"	AC	1,992.0	B	4"	12	T	L	123
20	KHADAM PARK	Township	Nishter Town	4"	AC	1,992.0	B	4"	12	T	L	110
21	R Block Model Town Extention	Township	Nishter Town	4"	PVC	1,992.0	B	4"	12	T	L	199
22	R Block Model Town Extention	Township	Nishter Town	4"	AC	1,992.0	B	4"	12	T	L	283
23	R Block Model Town Extention	Township	Nishter Town	4"	AC	1,992.0	B	4"	12	T	L	106
24	R Block Model Town Extention	Township	Nishter Town	4"	AC	1,992.0	B	4"	12	T	L	67
25	R Block Model Town Extention	Township	Nishter Town	4"	PVC	1,992.0	B	4"	12	T	L	107
26	Khadam Park near Itefaq Cricket Ground	Township	Nishter Town	8"	AC	2,000.0	B	8"	16	P	L	278
27	R Block Model Town Extention	Township	Nishter Town	4"	AC	1,992.0	B	4"	12	T	L	74
28		Township	Nishter Town	4"	AC	1987	B	6"	10	S	M	446
29	Q Block Model Town Extention	Township	Nishter Town	4"	AC	1987	B	6"	3	T	L	291
30	Q Block Model Colony	Township	Nishter Town	4"	AC	1,987.0	B	4"	20	T	L	246
31	Q Block Model Colony	Township	Nishter Town	4"	AC	1,974.0	B	4"	20	T	L	102

Example 2-1: Diameter (inch), length (meter) and replacement year of pipelines



Presentation of asset database analysis by participants **(40 minutes)**

Course participants will present their own database analysis results in the class. Some participants might show a graph with replacement year and pipe diameters/ lengths.

Conclusion **(20 minutes)**

The lecturer will conclude day 2 by reviewing an example of actual and prospective pipeline replacement in Yokohama and database analysis manners with actual data of tube wells and pipelines in Lahore. The lecturer will invite questions from course participants for further clarifications. Lastly it will be emphasized that both the daily practices described in Day 1 and replacement planning are important and co-related each other.

Review Questions

1) Many leakages have been found in AC pipes. Do you hear many customer complaints in AC pipe areas?
2) Would AC pipe replacement reduce customer complaints?
3) Would AC pipe replacement increase collection rates of water/ sewerage charges?

Lecture 5

1. Lecture Information

Topics: 1) Presentation of replacement plans by participants 2) Replacement cost
Lecture Duration: 4 Hours

2. Introduction of Topic

Review of day 2 **(10 minutes)**

The lecturer reviews the day 2 sessions: actual and prospective pipeline replacement in Yokohama and database analysis manners.

Reflection of day 2 **(10 minutes)**

The lecturer promotes each participant to present what he/ she learned in day 1/2 and how they would disseminate it to co-staffs.

Brain storming **(10 minutes)**

The lecturer asks participants what difficult exercises in Day2 are, thereby promoting them to help and teach each other.

Exercise 1 **(40 minutes)**

Let us add some information, e.g. how many years from installation. First please input a formula “=2016- installation year” to get how many years from installation. Then, for example, if you input

=IF(K3<6,"0-5",IF(K3<11,"6-10",IF(K3<16,"11-15",">15")))

Or

=IF(K5<=5,"0-5",IF(K5<=10,"6-10",IF(K5<=15,"11-15",IF(K5>15,">15"))))

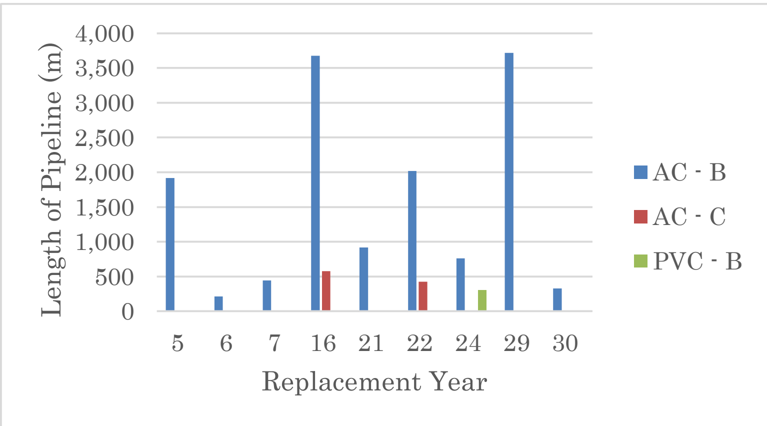
you can get a range of years from the installation.

Sr.No.	Street_Name	Sub_Division	Town	Diameter	Material	Installation Year	age	Condition	ment_Diameter	Replacement_Year	Replacement yr range	Level	Risk	Length of pipe (m)
1	main pecco road	Township	Nishter Town	10"	AC	2000	16	B	10"	11	11-15	P	M	1897
2	Main pecco road	Township	Nishter Town	10"	AC	2011	5	B	10"	25	>15	P	L	1916
3	Asghar MPA Road	Township	Nishter Town	8"	AC	2000	16	C	8"	1	0-5	T	H	579
4		Township	Nishter Town	8"	AC	2000	16	B	8"	12	11-15	S	L	601
5	main pindi rajputa	Township	Nishter Town	6"	AC	1994	22	C	8"	2	0-5	S	M	426
6		Township	Nishter Town	10"	AC	2010	6	B	10"	20	>15	S	L	213
7		Township	Nishter Town	8"	AC	1995	21	B	8"	1	0-5	S	L	918
8	model town link road	Township	Nishter Town	8"	AC	2009	7	B	8"	20	>15	S	L	445
9	R Block Model town	Township	Nishter Town	4"	AC	1994	22	B	4"	12	11-15	S	L	97
10	Karma_wala Bazar	Township	Nishter Town	6"	AC	1986	30	B	6"	15	11-15	T	L	330
11	School road pindi rajputan	Township	Nishter Town	10"	AC	1994	22	B	10"	10	6-10	T	M	902
12	main bazar liaqtabad	Township	Nishter Town	10"	AC	1994	22	B	10"	10	6-10	T	M	1021
13	Nasrat Road Behar Colony	Township	Nishter Town	8"	AC	2000	16	B	10"	5	0-5	P	M	648
14		Township	Nishter Town	12"	AC	1987	29	B	12"	15	11-15	T	L	479
15		Township	Nishter Town	8"	AC	1987	29	B	8"	15	11-15	P	L	1943
16	Q block model town extention	Township	Nishter Town	12"	AC	1987	29	B	12"	15	11-15	S	L	139
17	Q Block Model Town Extention	Township	Nishter Town	4"	AC	1987	29	B	4"	10	6-10	T	L	175
18	R Block Model Town Extention	Township	Nishter Town	8"	AC	2000	16	B	8"	20	>15	T	L	254
19	R Block Model Town Extention	Township	Nishter Town	4"	AC	1992	24	B	4"	12	11-15	T	L	123

Example 1-1: Age, condition, materials (AC/ PVC) and length of pipelines (table)

Shape_Length (m)	Material Condition					
	AC		AC Total	PVC	PVC Total	Ttoal
How many years from installation	B	C		B		
5	1,916		1,916			1,916
6	213		213			213
7	445		445			445
16	3,677	579	4,257			4,257
21	918		918			918
22	2,020	426	2,447			2,447
24	763		763	307	307	1,069
29	3,719		3,719			3,719
30	330		330			330
(空白)	102		102			102
Ttoal	14,103	1,006	15,109	307	307	15,416

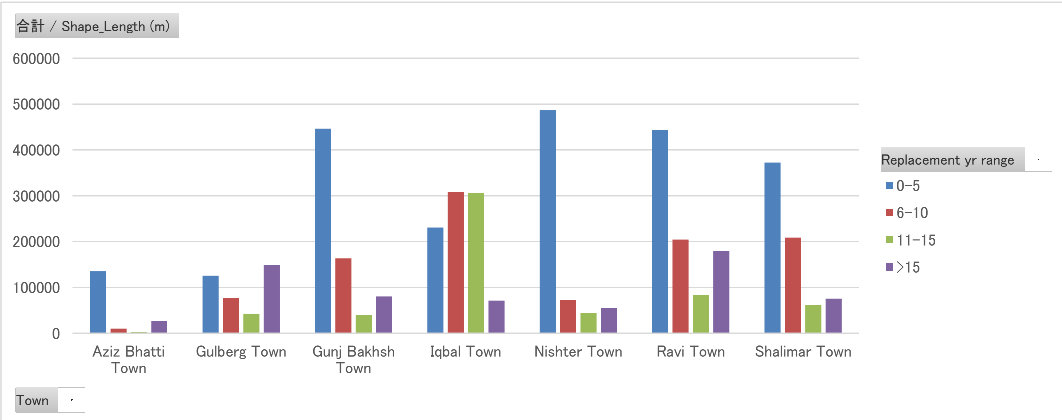
Example 1-2: Age, condition, materials (AC/ PVC) and length of pipelines (graph)



Example 1-3: Pipeline Replacement in each town of Lahore (table) unit: meter

Town	0-5	6-10	11-15	>15	Total
Aziz Bhatti Town	135324	10072	2717	26556	174669
Gulberg Town	125692	77557	42284	148704	394237
Gunj Bakhsh Town	446671	163515	39951	80041	730178
Iqbal Town	230795	308241	306631	71165	916832
Nishter Town	486552	72078	44200	54950	657779
Ravi Town	443878	204613	83309	179622	911422
Shalimar Town	372534	208761	61809	75268	718371
Total	2241445	1044837	580901	636306	4503490

Example 1-4: Pipeline Replacement in each town of Lahore (graph)



Presentation of replacement plans by participants (40 minutes)

Some participants might show their short/ medium/ long term replacement plans, using the "replacement year" in the database. It is, however, found in the above Example 1-2 that the replacement demand varies with the year. Annual budget would not fluctuate by as much as double or triple. It is important to make an effort to equalize distribution of replacement budget, by e.g. making those assets life spans longer with careful monitoring and preventive maintenance.

Exercise 2 (50 minutes)

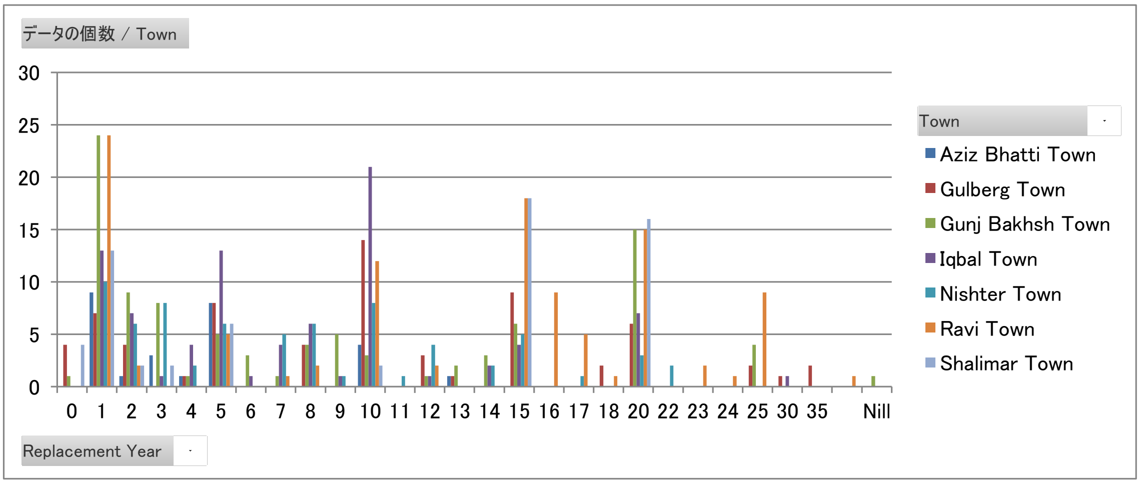
Please make your short/ medium/ long term replacement plans, using Pivot Table in the Excel.

The following table and graph shows a data analysis of all tube wells in Lahore.

Example 2-1 Tube well replacement from the year 2016 in each town of Lahore (table)

Town	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	20	22	23	24	25	30	35		Nill	Total
Aziz Bhatti Town		9	1	3	1	8					4			1															27
Gulberg Town	4	7	4		1	8			4		14		3	1		9			2	6				2	1	2			68
Gunj Bakhsh Town	1	24	9	8	1	5	3	1	4	5	3		1	2	3	6				15				4				1	96
Iqbal Town		13	7	1	4	13	1	4	6	1	21		1		2	4				7					1				86
Nishter Town		10	6	8	2	6		5	6	1	8	1	4		2	5		1		3	2								70
Ravi Town		24	2			5		1	2		12		2			18	9	5	1	15		2	1	9			1		109
Shalimar Town	4	13	2	2		6					2					18				16									63
Total	9	100	31	22	9	51	4	11	22	7	64	1	11	4	7	60	9	6	3	62	2	2	1	15	2	2	1	1	519

Example 2-2 Tube well replacement from the year 2016 in each town of Lahore (graph)



Replacement cost **(50 minutes)**

The following table shows a replacement cost of old water supply pipes. The old pipes should be replaced by HDPE. The following table shows the material and construction cost;

	A	B	C	D	E	F	G	H
1	Diameter		Material	Cost of Different Pressure Rated Pipes/m				Construction Cost/ m
2	(mm)	(Inch)		PN 8	PN 10	PN 12.5	PN 16	
3	50	2"	HDPE	97	120	148	181	244
4	110	4"	HDPE	473	582	713	864	529
5	160	6"	HDPE	1000	1220	1512	1835	1001
6	200	8"	HDPE	1560	1910	2355	2860	1539
7	250	10"	HDPE	2310	2836	3475	4461	2385
8	315	12"	HDPE	4095	4916	6161	7455	3321
9				*The cost is in Pak Rupee.*				

We'll need to add fields in "Existing Wtr supply lines" sheet as follows;

1. material cost per meter
2. Total Material cost
3. Construction cost per meter
4. Total Construction cost
5. Total Material and Construction Cost

Now it should look like below;

	R	S	T	U	V	W
1						
2	Cummulative Length	Material Cost/m	Total Material Cost	Const. Cost /m	Total Const. Cost	Total material & Const.
3	226.2397776					
4	630.9364019					
5	1179.331479					
6	1933.648482					
7	2375.146592					
8	2786.024012					
9	1896.653919					
10	3812.603351					
11	4026.008609					
12	4927.69519					
13	5949.189951					
14	6596.933937					
15	7152.397213					
16	7190.042472					
17	7194.756608					
18	7235.08102					
19	7415.415614					
20	8780.826129					
21	8790.551909					

Sub Divisions | Pivot Table | Exs Wtr supply Lines | Costing Table | Exs Tubewell | Exs Water Filtration Plant | Exs Valves

Now look if the following columns represent the mentioned fields in "Exs Wtr supply lines" sheet;

L= Replacement Diameter

Q= Length of Pipe

Now look in the costing table if these columns represent the mentioned fields;

B= Diameter (inch)

D= PN8 Cost/m

H= Construction Cost/m

Now in "Exs Wtr Supply line" sheet, select 'S3' cell to get the cost per meter for corresponding diameter in row # 3.

Input the following formula;

=IF(L3='Costing Table'!B$3,'Costing Table'!D$3,IF(L3='Costing Table'!B$4,'Costing Table'!D$4,IF(L3='Costing Table'!B$5,'Costing Table'!D$5,IF(L3='Costing Table'!B$6,'Costing Table'!D$6,IF(L3='Costing Table'!B$7,'Costing Table'!D$7,IF(L3='Costing Table'!B$8,'Costing

Table'!D$8))))))

Or simply do the following;

1. Type "=IF(L3="
2. Then go to "costing table" sheet and select 'B3'
3. Type comma, and then select "D3" and type a comma. The formula should look like this;

   =IF(L3='Costing Table'!B3,'Costing Table'!D3,
4. Now continue the formula, type "=IF(L3="
5. Then stay in "costing table" sheet and select 'B4'
6. Type comma, and then select "D4" and type a comma. The formula should look like this;

   =IF(L3='Costing Table'!B3,'Costing Table'!D3,IF(L3='Costing Table'!B4,'Costing Table'!D4,

You will continue this till "B8" and "D8" and at the insert))))). Also The formula should look like this

=IF(L3='Costing Table'!B3,'Costing Table'!D3,IF(L3='Costing Table'!B4,'Costing Table'!D4,IF(L3='Costing Table'!B5,'Costing Table'!D5,IF(L3='Costing Table'!B6,'Costing Table'!D6,IF(L3='Costing Table'!B7,'Costing Table'!D7,IF(L3='Costing Table'!B8,'Costing Table'!D8))))))

Now put the '$' sign between 'B' and 'D' values to fix the cells.

=IF(L3='Costing Table'!B$3,'Costing Table'!D$3,IF(L3='Costing Table'!B$4,'Costing Table'!D$4,IF(L3='Costing Table'!B$5,'Costing Table'!D$5,IF(L3='Costing Table'!B$6,'Costing Table'!D$6,IF(L3='Costing Table'!B$7,'Costing Table'!D$7,IF(L3='Costing Table'!B$8,'Costing Table'!D$8))))))

Now press enter, you will get "2310" if you have done it correctly.

R	S	T	U	V	
mulative I	Material Cost/m	Total Material Cost	Const. Cost /m	Total Const. Cost	Total mate
226.2397776	2310				
630.9364019					
1179.331479					
1933.648482					
2375.146592					
2786.024012					

If you double click on the bottom right corner, it will expand and apply the same formula till the last row.

Now in the “Total Material cost” go to ‘T3’ and type the following formula to get the Total material cost.

=Q3*S3

You will get the total material cost. Expand it by double clicking on bottom right corner of ‘T3’ cell and the formula will be applied till the last row.

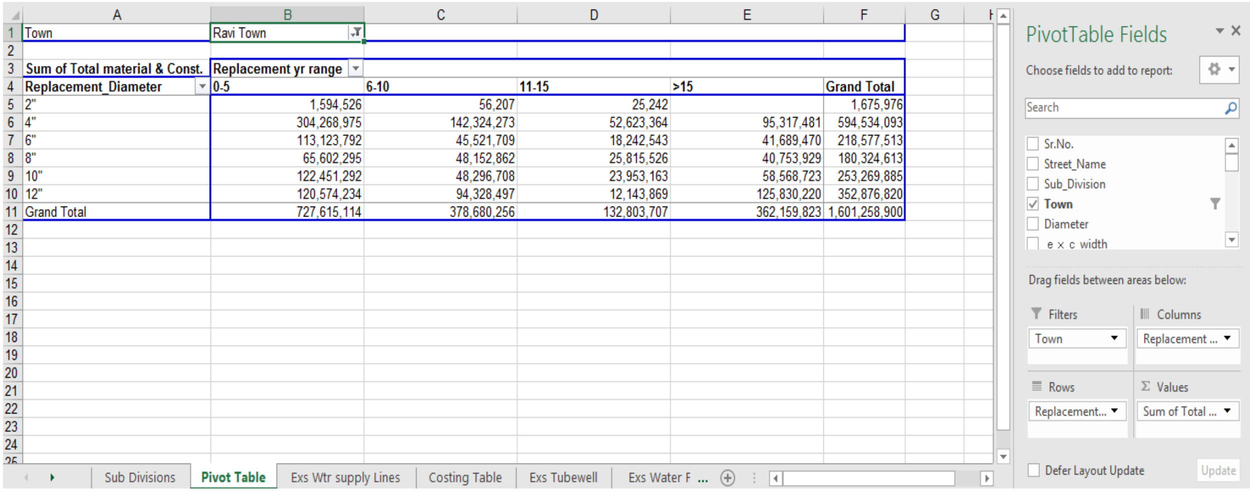
Now calculate the construction cost/m and total construction using the procedure you just learnt. You can get the total material and construction cost by adding the two already calculated material and construction costs.

The sheet will look like below.

P	Q	R	S	T	U	V	W
Risk	Length of pipe (m)	ımulative l	Material Cost/m	Total Material Cost	Const. Cost /m	Total Const. Cost	Total material & Const.
M	226.2397776	226.2397776	2310	522614	2385	539581.8697	1062196
M	404.6966243	630.9364019	2310	934849	2385	965201.4489	1900051
M	548.3950768	1179.331479	2310	1266793	2385	1307922.258	2574715
M	754.3170036	1933.648482	2310	1742472	2385	1799046.054	3541518
M	441.4981101	2375.146592	2310	1019861	2385	1052972.992	2072834
M	410.8774195	2786.024012	2310	949127	2385	979942.6455	1929069
M	1896.653919	1896.653919	2310	4381271	2385	4523519.597	8904790
L	1915.949432	3812.603351	2310	4425843	2385	4569539.396	8995383
L	213.4052574	4026.008609	2310	492966	2385	508971.5388	1001938
M	901.6865813	4927.69519	2310	2082896	2385	2150522.496	4233418
M	1021.494761	5949.189951	2310	2359653	2385	2436265.006	4795918
M	647.7439854	6596.933937	2310	1496289	2385	1544869.405	3041158
M	555.4632768	7152.397213	2310	1283120	2385	1324779.915	2607900
L	37.64525845	7190.042472	2310	86961	2385	89783.9414	176744
L	4.714136618	7194.756608	2310	10890	2385	11243.21583	22133
L	40.32441192	7235.08102	2310	93149	2385	96173.72242	189323
M	180.3345934	7415.415614	2310	416573	2385	430098.0053	846671
M	1365.410515	8780.826129	2310	3154098	2385	3256504.079	6410602
M	9.725779647	8790.551909	2310	22467	2385	23195.98446	45663

Table | Exs Wtr supply Lines | Costing Table | Exs Tubewell | Exs Water Filtration Plant | Exs Valves | ...

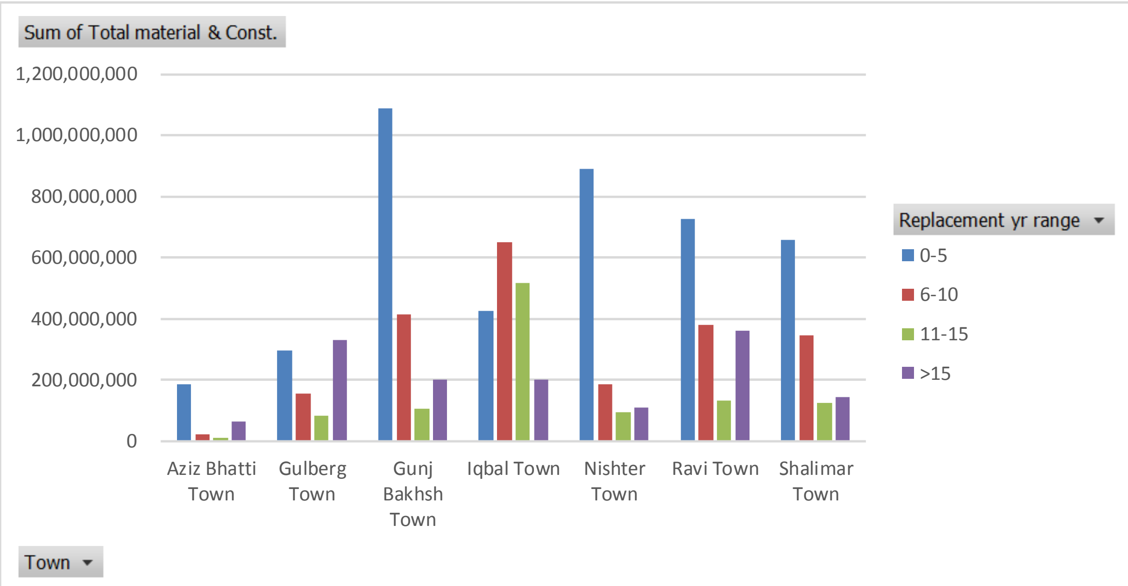
Now select the whole data and insert a pivot table to get the desired analysis. In this exercise , we have used the pivot table to generate the replacement cost of Ravi Town water supply pipes over a range of years as shown below.



Town	Ravi Town				
Sum of Total material & Const.	Replacement yr range				
Replacement_Diameter	0-5	6-10	11-15	>15	Grand Total
2"	1,594,526	56,207	25,242		1,675,976
4"	304,268,975	142,324,273	52,623,364	95,317,481	594,534,093
6"	113,123,792	45,521,709	18,242,543	41,689,470	218,577,513
8"	65,602,295	48,152,862	25,815,526	40,753,929	180,324,613
10"	122,451,292	48,296,708	23,953,163	58,568,723	253,269,885
12"	120,574,234	94,328,497	12,143,869	125,830,220	352,876,820
Grand Total	727,615,114	378,680,256	132,803,707	362,159,823	1,601,258,900

Then let's calculate the replacement cost of all water supply lines in Lahore over range of years.

Sum of Total mater	Replacement yr range				
Town	0-5	6-10	11-15	>15	Grand Total
Aziz Bhatti Town	185,403,496	19,756,561	9,588,960	63,813,814	278,562,832
Gulberg Town	297,436,638	155,803,822	83,009,541	331,050,800	867,300,802
Gunj Bakhsh Town	1,086,468,286	415,525,725	103,628,531	202,211,284	1,807,833,826
Iqbal Town	425,919,353	648,808,775	517,205,448	200,829,247	1,792,762,822
Nishter Town	888,594,127	183,652,234	92,780,167	108,259,202	1,273,285,729
Ravi Town	727,615,114	378,680,256	132,803,707	362,159,823	1,601,258,900
Shalimar Town	656,215,937	344,278,292	125,817,497	143,879,672	1,270,191,397
Grand Total	4,267,652,951	2,146,505,665	1,064,833,851	1,412,203,841	8,891,196,308



If you don't get the diameters or year range in proper order, then you can manually drag the rows or columns to desired position.

For the desired number format, you can just select the values and right click to go to "Number Format".

Presentation of replacement plans by participants (60 minutes)

Many participants would show their own short/ medium/ long term plans. If annual replacement budget is limited, we have to give a priority to allocate the budget. The following criteria, e.g. pipelines, might help allocate the budget.

- Pipelines with much leakages
- Pipelines providing water/ sewerage for wider area
- Pipe lines near schools or hospitals
- Pipelines near pumps
- AC pipelines
- Pipelines supplying areas with higher rates of water/ sewerage charge collection
- Pipelines without substitute lines (no backup)
- Leakage of the pipelines might lead another accident

It is, thus, more realistic to prepare replacement plans given a priority, e.g.

This year: priority 1, priority 2, priority 3

Next year: priority 4, priority 5, priority 6

If the priority 3 has not been implemented by the end of this year, priority 3 would be the first target for the next year.

Conclusion (20 minutes)

The lecturer will conclude day 3 by reviewing short/ medium/ long term replacement plans with actual data in Lahore. The lecturer will invite questions from course participants for further clarifications. Lastly the lecturer will emphasize implementation of what they learned from the course, and promoting them to:

1) Carry out a daily monitoring of assets with check sheets

2) Evaluate repair or replacement of the existing assets, especially those with values of more than two (2) million Rs.

3) Formulate of an annual “repair and maintenance” budget in non-development/ development, every year, May 15- June 15

Review Questions

1) What would be urgent replacement work for consumers?

2) Why do you give priority to the work?

3) How do you prepare necessary human resources/ good materials and fund (budget)?

Definition of Terms

Asset management

Asset management is to ensure that assets are on booked on the utility's register when placed in service, depreciated appropriately on an annual basis, and removed from the register when retired.

Asset replacement

Asset replacement is substitution of an entire asset with a new or equivalent asset without enhancement of capability. Replacement of assets is done when it is insufficient to keep the asset serviceable or when it is more cost effective to replace.

Replacement plan

Replacement plan outlines replacement or rehabilitation approaches to maximize the performance and minimize costs of the assets. It also describes what capital investments are needed in short/ medium/ long term.

Cost comparison

Cost comparison is a quantitative manner of selective judgment among more than two (2) cases by estimation of cash requirements and cumulative costs over asset life

Monitoring

Condition assessment to check deterioration or eventual failure of the existing assets

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1. Progress Report for Year II, March 2014, Punjab Cities Governance Improvement Project
2. Mechanism of Integrated Development & Asset Management Plan (IDAMP), 2015, Planning and Development Department, Government of Punjab
3. Uniform Financial Management Manual, Volume II Uniform FM Procedures Manual, Water and Sanitation Agencies (WASAs)
4. The Urban Unit, Standard Operating Procedures, Second Edition, Punjab Procurement Rules 2014

MODULE # 3

Asset Database Analysis

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Research Analyst,
The Urban Unit

Lecture Outline

Analysis

1. Asset Condition
2. Age analysis
3. Replacement Cost Calculation
4. Asset prioritization for Replacement

Database Description

Data Available

1	Street_Name	Sub_Division	Town	Diameter	Material	Installation	Condit	placement_Dia	Replacement_Y	Level	Risk	hape_Length
2	main pecco road	Township	Nishter Town	10"	AC	2000	B	10"	11	P	M	1896.653919
3	Main pecco road	Township	Nishter Town	10"	AC	2011	B	10"	25	P	L	1915.949432
5		Township	Nishter Town	6"	AC	2000	B	6"	12	S	L	600.8450439
7		Township	Nishter Town	10"	AC	2010	B	10"	20	S	L	213.4052574
9	model town link road	Township	Nishter Town	8"	AC	2009	B	8"	20	S	L	444.5776578
10	R Block Model town	Township	Nishter Town	4"	AC	1994	B	4"	12	S	L	97.24220231
11	Karma_wala Bazar	Township	Nishter Town	6"	AC	1986	B	6"	15	T	L	329.7944242
15		Township	Nishter Town	12"	AC	1987	B	12"	15	T	L	478.8977818
16		Township	Nishter Town	8"	AC	1987	B	8"	15	P	L	1943.078345
17	extention	Township	Nishter Town	12"	AC	1987	B	12"	15	S	L	139.3136498
19	Extention	Township	Nishter Town	8"	AC	2000	B	8"	20	T	L	253.9458667
20	Extention	Township	Nishter Town	4"	AC	1992	B	4"	12	T	L	123.0487501
21	KHADAM PARK	Township	Nishter Town	4"	AC	1992	B	4"	12	T	L	110.4099696
22	R Block Model Town Extention	Township	Nishter Town	4"	PVC	1992	B	4"	12	T	L	199.2874524
23	R Block Model Town Extention	Township	Nishter Town	4"	AC	1992	B	4"	12	T	L	282.9811107
24	R Block Model Town Extention	Township	Nishter Town	4"	AC	1992	B	4"	12	T	L	105.9039282
25	R Block Model Town Extention	Township	Nishter Town	4"	AC	1992	B	4"	12	T	L	66.6975641
26	R Block Model Town Extention	Township	Nishter Town	4"	PVC	1992	B	4"	12	T	L	107.4636598
27	Khadam Park near Itefaq Cricket Ground	Township	Nishter Town	8"	AC	2000	B	8"	16	P	L	277.9007926
28	R Block Model Town Extention	Township	Nishter Town	4"	AC	1992	B	4"	12	T	L	73.52308128
31	Q Block Model Colony	Township	Nishter Town	4"	AC	1987	B	4"	20	T	L	245.8719307
32	Q Block Model Colony	Township	Nishter Town	4"	AC	1974	B	4"	20	T	L	102.1487785
33	Q Block Model Colony	Township	Nishter Town	4"	AC	1974	B	4"	20	T	L	213.0720068
34	Q Block Model Colony	Township	Nishter Town	4"	AC	1974	B	4"	20	T	L	240.9920837
35	Q Block Model Colony	Township	Nishter Town	4"	AC	1974	B	4"	20	T	L	116.8837562
36	Q Block Model Colony	Township	Nishter Town	4"	AC	1974	B	4"	20	T	L	210.3503903
37	Q Block Model Colony	Township	Nishter Town	4"	AC	1974	B	4"	20	T	L	210.8930082
38	Q Block Model Colony	Township	Nishter Town	4"	AC	1974	B	4"	20	T	L	71.49516675

Figure 1: Water supply pipes data of Lahore

Asset attribute/information

Asset parameters include :

1	Diameter (inch)
2	Material (pipe material)
3	Year of Installation
4	Level (P,S T)
5	Condition (A,B,C,D,F)
6	Risk (H,M L)
7	Replacement Year
8	Replacement dia
9	Town Name
10	Subdivision/Zone Name

➢Asset Condition

Asset condition explains its state in term of defined ranking. For example

A =	Excellent: No noticeable defects. Some aging or wear may be visible.
B =	Good: Only minor deterioration or defects are evident.
C =	Fair: Some deterioration or defects are evident, but function is not significantly affected.
D =	Poor: Serious deterioration in at least some portion of the structure. Function is inadequate.
F =	Failed: No longer functional. General failure or complete failure of a major structural component.

➢Asset Risk

Risk is the probability of failure of the asset and defined in term of High, Medium and Low:

H → High
M → Medium
L → low

Cont.

➢Level

Level is classified in three classes; Primary level, secondary level and tertiary level. In the attribute table they will be shown as:

P → Primary,
S → Secondary,
T →Tertiary

Cont.

➢ Replacement Year

Replacement year indicates the remaining life of an asset and provide information on when an asset should be replaced.

➢ Replacement diameter

Replacement diameter means when a pipe has to be replaced, what should be its future diameter and also diameter reveals the information that whether it should be changed or should remain same.

Summary of WASAs Lahore

	Lahore	Gujranwala	Faisalabad	Multan	Rawalpindi
Tube wells	519	53	85	104	400
Water Pipelines (km)	4500	507	1436	1290	714
Disposal stations	99	22	22	20	-
Sewerage Pipeline (km)	3957	808	1760	1382	134

What is Pivot Table?

Pivot tables are one of Excel's most powerful features.

✓A pivot table allows you to extract , summarize and explore data interactively from detailed data set.

✓Building a pivot table is the process of answering questions you have about the data e.g.,:

- ✓What is total length of Pipes by Subdivision?
- ✓What is the length of pipelines with 6” diameter?

✓Once you create a pivot table, you can quickly transform huge numbers of rows and columns into a meaningful, nicely formatted report.

Open your MS Excel file.
Our data set consists of 35865 rows and 12 fields.

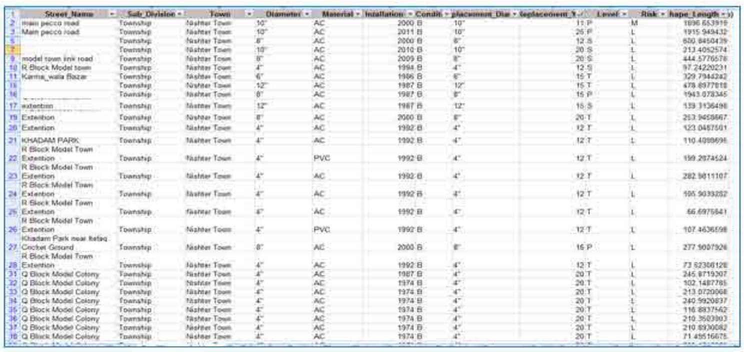


Figure 1: Water supply pipes data of Lahore

Excel Sheet

Steps for creating pivot tables

Steps for creating **pivot tables:**

- Select the data you want to analyze,
- Then go to Insert and click on "Pivot Table"
- Choose "New Work Sheet" for the Pivot table to be placed

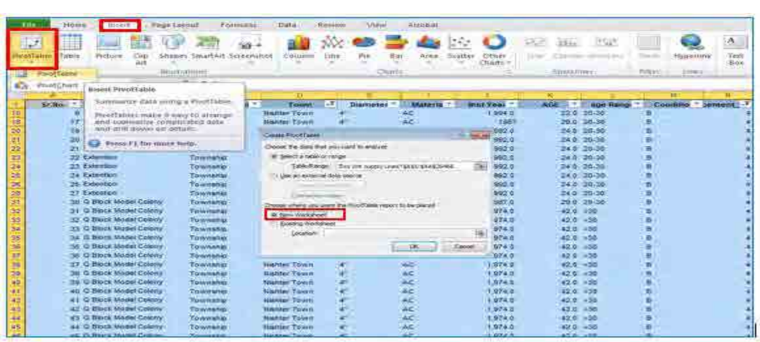
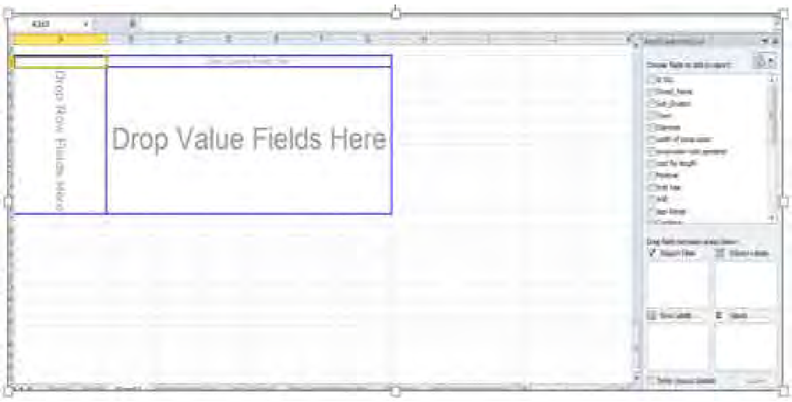


Figure 2: Creating Pivot Table

ALJAZARI ACADEMY

Cont.



ALJAZARI ACADEMY

Asset Condition Analysis

Assignment

Please prepare the following in steps;

1. Table and graph showing %age of pipelength in terms of condition on subdivision level.

2. The D condition lines will be then categorized according diameter. (3" to 6") with lengths

3. Write a brief report on findings
Step taken
Way forward

Assignment

Please prepare the following in steps;

1. Categories the pipeline data age wise and select a subdivision which has oldest pipes.

2. Rank the lines as per their condition.

3.Calculate the Total replacement cost for D & F condition pipes. (Relevant WASA)
4.Write brief paragraph on findings.

HDPE Pipes Rates (Lahore)	
4	351.64
5	412.28
6	485.04
8	703.28
10	1057.8
12	1701.1

Asbestos Cement Pipes Rates	
Pipe Size "	rates
3	719.8
4	935.15
6	1479.1
8	2484.05
10	3380.05
12	4465.75
14	6396.4
16	8133.3
18	10117.1
20	12447.65
24	17178.1