

**DEVELOPMENT OF AN INTEGRATED
ENVIRONMENTAL CONTROL SYSTEM FOR
IDENTIFICATION AND EVALUATION OF SURFACE
AND GROUND WATER CONTAMINATION**



**A THESIS
SUBMITTED IN PARTIAL FULFILMENT OF
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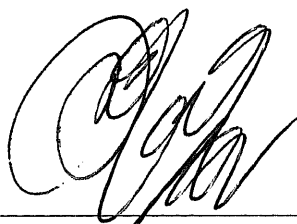


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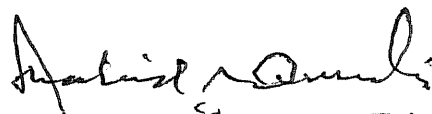


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ABSTRACT

ABSTRACT

Various natural processes including geological, hydrological, climateological, meteorological and biological process seriously damage environment which leads to the disruption of social and communal harmony. The main concern is the protection of public health and protection of eco-system both of which compliment to each other in demanding absolute standards of very high level of quality. To meet challenges an integrated environmental control system was developed for monitoring and modeling of surface and ground water contamination by deploying Visual Basic, for Windows 95 Platform.

The main objectives of this Integrated environmental control system (IECS) is to provide standard possible reasons for contamination due to physicochemical and hydro-chemical changes and to determine their impact on surface and groundwater, and on surrounding biophysical resources. IECS would be able to identify and analyze major environmental impacts in terms of magnitude, direction, duration, location, and also provide preventive measures to minimize these impacts. Concisely this system comprises of collection of data, water analysis, prediction of impacts, reasons for contamination, evaluation of preventives and framing of recommendations. Water quality analysis are formulated after consulting environmental quality standards of different countries including WHO.

Envision can be utilized in any country for monitoring and modeling of surface and ground water contamination. This system is also very useful for universities, environmental research organizations and water resources management organizations. This system can also be utilized in petroleum industry at exploration and production locations for evaluation of ground water contamination. The output of EnVision is directed to printer, fully customizable 2d/3d charts, commercial software file export, internet browser specific and general HTML page.

CHAPTER - 1

INTRODUCTION

INTRODUCTION

Water is renewable source, which cycle and transported through various phases between cloud, rain, snow and ice. Saline water confined to ocean, frozen water locked in polar icecaps and glaciers, groundwater stored in aquifer equilibrium with fresh water in lakes and rivers are available for man. The continuous provision of this water from agriculture, flora and fauna, industry, power generation and domesticity depends basically on atmospheric process and can be influenced by " man activities on the earth surface". The main concern is the protection of public health and protection of eco-system both of which compliment to each other in demanding absolute standards of very high level of quality. In order to achieve this quality Integrated Environmental Control System was developed for monitoring and modeling of surface and groundwater contamination (Fig. 1.1 & 1.2). Specifically this system is committed to;

- It would seek efficient use of groundwater, surface water and wastewater along with its treatment. This could be achieved by continuous improvement in our environmental performance supported by development and managing water in accordance with world water quality standards.
- It would contribute constructively to the development and improvement of health effects, safety regulation and polices.

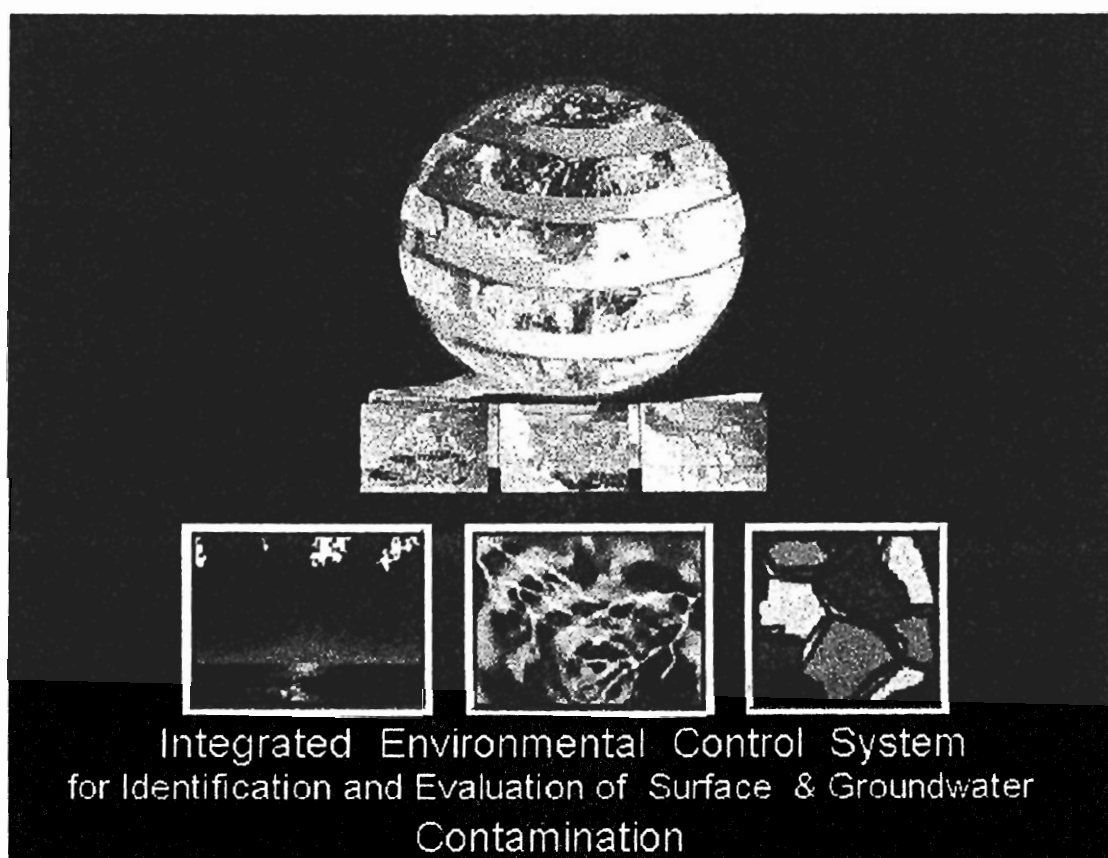


Fig. 1.1. Integrated Environmental Control System (EnVision).

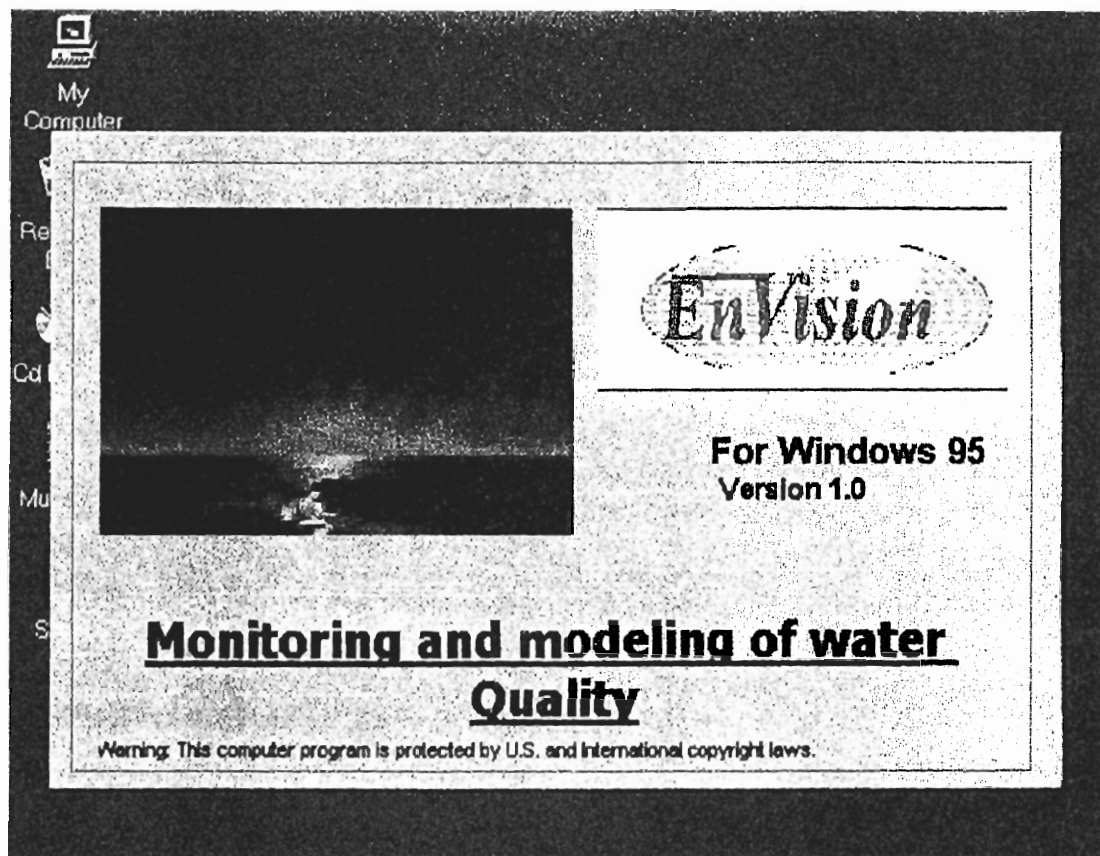


Fig. 1.2. EnVision Monitoring and Modeling of Water Quality.

- The environmental impact of any activity and reasoning for significant changes would be assessed in terms of magnitude, direction, duration and location.
- It would give preventive and remedial measure for pursuing and reducing the toxic substances and industrial effluents, substances undesirable in excessive amount and microbiological content.
- It would provide convenient source for those involved in developing and implementing their national standards as well as for those engaged in research work.
- It would generally provide practical remedial and preventive measure.

This Integrated environmental control system is a promise to healthy and environment friendly surroundings Worldwide. The Windows 95 based application mainly concerns with: -

- ◆ Seamless detection and evaluation of contamination
- ◆ Monitoring of Hazardous environmental impacts
- ◆ Productive and reliable water analysis
- ◆ Expert suggestions and recommendations

It also provides today's hottest market demanding cutting-edge tools and technologies. The features enriched software directs output under following formats:-

- ◆ Fully customizable 2d / 3d graphical charts
- ◆ Soft and hard copy outputs (Disk files / printer output)
- ◆ Commercial software file export
- ◆ Internet Browser specific and general HTML document

CHAPTER - 2

ENVIRONMENTAL POLLUTION

ENVIRONMENTAL POLLUTION

For the first time in his entire cultural history, man is facing one of the most horrible ecological crisis-the problem of pollution of his environment, which sometime in past was pure, virgin, undisturbed, uncontaminated and basically quite hospitable for him. Despite all progress poverty, starvation, and pollution reflect mankind's failure to design social and political institutions which are capable of properly assessing and controlling technological innovations.

Environmental pollution is the unfavorable alteration of our surroundings, wholly or largely as a by-product of man's actions, through direct or indirect effects of changes in energy patterns, radiation levels, chemical and physical constitution and abundances of organisms. The changes may affect man directly or through his supplies of water and of agricultural and other biological products, his physical objects or possessions, or his opportunities for recreation and appreciation of nature.

ORIGIN OF POLLUTION

White (1967) and McHarg (1969) had blamed Judeo-Christian ethic for pollution which taught man to believe that the earth was made for man to do with as he wished, and thereby encouraged exploitation. This view was contradicted by Wright (1970) who pointed out that the Judeo-Christian religion teaches stewardship and he postulated that it is not

religious belief but human greed and ignorance which have permitted our culture to develop an ecological crisis like pollution. Tuan (1970) explained an ancient oriental culture untouched by the Judeo-Christian tradition which despoiled their forests and faced ecological crisis.

Southwick, (1976) has associated the human population explosion with the pollution problem. He postulated that with more people there has been more sewage, more solid wastes, more fuel being burned, more fertilizers and insecticides being used to produce more food for hungry mouths. But, there have been certain writers who have pointed out that it has been the wasteful aspects of our technology which strive always to produce more convenient products ("disposable" items) which pollute our environment.

Modern ecologists like Odum (1971), Southwick (1976) and Smith (1977) who regarded many factors such as human population explosion, unplanned urbanization and deforestation, profit oriented capitalism and technological advancement, which may be responsible for origin of pollution crisis on earth, in fact, in countries having the greatest technological advances, the worst pollution occurs.

POLLUTANTS- THE CREATORS OF POLLUTION

A pollutant may be defined as any thing, living or non living, or any physical agent (e.g., heat, sound) that in its excess makes any part of the environment undesirable; if water, undesirable for drinking, recreation, visual enjoyment, or as a habitat for the aquatic life normal to it: if air, undesirable for breathing, for the condition of buildings and monuments exposed to it, or for animal and plant life; if soil and land, undesirable for raising food and fiber, animals, or for recreation or aesthetic enjoyment.

In common usage, "pollutant" is a term which is applied usually to nonliving, man-made substances or other nuisances, present in such concentration in a particular location as may be or tend to be injurious to environment.

TYPES OF POLLUTANTS

According to Katyal & Satake, 1989 certain common pollutants of developed and under developed countries are as follows:

(i) Gaseous pollutants: Oxides of nitrogen (particularly, nitric oxide, NO; nitrogen dioxide, NO₂) SO₂, H₂S, CO, halogens (chlorine, bromine, iodine).

(ii) Fluoride compounds

(iii) Metals: Mercury, lead, iron, zinc, nickel, tin, cadmium, etc.

(iv) Complex organic pollutants: Benzene, benzpyrens, acetic acid, ether, etc.

(v) Photochemical Oxidants: Ozone, PBzN, NO_x, aldehyde, ethylene, etc.

(vi) Deposited matter: Soot, smoke, tar, dust, grit etc.

(vii) Solid waste

(viii)Economic poisons: Herbicides, fungicides, pesticides, nematocidcs, insecticides, rodenticides, and other biocides.

(ix) Fertilizers

(x) Radioactive waste

(xi) Noise

(xii)Heat

Table 2.1 Order of Pollutant Priority.

<i>Order of pollutant priority</i>	<i>Medium</i>
I. SO _x suspended particles Strontium, caesium	Air Food
II. Ozone DDT and other organo- chlorine compounds	Air Biota, Man
III. Nitrates, nitrites Oxides of nitrogen	Drinking water Air
IV. Mercury compounds Lead and CO	Food, Water Food and air
V. Petroleum hydrocarbons Carbon monoxide	Sea Air
VI. Fluorides	Water(Fresh)
VIII. Asbestos	Air
XI. Arsenic	Drinking water
X. Mycotoxins and microbial Contaminants	Food

TYPES OF POLLUTION

The usual practice to classify pollution is done according to the environment i.e., air, water, soil in which it occurs or according to the type of pollutant e.g. lead, mercury, carbon dioxide, solid waste, noise, biocide, heat, etc. by which pollution has been caused (Fig. 2.1).

Sometimes, pollution is made to classify into two broad categories:

(a) *Natural pollution.* It originates from natural processes.

(b) *Artificial (Anthropogenic) pollution.* It originates due to activities of man.

Types of pollution:

- | | |
|--------------------------|------------------------|
| 1. Air Pollution | 5. Marine Pollution |
| 2. Water Pollution | 6. Noise Pollution |
| 3. Solid Waste Pollution | 7. Radiation Pollution |
| 4. Land Pollution | 8. Thermal Pollution |

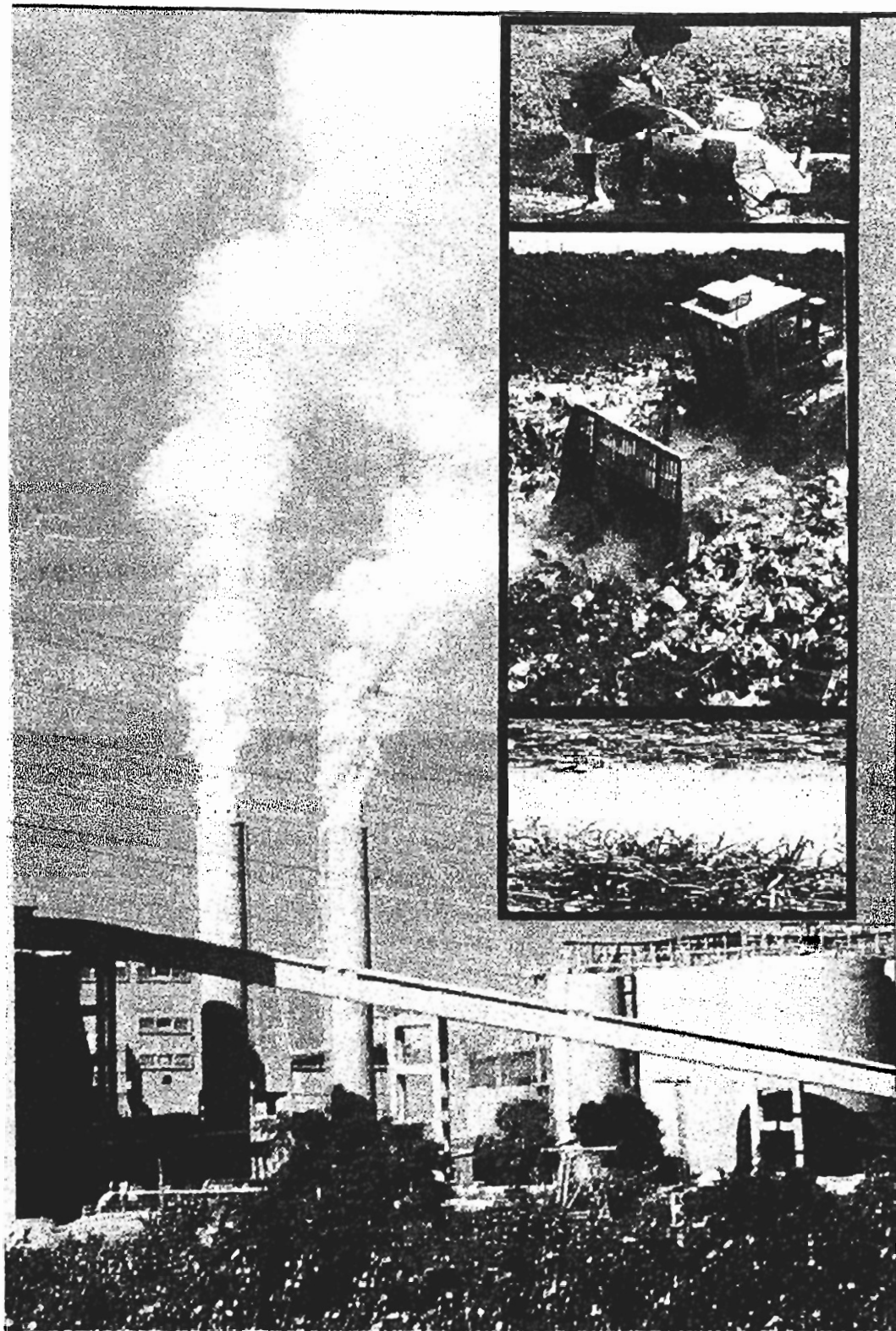


Fig. 2.1. Different sources of Environmental Pollution.

EFFECTS OF POLLUTION

Effects On Humans

Human beings are probably most concerned about the direct effects of pollutants upon their own health, even though these effects are not necessarily the most dangerous over the long run. There is growing evidence that many chronic diseases (such as, asthma, emphysema, and bronchitis) are environmentally induced and results from long-term exposures to levels of various substances too low to produce acute effects. Asbestos is known to produce increased mortality from lung cancer and asbestosis (severe scarring of the lungs by asbestos fibers) among asbestos workers but these effects take 20 to 30 years to show up.

It has been recognized that many diseases are waterborne and that their frequency can be checked dramatically through purification of municipal and individual water supplies. The increasing use of artificial fertilizers, agricultural runoff, refuse dump runoff, disposal of waste from animal and human, changes in land use, soil type, geological condition are main factors responsible for the progressive increase in nitrate level in water supplies. Its most important effect in long-term exposure is an increase in methemoglobin level accompanied by histopathological change in lungs and heart. Arsenic is introduced in water through the dissolution of minerals and ores from industrial effluent, and via atmospheric deposition. Concentration of arsenic is considered to be most toxic form associated with estimated excess life time skin cancer. Water, with higher Turbidity

level, affects microbiological quality of drinking water and its presence effect on disinfection.

Effects On Plants

Agriculture and horticulture are both affected by pollution. The characteristic types of injury produced by photochemical smog have become so severe in some parts of world that it is essentially impossible to grow orchids, spinach, romaine lettuce, Swiss chard and some other leafy plants. Air pollutants having severe effects on vegetation include sulfur oxides (from copper and lead smelters) and hydrogen fluoride (from fertilizer manufacturing and aluminum reduction). Even when pollution levels have been not high enough to produce noticeable injury, retardation of growth may occur. As some plants have been likely to be more sensitive than others to the pollutant, whether it be an air or water pollutant or radiation, there may occur complex changes in the plant ecosystem, having effects on one species leading to effects on the others. Sometimes the undesirable effect of a pollutant has been the increase in plant life, as when the introduction of plant nutrients such as phosphorus, nitrogen, and carbon gives rise to algal blooms in water bodies.

Effects On Animals

Air pollutants are known to produce eye and respiratory irritation in animals as well as in humans. Mankind has even made use of the sensitivity of some animals to certain pollutants; an example is the use of

canaries to detect poisonous gases in coalmines as well as nerve gas near trains that are carrying it. Water pollutants can also endanger aquatic life and every year millions of fish are reported killed by municipal and industrial wastes. Sewage, toxic chemicals, and disease organisms can also make water unfit for use by farm animals. There are some types of known pollution that have adverse effects on animals at levels that do not appear to affect human health. The excess heating of water in rivers or lakes can kill fish, and pesticide levels in many species of birds have reduced reproduction rates through mechanisms like as interference in calcium metabolism.

Effects On Materials

Pollutants are able to accelerate the deterioration of materials and construction. Air pollutants, particularly sulfur dioxide gas and the sulfuric acid aerosols into which the gas is converted in the atmosphere, can corrode metals and building materials, increasing the frequency of repair and replacement. Water pollutants, like suspended particles or dissolved inorganic compounds, can also adversely affect pumps, industrial equipment, and bridges.

Synergism And Antagonism

It has been impossible to discuss the effects of pollution properly merely by discussing the effects of individual pollutants. Combined effects of two or more pollutants are more severe or even qualitatively different

from the individual effects of the separate pollutants is termed as *synergism* (Katyal & Satake, 1989). Matter, such as aerosols of soluble salts of ferrous iron, manganese, and vanadium, can increase the toxicity of sulphur dioxide. Sometimes the combined effects of two pollutants are less rather than more severe, and this situation is referred to as *antagonism* (Katyal & Satake, 1989). Cyanides in industrial wastes are quite poisonous to aquatic life, and in the presence of zinc or cadmium they are extremely poisonous (Katyal & Satake, 1989).

Global Effects

One of the most worrisome aspects of the growth of pollution has been that man has now become a major factor in several of the great biogeochemical cycles and may be causing irreversible change or irreparable harm without realizing it. These biogeochemical cycles are the circulation of various elements through the biosphere (the part of the earth characterized by the existence of plant or animal life), the atmosphere, the hydrosphere (the earth's oceans and other waters), and the lithosphere (the solid part of the earth's surface). Since the on set of the industrial revolution, there happen to be subtle but significant changes in the biosphere. These changes have been got accelerated in recent years, so that in the momentary span of less than 100 years many forms of life have become threatened with extinction, and the health and welfare of a man himself has been in jeopardy (Katyal & Satake, 1989).

CHAPTER - 3

WATER POLLUTION

WATER POLLUTION

Water pollution refers to degradation of water quality as measured by biological, chemical, or physical criteria. Degradation of water is generally judged in terms of the intended use of the water, departure from norm, effects on public health, or ecological impacts (Keller, 1992).

Point And Non-Point Pollution Sources

Sources of pollution may be subdivided into Point sources and Non-point sources (Fig. 3.1). Point sources, as their name suggests, are sources from which pollution are released at one readily identifiable spot: such as pipes that empty into streams or rivers from industrial or municipal site viz. steel null, a septic tank. Non-point sources are more diffused and intermittent and are influenced by such factors as land use, climate, hydrology, topography, native vegetation, and geology. Common Non-point sources include fertilizer runoff from farmland, acid drainage from an abandoned strip mine, or runoff of sodium or calcium chloride from road salts. The point sources are often easier to identify as potential pollution problems (Fig. 3.2).

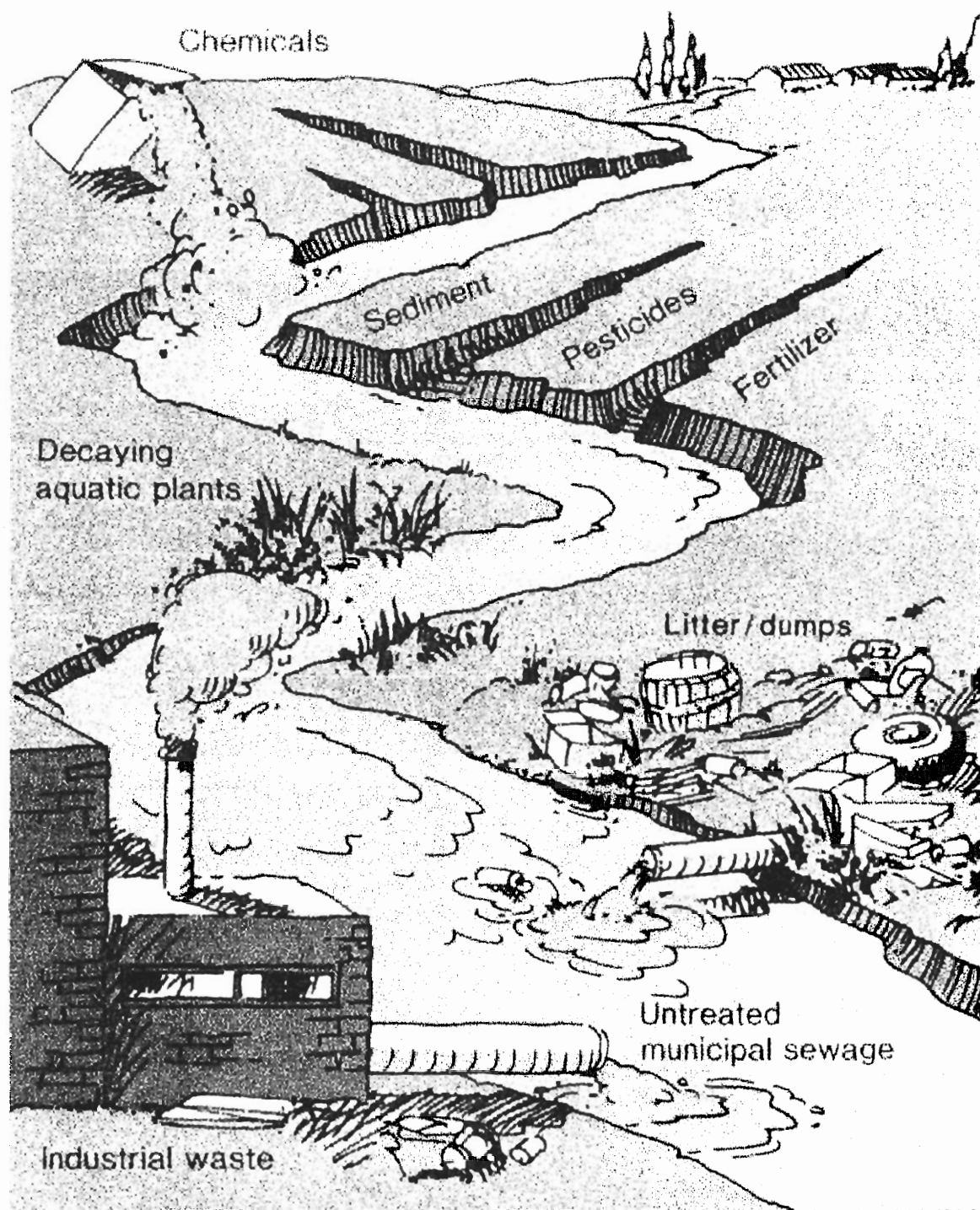


Fig. 3.1. Point and Non-Point sources of water pollution.

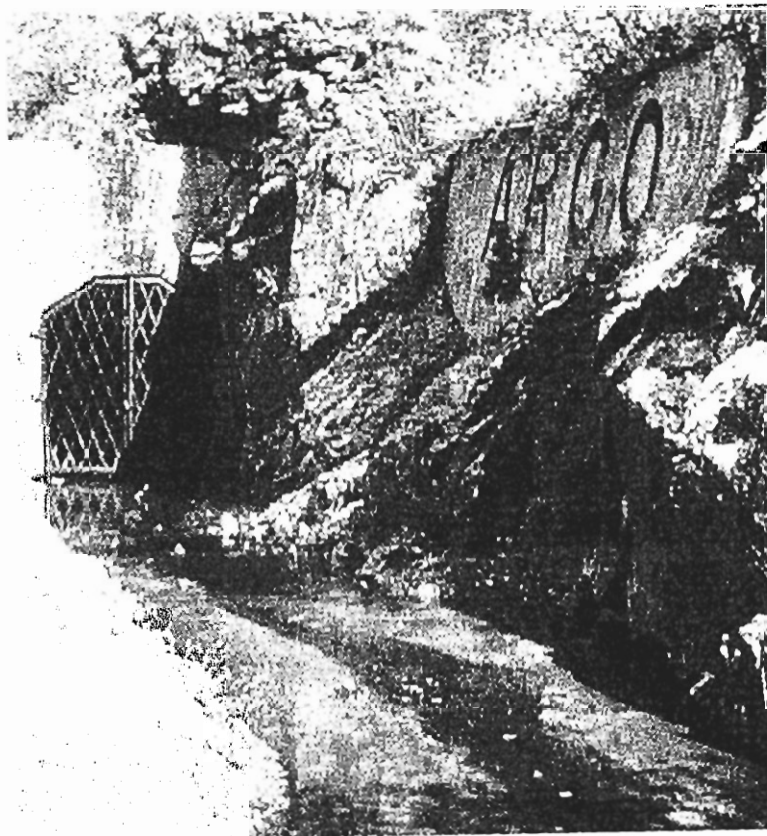


Fig. 3.2. Point Source identifying potential pollution problem.

SOURCES OF WATER POLLUTION

The major sources of water pollution could be classified as ground, surface, domestic, industrial, agricultural, and shipping wastewater.

Groundwater Pollution

Groundwater pollution, whether from point or Non-point sources is especially insidious because it is not visible and often goes undetected for some time. Also, in most instances, the passage of pollutants from their source into an aquifer used for drinking water is slow because that passage occurs by permeation through rocks and soils, not by overland flow. There may, therefore, be a significant time lapse between the introduction of a pollutant into the system in one spot and its appearance in groundwater elsewhere. This is a problem with many old, abandoned toxic-waste dumpsites. Groundwater pollution from Non-point sources, like farmland, is also likely to be so widespread that cleanup is not feasible.

Surface Water Pollution

Surface water pollution occurs when too much of an undesirable or harmful substance flows into a body of water, exceeding the natural ability of that ecosystem to utilize, or remove the undesirable material or convert it to a harmless form.

Domestic Water Pollution

It includes wastewater from homes and commercial establishments. Domestic wastewater arises from many small sources spread over a fairly wide area but is transmitted by sewers to a municipal waste treatment plant.

Industrial Water Pollution

Hundreds of new chemicals are created by industrial scientists each year. The rate at which new chemicals are developed makes it impossible to demonstrate the safety of the new chemicals as fast as they are invented.

- **Organic Compounds**

The majority of new chemical compounds created each year are organic (carbon-containing) compounds. Many thousands of these compounds, naturally occurring and synthetic, are widely used as herbicides and pesticides, as well as in a variety of industrial processes. Their negative effects in organisms vary with the particular type of compound: Some are carcinogenic, some are directly toxic to humans or other organisms, and others make water unpalatable. Some also accumulate in organisms like the heavy metals (Montgomery, 1992).

- **Organic matter**

Organic matter in general (as distinguished from the smaller subset of toxic organic compounds) includes a variety of materials, ranging from dead leaves settling in a stream to algae on a pond. It's most abundant and problematic form in the context of water pollution is human and animal wastes. Feedlots and other animal-husbandry activities create large concentrations of animal wastes. Food processing plants are other sources of large quantities of organic matter discharged in wastewater.

Most of rivers and fresh-water streams are seriously polluted by industrial wastes or effluents. Which come along waste waters of different industries such as petro-chemical complexes; fertilizer factories; oil refineries ; pulp, paper, textile, sugar and steel mills, tanneries, distilleries, coal washeries, synthetic material plants for drugs, fibers, rubber, plastics, etc. The industrial wastes of these industries and mills include metals (copper, zinc, lead, mercury, etc.), detergents, petroleum, acids, alkalis, phenols, carbonates, alcohols, cyanide, arsenic, chlorine and many other inorganic and organic toxicants. All of these chemicals or industrial wastes have been toxic to animals and may bring about death or sublethal pathology of the liver, kidneys, reproductive systems, respiratory systems, or nervous systems in both in vertebrate and vertebrate aquatic animals (Katyal & Satake, 1989).

Agricultural Water Pollution

It includes sediments, fertilizer, and farm animal wastes. These pollutants can all enter waterways as runoff from agricultural lands but farm animal wastes are an especially large problem near the large feedlots on which thousands of animals are concentrated (Katyal & Satake, 1989). Three principal constituents of commercial fertilizers are nitrates, phosphates, and potash when applied to or incorporated in the soil, they are not immediately taken up by plants. The compounds must be soluble for plants to use them, but that means that they can also dissolve in surface and ground runoff water. These plant foods then contribute to eutrophication problems (Montgomery, 1992).

Shipping Water Pollution

It includes both human sewage and other waste. The most important of which has been oil. Oil pollution, an oxygen-demanding waste, is of concern not only from sensational major spills from ships and offshore drilling rigs but also from small spills and cleaning operations.

Some water pollution is caused due to solid wastes that are not; prevented from contaminating surface and groundwater, and some is caused due to the settling of air pollutants (Katyal & Satake, 1989).

Sediment Water Pollution

In many agricultural areas, sediment pollution of lakes and streams is the most serious water-quality problem. Sediment transport is a perfectly natural consequence of stream erosion, but agricultural development typically increases erosion rates by four to nine times unless agricultural practices are chosen carefully. Sediment pollution not only causes water to be murky and unpleasant to look at, swim in, or drink, but it also reduces the light available to underwater plants (Montgomery, 1992).

Thermal Water Pollution

Heating of waters, primarily from hot-water emission from industrial operation and power plants, causes thermal pollution. There are several problems with heated water. Water several degrees warmer than the surrounding water holds less oxygen. Warmer water favors different species than cooler water and may increase growth rates of undesirable organism (Montgomery, 1992).

PRINCIPAL EFFECTS OF WATER POLLUTION

Several waterborne infectious diseases are directly related to polluted water. Well water contaminated by nitrates from fertilizer runoff poses a hazard to health, particularly for infants (Katyal & Satake, 1989). The toxic and pathological effects of some heavy metal water pollutants have been tabulated in Table 3.1.

Table 3.1. Pathological effects of heavy metal water pollutants (Katyal & Satake, 1989).

Metal	Pathological effects on man
1. Mercury	Abdominal pain, headache, diarrhea, hemolysis, chest pain.
2. Lead	Anemia, vomiting, loss of appetite, convulsions, damage of brain, liver and Kidney.
3. Arsenic	Disturbed peripheral circulation, mental disturbance, liver cirrhosis, hyperkeratosis, lung cancer, ulcers in gastrointestinal tract, kidney damage.
4. Cadmium	Diarrhea, growth retardation, bone deformation, kidney damage, testicular atrophy, anemia, injury of central nervous system and liver, hypertension.
5. Copper	Hypertension, uremia, coma, sporadic fever.
6. Barium	Excessive salivation, vomiting, diarrhea, paralysis, Colic pain.
7. Zinc	Vomiting, renal damage, cramps.
8. Selenium	Damage of liver, kidney and spleen, fever, nervousness, vomiting, low blood pressure, blindness, and even death.
9. Hexavalent chromium	Nephritis, gastrointestinal ulceration, diseases in central nervous system, cancer.
10. Cobalt	Diarrhea, low blood pressure, lung irritation, bone deformities, paralysis.

WATER POLLUTANT

From a public health or ecologic point of view, a pollutant is any biological, physical, or chemical substance in which identifiable excess is known to be harmful to other desirable living organism. Thus excessive amounts of heavy metals, certain radioactive isotopes, phosphorus, nitrogen, sodium, and other useful even necessary elements, as well as certain pathogenic bacteria and viruses, are all pollutants(Keller, 1992).

Many synthetic organic and inorganic compounds are also toxic to people and other living things. When these materials are accidentally introduced into surface or subsurface waters, serious pollution may occur.

CLASSIFICATION OF POLLUTANTS

Biochemical Oxygen Demand (BOD)

Dead organic matter in streams decays. Bacteria carrying out this decay require oxygen. If there is enough bacterial activity, the oxygen in the water can be reduced to levels so low which affects aquatic life; because they cause annoying odors; impair domestic and livestock water supplies by affecting taste, odors, and colors and they may give rise to scum and solids that make water unseful.

A stream without oxygen is a dead stream for fish and many organisms we value. The amount of oxygen required for such biochemical decomposition is called the biochemical oxygen demand (BOD), a

commonly used measure in water quality management (Keller, 1992). Approximately 33% of all BOD in streams results from agricultural activities, but urban areas, particularly those with sewer systems that combine sewage and storm water runoff, may add considerable BOD to stream during floods, when sewers entering treatment plants can be overloaded and overflow into streams, producing pollution events (Keller, 1992). Precisely, strong sewage or other oxygen-demanding wastes from industry or agriculture can lead to the depletion of the dissolved oxygen in the water. "Septic" conditions are said to be present when the dissolved oxygen- level is very low (Katyal & Satake, 1989).

Fecal Coliform Bacteria

Waste water released from municipalities, Santeria, tanning and slaughtering plants, and boats may be sources of bacteria or other microorganisms which are capable of producing disease in men and animals, including livestock.

There have been several types of human infections, not all of which are transmissible through water (Table 3.2).

Table 3.2. Human infections (Katyal & Satake, 1989).

Human Infections
<ul style="list-style-type: none"> • Animal infections that are of public health importance because they are transmissible to man. <ul style="list-style-type: none"> • Tetanus from horses and cattle transmitted by inoculation or contact with animal feces. • Bubonic plague from wild rodents by insect: (flea) bite. • Anthrax from herbivorous animals by direct contact. • Rabies from dogs, bats, etc., by bites. • Bovine tuberculosis from cattle through ingestion or airborne transmission. • Jungle yellow fever from monkeys through mosquito bites. • Several types of encephalitis from birds and fowl through mosquito bites. • Trichinosis from swine through ingestion. • Primarily human infections in which the infective agent has a certain period of extra human residence before transmission. <ul style="list-style-type: none"> • Schistosomiasis ("snail fever") from water from snails. • Urban yellow fever from mosquitoes. • Hookworm from soil by skin penetration. • Malaria (also a mosquito infection) from mosquitoes. • Typhus from lice. • Infections that persist or multiply in the external environment and are transmissible from man to man. <ul style="list-style-type: none"> • Cholera, typhoid fever, bacillary dysentery, poliomyelitis, and infectious hepatitis from water and food through ingestion. • Staphylococcal and streptococcal diseases from food, air and the proximate environment through contact and inhalation. • Smallpox from air, dust, and the proximate environment through inhalation. • Cocksackie and ECHO virus diseases from water through ingestion.

Coliform bacteria like *Escherichia coli* have been normal inhabitants of human and animal intestines, and the daily per capita excretion in human feces may number from 125 to 400 billion (Katyal & Satake, 1989). These organisms get reduced in number in the water by death in the non-normal environment and by their removal and destruction in wastewater and drinking water treatment processes.

Plant Nutrients

Plant nutrients, like nitrogen and phosphorus, released by human activity and variety of sources related to land use are able to stimulate the growth of aquatic plants, which get interfere with water uses and later decay to produce disagreeable odors and add to the BOD of the water.

Increase in nutrients (eutrophication) is often observed in urban streams because of the introduction of fertilizers, detergents, and the products of sewage treatment plants. The highest concentration of phosphorus and nitrogen are found in agricultural areas- site of such sources are fertilized farm fields and feedlots.

Exotic Organic Chemicals

The exotic organic chemicals include surfactants in detergents Pesticides, various industrial products, and the decomposition products of other organic compounds. Analysis of polluted waters reveals the presence

of a wide variety of these compounds. As many new chemical compounds get introduced each year without much knowledge of their effects on natural ecosystems, there exists always a possibility that irreversible damage might get caused before scientists could be able to realize it.

Oil spills, are one kind of organic-compound pollution. At least as much additional oil pollution occurs each year from the careless disposal of used crankcase oil, dumping of bilge from ships, and the runoff of oil from city streets during rainstorms. Underground tanks and pipelines may also leak, and drilling muds and waste brines discarded in oil fields may be contaminated with petroleum.

Inorganic Pollutants- Metals

Many of the inorganic industrial pollutants of particular concern are potentially toxic metals. Manufacturing, mining, and mineral-processing activities can all increase the influxes of these naturally occurring substances into the environment and locally increase concentrations from harmless to toxic levels. Examples of metal pollutants commonly released in wastewater from various industries are shown in Table 3.3.

Table 3.3. Principal trace metals in industrial wastewater (Katyal & Satake, 1989).

Industry	Metals
Mining and Ore processing	Arsenic, beryllium, cadmium, lead, mercury, manganese, uranium, zinc
Metallurgy, alloys	Arsenic, beryllium, bismuth, cadmium, chromium, copper, lead, mercury, nickel, vanadium, zinc.
Chemical Industry	Arsenic, barium, cadmium, chromium, copper, lead, mercury, tin, uranium, vanadium, zinc.
Glass	Arsenic, barium, lead, nickel.
Pulp and paper mill	Chromium, copper, lead, mercury, nickel
Textile	Arsenic, barium, cadmium, copper, lead, mercury, nickels.
Fertilizer	Arsenic, cadmium, chromium, copper, lead, mercury, manganese, nickel, zinc.
Petroleum refining	Arsenic, cadmium, chromium, copper, lead, nickel, vanadium, zinc.

Other Inorganic Pollutants

Some nonmetallic elements commonly used in industry are also potentially toxic to aquatic life, if not to humans. For example, chlorine is widely used to kill bacteria in municipal water and sewage treatment plants and to destroy various microorganisms that might otherwise foul the plumbing in power stations. Released in wastewater, it can also kill algae and harm fish populations.

Sediments

Sediments are soil and mineral particles which are washed from the land by storms or floodwaters, from croplands, unprotected forest soils, overgrazed pastures, strip mines, roads, and bulldozed urban areas. It depletes a land resource (soil) at its site of origin, reduces the quality of the water resource it enters, and may deposit sterile materials on productive croplands or other useful land. Sediments are able to fill stream channels and reservoirs; erode power turbines and pumping equipment; reduce the amount of sunlight available to green aquatic plants and plug water filters.

Heavy metals such as mercury, zinc, and cadmium are dangerous pollutants and are often deposited with natural sediment in the bottoms of stream channels. If these metals are deposited on floodplains, then the heavy metals may become incorporated in plants food crops, and animals. If they are dissolved and the water is withdrawn for agriculture or human use, heavy metal poisoning can result.

Radioactive Substances

Harmful radiation may result in water environments from the wastes of uranium and thorium mining and refining, from nuclear power plants; and from industrial, medical, and scientific utilization of radioactive materials.

CHAPTER - 4

PREVIOUS WATER QUALITY CONTROL METHODOLOGY

PREVIOUS WATER QUALITY CONTROL METHODOLOGY

Field Data Acquisition And Handling

Generally local area information collected for a project e.g., geographical location, temperature, humidity, source of sample, nature of the sample, water table, sample code, are entered into a Proforma for further processing.

Observed Water Quality Parameters Data Handling

The laboratory results for each sample are usually entered into a table sheet (Fig 4.1) which has very limited number of water quality parameters with no broad classification. This data sheet lacks standardized values for highest desirable level and Maximum Permissible level. Further such data sheet would not fulfil overall requirements and would not be safe for its proper use in future.

Analysis For Contamination

After getting observed values the analyst evaluate that which water quality parameter is not in a feasible range with reference to its standardized value. If a constituent is found contaminated, then the analyst has to look for its causes for contamination, preventive measures and other related information. For such analysis and interpretation a lot of efforts are required in order to accumulate data and information from

GOVERNMENT OF PAKISTAN
MINISTRY OF SCIENCE & TECHNOLOGY
PAKISTAN COUNCIL OF RESEARCH IN WATER RESOURCES

AESTHETIC, PHYSICO-CHEMICAL AND BACTERIOLOGICAL ANALYSIS REPORT

Sample No. 251 Sample Code WQL 12 Date of Collection 18-11-1993
Location T-9/2 Time A.M/P.M Temp. 20 °C
Source of Sample _____ (Cistern/Tap/Stream/Well/Tube well/
Dam/Hand pump/Pond/Spring).
Name of Collector _____ Date of Analysis _____

Sl. No.	Water Quality Parameters	Measured As	Highest Desirable Level	Result
1.	Alkalinity	(m/mol/l)	NGVS	<u>8.64</u>
2.	Barium	mg/l	NGVS	<u>09</u>
3.	Bicarbonate	mg/l	NGVS	<u>420</u>
4.	Calcium	mg/l	75 (KSA)	<u>59</u>
5.	Carbonate	mg/l	NGVS	<u>-</u>
6.	Chemical Oxygen Demand	mg/l	Variable	<u>-</u>
7.	Chloride as Cl.	mg/l	250 (WHO)	<u>106.35</u>
8.	Colour	TCU	15 (WHO)	<u>Muddy</u>
9.	Conductivity	micro-S	500 (MJ)	<u>1240</u>
10.	Dissolved Oxygen	mg/l	3-4 (MJ)	<u>3</u>
11.	Free Carbondioxide	mg/l	NGVS	<u>-</u>
12.	Free Chlorine	mg/l	NGVS	<u>-</u>
13.	Hardness as CaCO ₃	mg/l	500 (WHO)	<u>475</u>
14.	Iron	mg/l	0.3 (WHO)	<u>2.5</u>
15.	Lead	mg/l	0.05 (WHO)	<u>-</u>
16.	Lithium	mg/l	NGVS	<u>25</u>
17.	Magnesium	mg/l	150 (Canad)	<u>-</u>
18.	Nitrate (N)	mg/l	10 (WHO)	<u>1.1</u>
19.	Odour	-	Odourless	<u>Odour</u>
20.	pH	-	6.5 - 8.5	<u>6.5</u>
21.	Phosphate	mg/l	1-5 (MJ)	<u>9.1</u>
22.	Potassium	mg/l	NGVS	<u>9</u>
23.	Salinity	mg/l	NGVS	<u>-</u>
24.	Sodium	mg/l	200 (WHO)	<u>130</u>
25.	Taste	-	Unobjectionable	<u>Objectionable</u>
26.	Total Chlorine	mg/l	NGVS	<u>-</u>
27.	Total Dissolved Solid	mg/l	1000 (WHO)	<u>739</u>
28.	Turbidity	NTU	5 (WHO)	<u>112</u>
	Fluoride	-	-	<u>.13</u>
29.	Coliform	-	30. Non-Coliform	<u>-</u>
31.	E. Coliform	-	-	<u>-</u>

REMARKS: _____

NGVS: No Guideline Value Set
WHO: World Health Organization Standards
KSA: Saudi Arabian Standards
Canad: Canadian Standards
MJ: M. Jaffer, Phy.Chem. Vol.4, No.1, P.10, 1985

[Signature]
Assistant Director
PCRWR, House 5, St.17,
P-6/2, Islamabad.

PPM
Ar 0.06 ✓ ≈ 0.05
Zn 0.006
Ni 0.005
Cr NIL
Pb NIL
Cd NIL

Fig. 4.1. Previously adopted table-sheet for local area information and observed water quality parameters.

libraries and research organizations. Besides this no tools are available to represent contamination of a specific constituent in graphical mode. Thus all such processes make the decision-making process slow, lengthy and nonproductive.

In manual data processing there is still a need for the improvement of qualitative, quantitative and systematic approach to accelerate analysis of data to produce accurate results and information with proper handling.

By considering all the above difficulties Computer Aided Integrated Environmental Control System has been designed to overcome all such discrepancies.

CHAPTER - 5

SOFTWARE DESCRIPTION

SOFTWARE DESCRIPTION

Schematic Diagram Of Integrated Environmental Control System.

Schematic diagram for the development of Integrated Environmental Control System (EnVision) is shown in Figure 5.1. From this diagram an observer can easily analyze logical and operational flow of IECS features.

SOFTWARE FEATURES

Data-base Management System (DBMS)

DBMS deals with the world water quality standards. This system has the capabilities of deleting, modifying and updating water quality parameters (Fig. 5.2). DBMS manage water quality parameters under following categories; Aesthetic Physical and Chemical parameters, Trace metals and Organic parameters, and Bacteriological parameters. The following reference have been consulted during the preparation of DBMS: APHA (1985), Adriano (1986), Craun (1984), CCME (1991), Davis & Dewiest (1966), Dart (1974), Eden (1965), Fair (1954), Frazer (1980), Goyer (1986), IWE (1960), Jhon (1977), GCDW (1978), Michael & Suess (1982), Jaffar (1985), Oehme (1978), US-EPA (1972), US-EPA (1976), US-EPA (1978), US-EPA (1991), WHO (1984), WHO (1985), WHO (1995), WHO (1996).

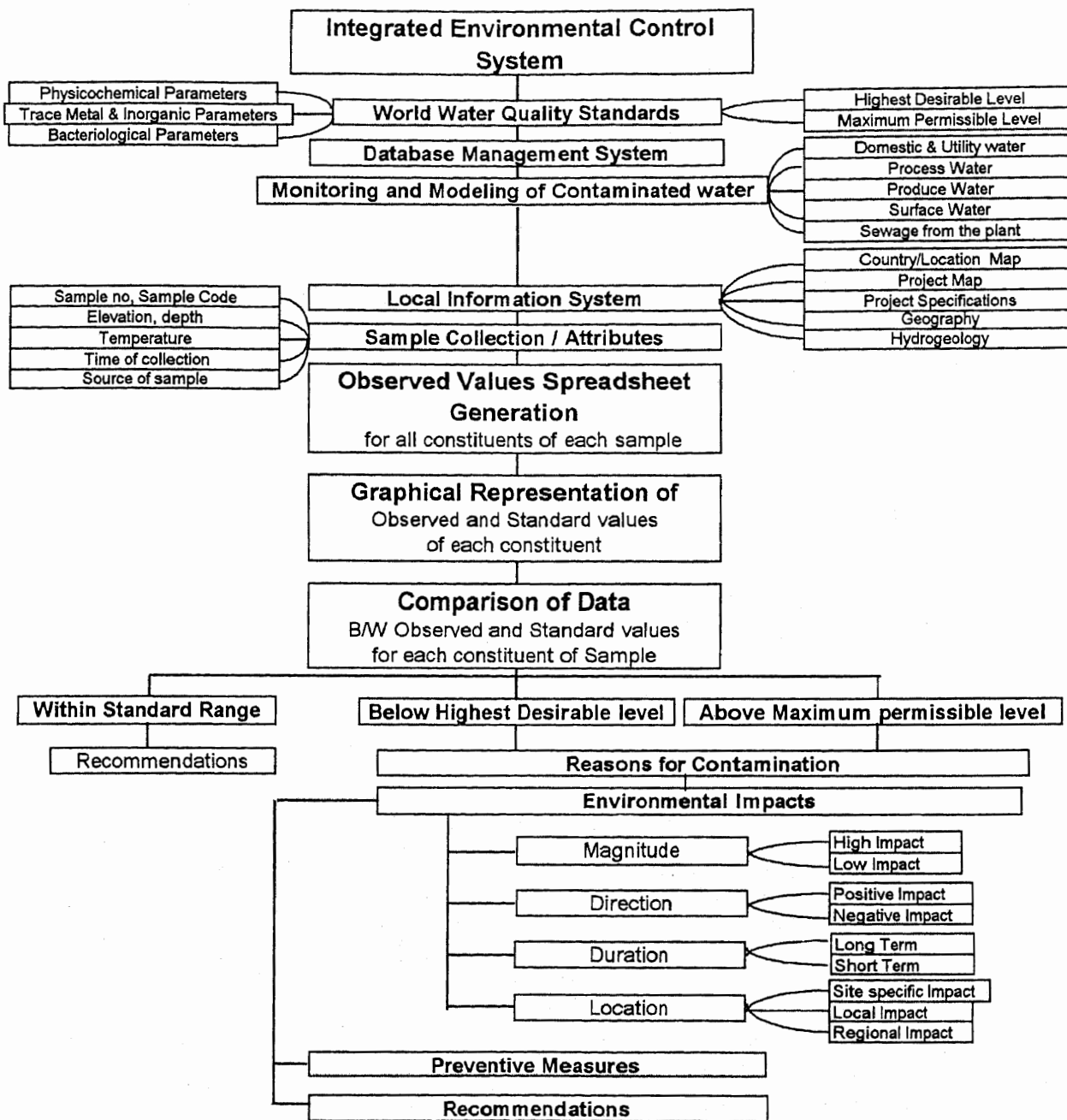


Fig. 5.1. Schematic diagram for Integrated Environmental Control System.

Visual Artist's EnVision - [Sample-2: LabResults of Sample No N/A]

File Edit Sample View Window Help

Water Quality Parameters	Units	Highest Desirable Level	Maximum Permissible Level
Aesthetic Physical and Chemical Parameters			
Alkalinity	m/mol/l	50.00	500.00
Bi Carbonate	mg/l	0.00	NGVS
Carbonate	mg/l	0.00	0.00
Chemical Oxygen Demand	mg/l	0.00	
Chloride	mg/l	200.00	600.00
Colour	TCU	5.00	15.00
Conductivity	micro-sec	500.00	0.00
Density	gm/ml	0.00	0.00
Dissolved Oxygen	mg/l	3.00	4.00
Free CO2	mg/l	NGVS	NGVS
Hardness as CaCO3	mg/l	200.00	500.00
Nitrate	mg/l	10.00	45.00
pH		6.50	8.50
Phosphate	mg/l	1.00	5.00
Salinity	mg/l	0.00	0.00
Sulphate	mg/l	200.00	400.00
T.D.S	mg/l	500.00	1500.00
Total Chlorine	mg/l	0.00	0.00
Turbidity	NTU	2.50	5.00
Taste	NTU	2.50	5.00
Odour	mg/l	5.00	15.00

Sample-2: LabResults of Sample No: N/A 5/26/99 6:18 PM NUM CAPS SCRL

Fig. 5.2. EnVision Database Management System showing standardized values of water quality parameters with reference to their HDL and MPL level.

Local Information System (LIS)

LIS deals with project area information (Fig. 5.3 & 5.4). Local Information system allow users to enter project specific information pertaining to location Map, Project Map, Geographical and Hydro-geological information of the area.

Sample Collection And Attributes

This feature facilitates comprehensive sample related data input for every sample collected from a project area. Data includes Sample no, Sample code, Elevation, Time, Temperature, depth etc. (Fig. 5.5).

Data Sheet For Observed Values

This part actually receives observed water quality parameters for each sample collected in tabular format (Fig. 5.6, 5.7 & 5.8). This is the actual raw values upon which monitoring and modeling of water quality is performed. All these entered values would be viewed and hardcopied at a later stage (Fig. 5.9, 5.10 & 5.11).

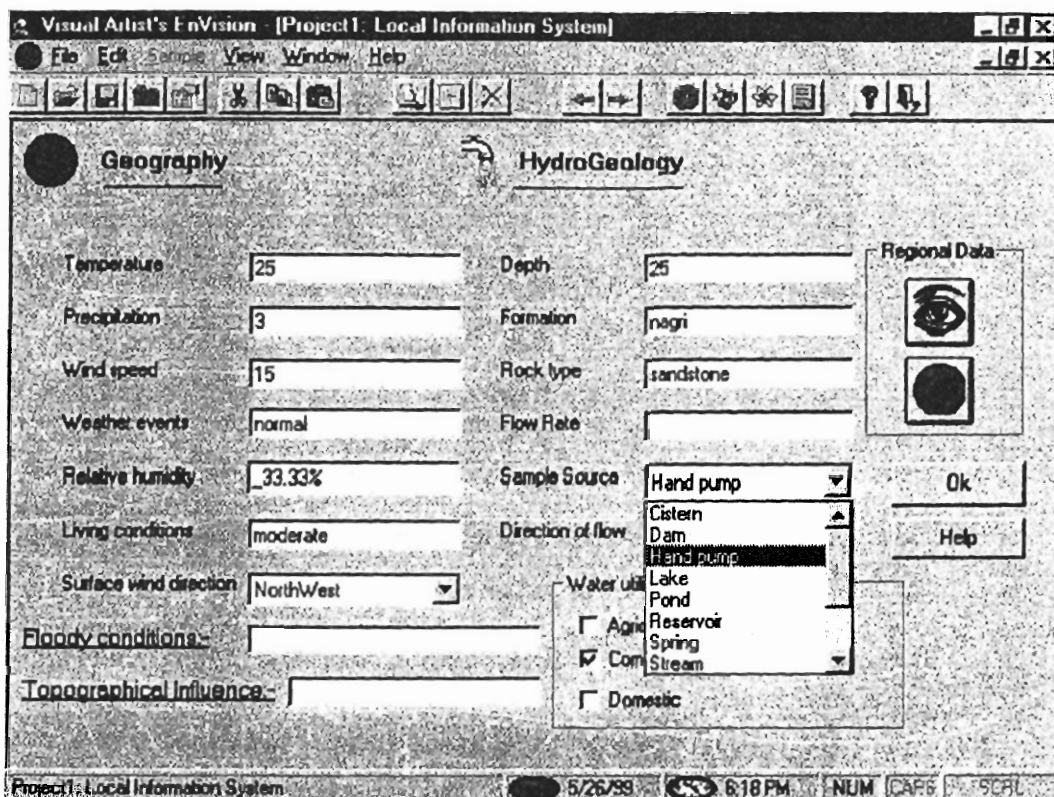


Fig. 5.3. EnVision Local Area Information System.

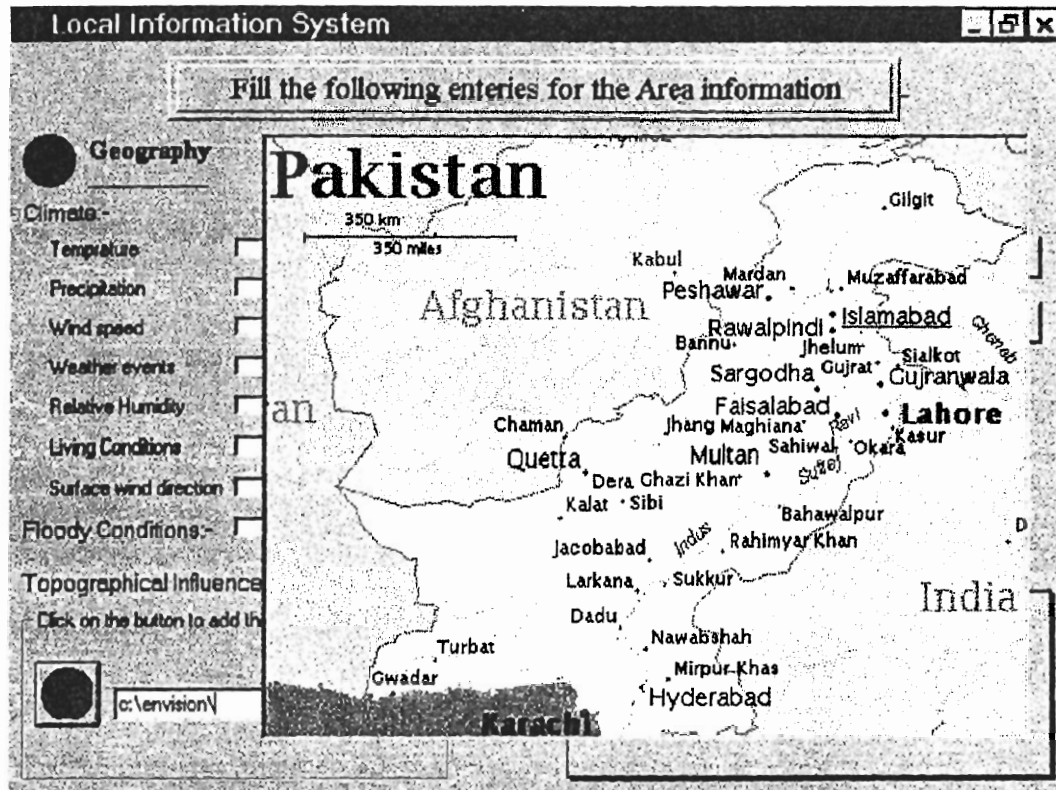


Fig. 5.4. EnVision Local Area Information System showing location map of the project area.

Visual Artist's EnVision - [Sample-1: Analysis Report]

File Edit Sample View Window Help

Name of collector: Rashid Jamil Chauhan Name of department: Peshawar University
 Date of collection: 10/15/98 Time of collection: 05:05
 Sample Number: 901 Sample Code: 901mp
 Location: Islamabad Temperature: 25

Sample Source

☐ Cistern ☒ Hand Pump ☐ Pond ☐ Stream ☐ Tap ☐ Tube Well
☐ Dam ☐ Lake ☐ Reservoir ☐ Spring ☐ Treated ☐ Well

Remarks :-

Observer can put text here for future reference and help.

Sample-1 Analysis Report 5/26/99 6:18 PM NUM CAPS SERL

Fig. 5.5. Spreadsheet for entering sample information and its attributes.

Visual Artist's EnVision - [Sample 2: LabResults of Sample No:N/A]

File Edit Sample View Window Help

Water Quality Parameters	Units	Highest	Maximum	Lab
Water Quality Standards for TraceMetal and Inorganic parameters				
Arsenic	mg/l	5.00	15.00	10.00
Calcium	mg/l	75.00	0.00	
Chloride	mg/l	200.00	600.00	300.00
Chromium	mg/l	0.05	0.00	
Copper	mg/l	0.05	0.00	0.01
Flouride	mg/l	1.00	1.50	1.00
Hardness as CaCo3	mg/l	200.00	500.00	200.00
Iron	mg/l	0.10	1.00	
Lead	mg/l	0.05	0.05	
Lithium	mg/l	NGVS	NGVS	
Magnesium	mg/l	30.00	150.00	40.00
Manganese	mg/l	0.05	0.50	
Nickle	mg/l	5.00	NGVS	
Nitrate	mg/l	10.00	45.00	11.00
Ph		6.50	9.20	
Potassium	mg/l	NGVS	NGVS	
Sodium	mg/l	30.00	200.00	50.00
Sulphate	mg/l	200.00	400.00	300.00
T.D.S	mg/l	500.00	1500.00	
Turbidity	NTU	2.50	5.00	6.00
Zinc	mg/l	5.00	15.00	

Sample 2: LabResults of Sample No:N/A 5/26/99 6:18 PM NUM CAPS SCRL

Fig. 5.6. Spreadsheet for entering observed water quality parameters viz. Trace Metals and Inorganic parameters..

Visual Artist's EnVision - [sample-901: LabResults of Sample No: Sample-901]					
File Edit Sample View Window Help					
Water Quality Parameters					
Aesthetic Physical and Chemical Parameters	Units	Highest Desirable	Maximum	Lab Observations	
Alkalinity	m/mol/l	50.00	500.00	43.00	
Bi Carbonate	mg/l	0.00	0.00		
Carbonate	mg/l	0.00	0.00		
Chemical Oxygen Demand	mg/l	0.00			
Chloride	mg/l	200.00	600.00	222.00	
Colour	TCU	5.00	15.00		
Conductivity	micro-sec	500.00	NGVS		
Density	gm/ml	NGVS	NGVS		
Dissolved Oxygen	mg/l	3.00	4.00	2.00	
Free CO2	mg/l	NGVS	NGVS		
Hardness as CaCo3	mg/l	200.00	500.00	666.00	
Nitrate	mg/l	10.00	45.00	45.00	
pH		6.50	8.50		
Phosphate	mg/l	1.00	5.00		
Salinity	mg/l	NGVS	NGVS		
Sulphate	mg/l	200.00	400.00	43.00	
T.D.S	mg/l	500.00	1500.00		
Total Chlorine	mg/l	NGVS	NGVS		
Turbidity	NTU	2.50	5.00	3.00	
Taste					
Odour					

Fig. 5.7. Spreadsheet for entering observed water quality parameters viz. Aesthetic, Physical and Chemical parameters.

Visual Artist's EnVision - [sample-901: LabResults of Sample No: Sample-901]

File Edit Sample View Window Help

Water Quality Parameters	Units	Highest Desirable	Maximum	Lab Observations
Water Quality Standards for Bacteriological parameters				
Coliform	No/100ml	0.00	3.00	1.00
E-Coliform	No/100ml	0.00	0.00	
Free Chlorine	mg/l	0.00	0.00	1.00
NonColiform	No/100ml	0.00	0.00	
Total Chlorine	mg/l	0.00	0.00	

sample-901: LabResults of Sample No: Sample-901 5/29/99 4:21 PM NUM CAPS SCRL

Fig. 5.8. Spreadsheet for entering observed water quality parameters viz. Bacteriological parameters.

EnVision - [Project 1: Summary Sheet]

File Edit View Format Chart Map Analysis Window Help

Estimated Concentration of Inorganic Constituents & Trace Metals

Serial No.	Map Code	Sample No.	Location	Source	Iron(mg/l)	Lead(mg/l)	Lithium(mg/l)	Copper(mg/l)	
1	MPC001	RWP001	Rawal Dam	Tap	0.55	0.16	0.00	0.01	
2	MPC002	RWP002	Rawal Dam	Tap	0.02	0.18	0.00	0.01	
3	MPC003	RWP003	Rawal Dam	Tap	0.01	0.13	0.00	0.01	
4	MPC004	RWP004	Morian	Reservoir	0.01	0.03	0.00	0.01	
5	MPC005	RWP005	Morian	Reservoir	0.02	0.65	0.00	0.01	
6	MPC006	RWP006	Jinnah School	Reservoir	0.01	0.06	0.00	0.01	
7	MPC007	RWP007	Saidpur	Reservoir	0.02	0.20	0.00	0.01	
8	MPC008	RWP008	Raja Bazar	Tank	0.00	0.46	0.00	0.01	
9	MPC009	RWP009	Liquat Bagh	Tap	0.02	0.05	0.00	0.01	
10	MPC0010	RWP0010	Gowalmandi	Reservoir	0.01	0.23	0.00	0.01	
11	MPC0011	RWP0011	Railway station	Well	0.03	0.26	0.00	0.01	
12	MPC0012	RWP0012	Railway station	Tube Well	0.05	0.44	0.00	0.01	
13	MPC0013	RWP0013	Police Line	Tap	0.02	0.88	0.00	0.01	
14	MPC0014	RWP0014	Sadar	Tap	0.05	0.10	0.00	0.01	
15	MPC0015	RWP0015	Lalkurti	Hand Pump	0.06	0.38	0.00	0.01	
16	MPC0016	RWP0016	Fauji Foundation	Tap	0.03	0.19	0.00	0.01	
17	MPC0017	RWP0017	M.H. Rwp.	Well	0.03	0.07	0.00	0.01	
18	MPC0018	RWP0018	Pirwadahi	Well	0.01	0.64	0.00	0.01	
19	MPC0019	RWP0019	Khyaban	Tap	0.03	0.70	0.00	0.01	
20	MPC0020	RWP0020	Ghosia Colon.	Tap	0.03	0.04	0.00	0.01	

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Fig. 5.9. Spreadsheet showing observed water quality parameters for different samples collected in a project area.

EnVision - [Project 1: Analysis Report]

File Edit View Format Chart Map Analysis Window Help

Lab Results for Sample No. IBA 985

Water Quality Parameters	Measured as	Highest Desirable Level	Maximum Permissible Level	Lab Results
Arsenic	mg/l	0.05	0.05	0.06
Alkalinity	m/mol/l	50	500	60
Chloride as Cl	mg/l	200	600	300
Colour	T.C.U	5	15	6
Conductivity	micro-S	500 NGVS		400
Calcium	mg/l	75	200	100
Dissolved Oxygen	mg/l	3	4.0	3.5
Fluorides	mg/l	1.0	1.5	0.99
Hardness as CaCO ₃	mg/l	200	500	400
Iron	mg/l	0.3	1.0	0.29
Lead	Well	0.05	0.05	0.02
Magnesium	mg/l	30	150	30
Manganese	mg/l	0.05	0.5	0.6
Nitrate	mg/l	10	45	45
pH		6.5	8.5	9.5
Phosphate	mg/l	1.0	5	1.0
Sodium	mg/l	200	300	250
T.D.S	mg/l	500	1500	1000
Turbidity	N.T.U	2.5	5.0	5.0
Zinc	mg/l	5.0	15	14.0

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Fig. 5.10. Spreadsheet showing lab result (observed water quality parameter) for a sample in a project area.

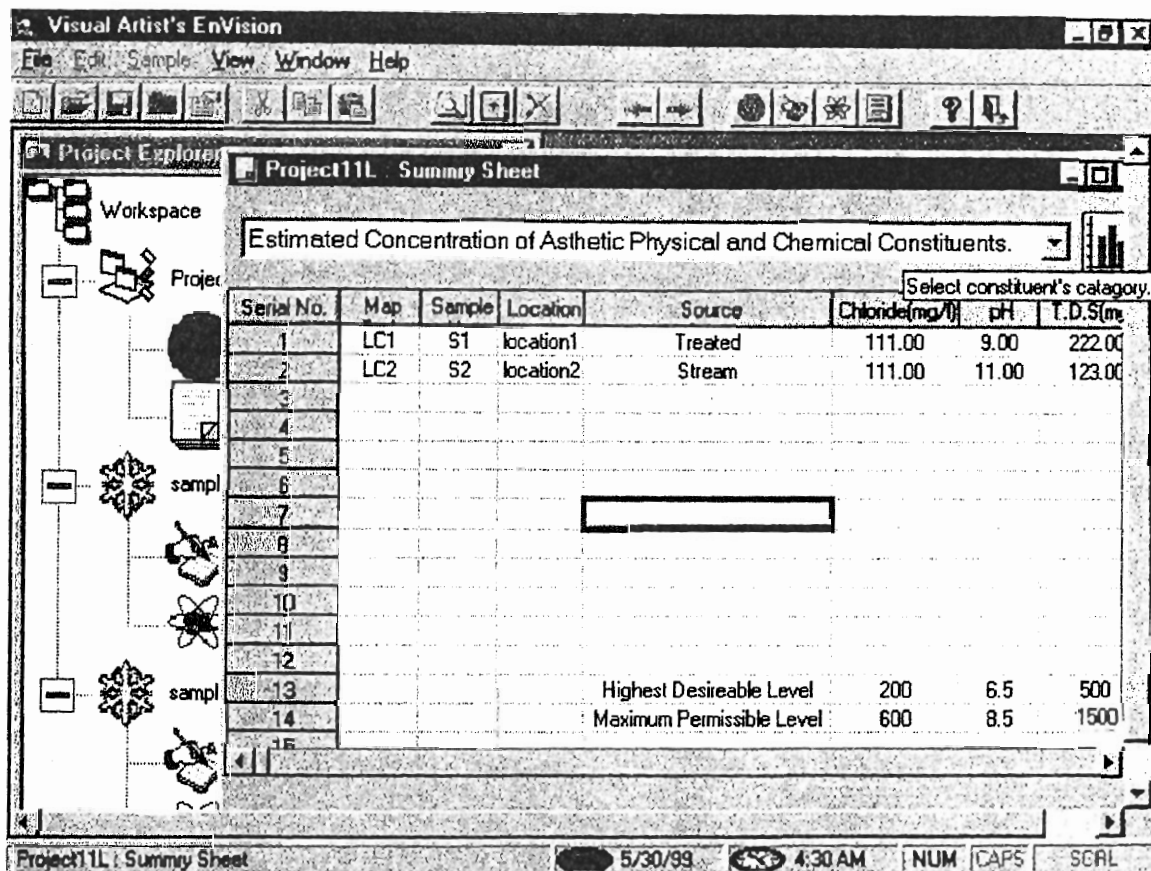


Fig. 5.11. EnVision displaying Project Explorer and Summary sheet for water samples with their information viz. sample code, sample no, location, source, lab result as well as HDL and MPL standards.

Graphical Representation Of Water Quality Parameters

This feature of EnVision is designed to represent data graphically both in 2D and 3D formats (Fig. 5.12, 5.13, 5.14 & 5.15). This feature shows graphically which water quality parameter is below or above highest desirable level, or below or above maximum permissible level. Observers can easily identify and analyze trends in contamination level with this feature.

Comparison And Interpretation Of Water Quality Parameters

It is the most important feature of EnVision and has been shown in figures 5.16 and 5.17. In this step each constituent of water is compared with its respective water quality standard to measure water quality level with reference to highest desirable level and maximum permissible level. After this comparison, the system provides information regarding detection of contamination, reasons for contamination, trend in concentration and effect of these trends. Information can also be obtained on the constituents entering the environment by quantity, source and through distribution. This system also provides comprehensive environmental impacts of each constituent in terms of magnitude (high, low & neutral impact), direction (positive & negative impact), duration (long & short-term impact) and location (local & regional impact).

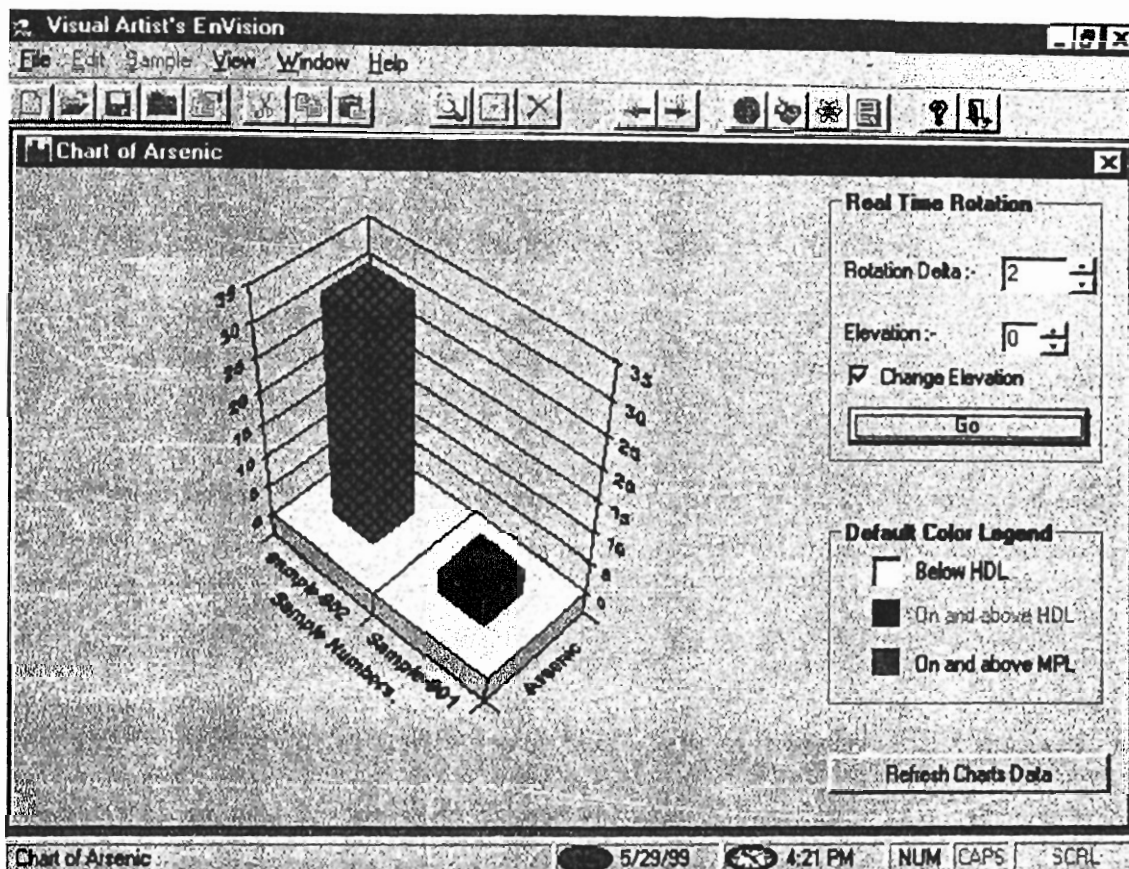


Fig. 5.12. Graphical representation of one observed water quality parameter with reference to its HDL and MPL standard.

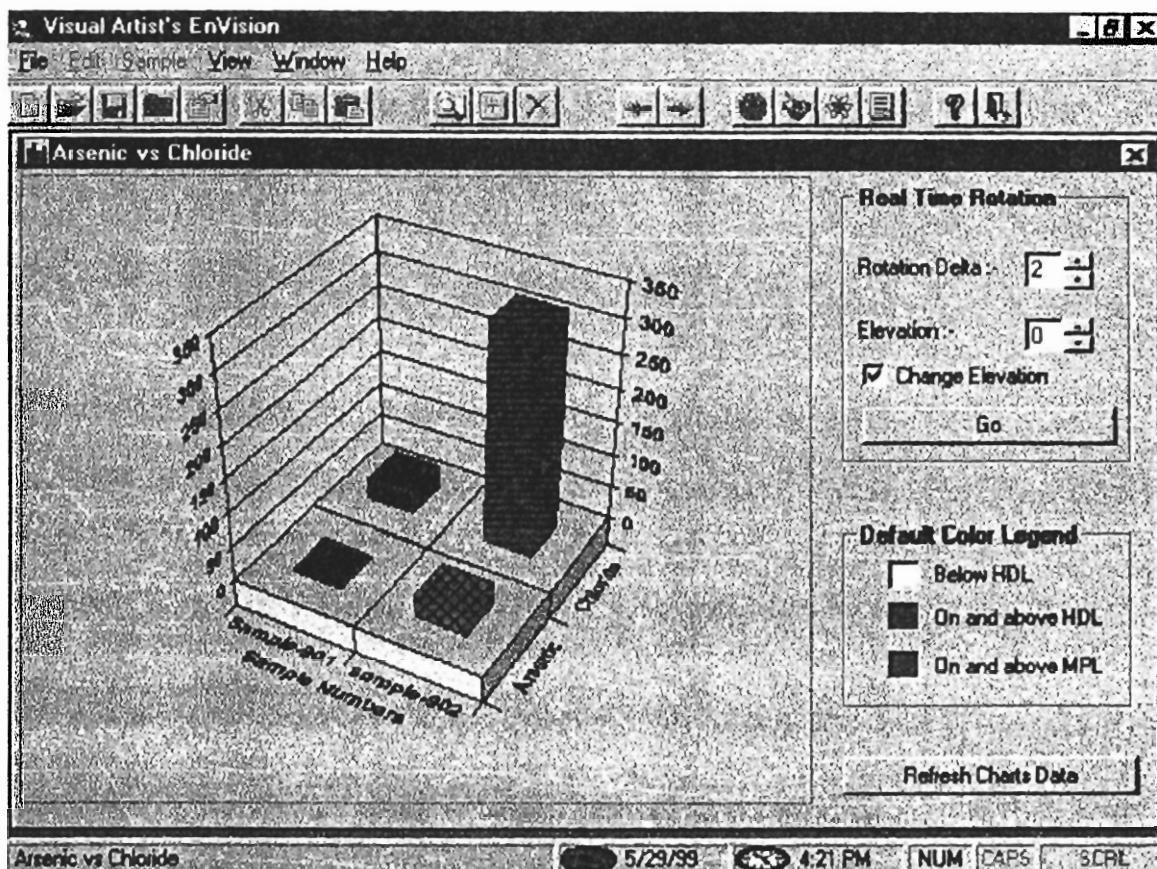


Fig. 5.13. Graphical representation of two observed water quality parameters with reference to their HDL and MPL standard.

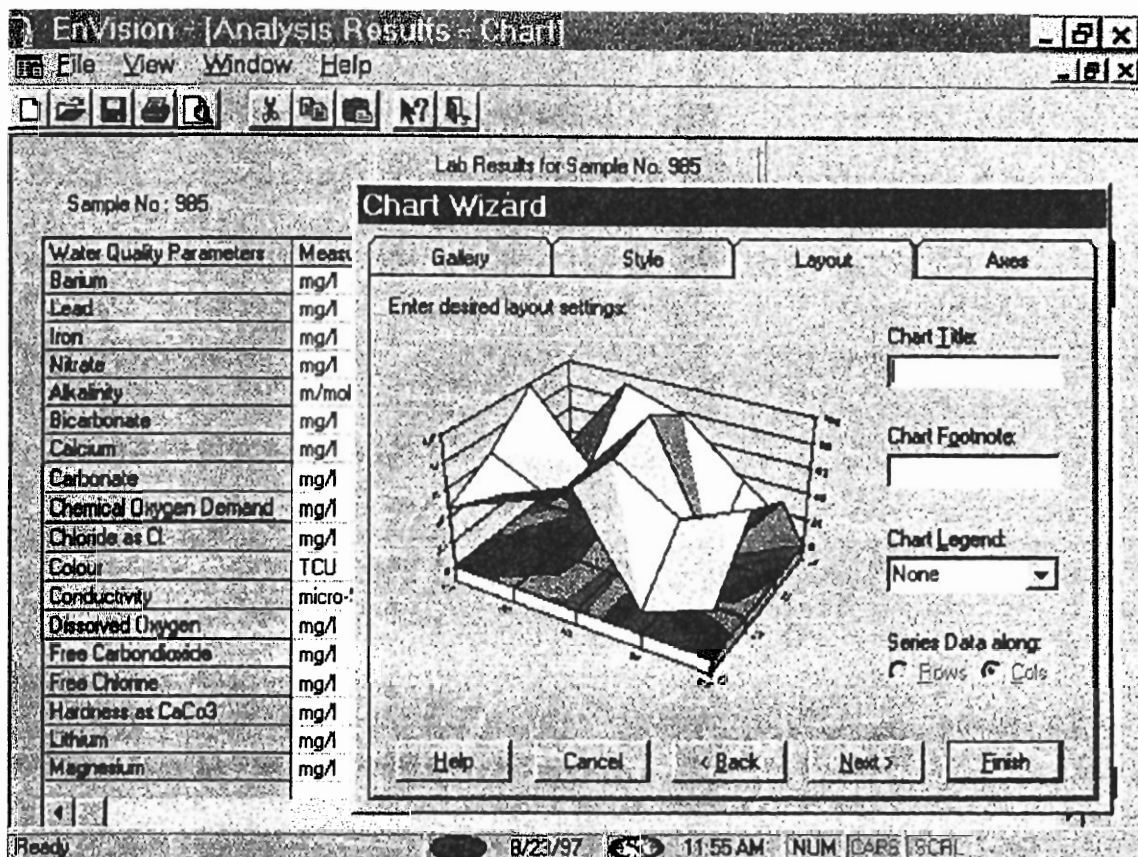


Fig. 5.14. Graphical representation of water quality parameter to observe contamination level with reference to its standard value.

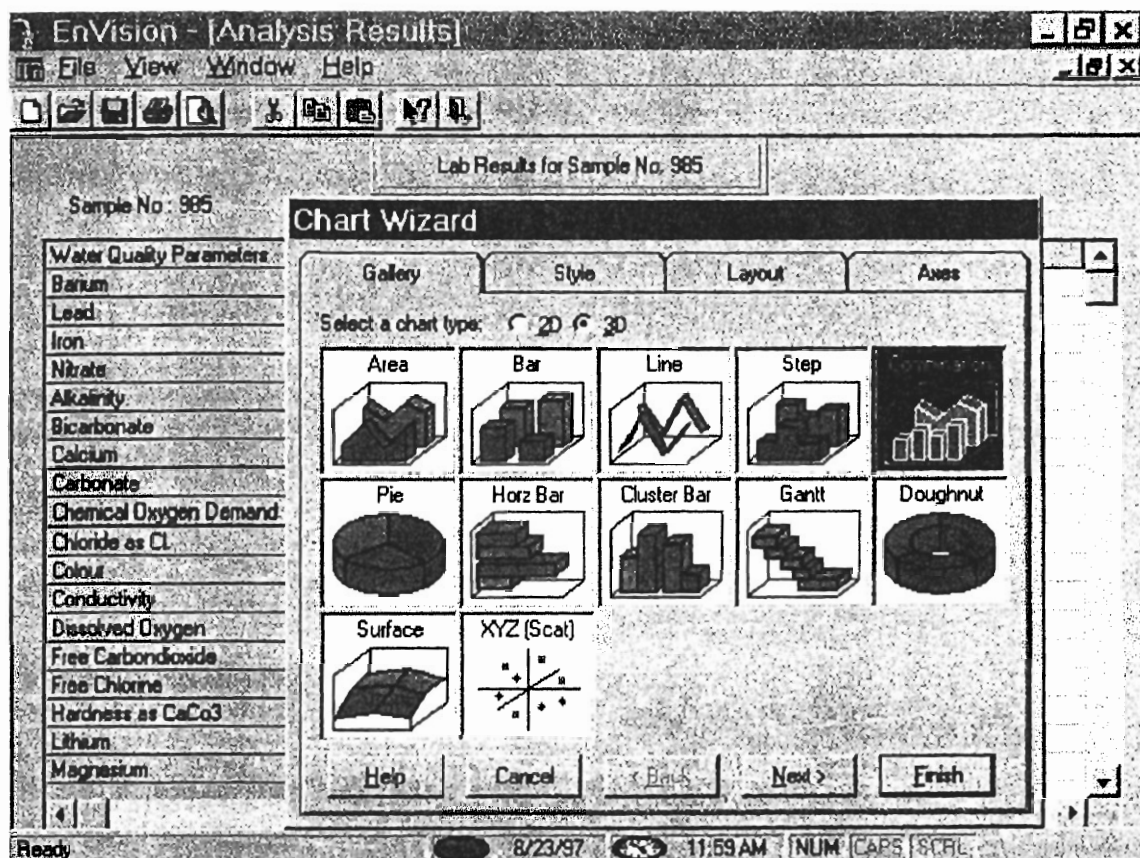


Fig. 5.15. Customization of charts in EnVision.

Visual Artist's EnVision - [Sample 2: LabResults of Sample No:N/A]					
File Edit Sample View Window Help					
Water Quality Parameters					
Water Quality Standards for TraceMetal and Inorganic parameters	Units	Highest	Maximum	Lab	
Arsenic	mg/l	5.00	15.00	10.00	
Calcium	mg/l	75.00	0.00		
Chloride	mg/l	200.00	600.00	300.00	
Chromium	mg/l	0.05	0.00		
Copper	mg/l	0.05	0.00	0.01	
Flouride	mg/l	1.00	1.50	1.00	
Hardness as CaCo3	mg/l	200.00	500.00	200.00	
Iron	mg/l	0.10	1.00		
Lead	mg/l	0.05	0.05		
Lithium	mg/l	NGVS	NGVS		
Magnesium	mg/l	30.00	150.00	40.00	
Manganese	mg/l	0.05	0.50		
Nickle	mg/l	5.00	NGVS		
Nitrate	mg/l	10.00	45.00	11.00	
Ph		6.50	9.20		
Potassium	mg/l	NGVS	NGVS		
Sodium	mg/l	30.00	200.00	50.00	
Sulphate	mg/l	200.00	400.00	300.00	
T.D.S	mg/l	500.00	1500.00		
Turbidity	NTU	2.50	5.00	6.00	
Zinc	mg/l	5.00	15.00		

Fig. 5.16. Comparison of observed water quality parameters with their standardized values.

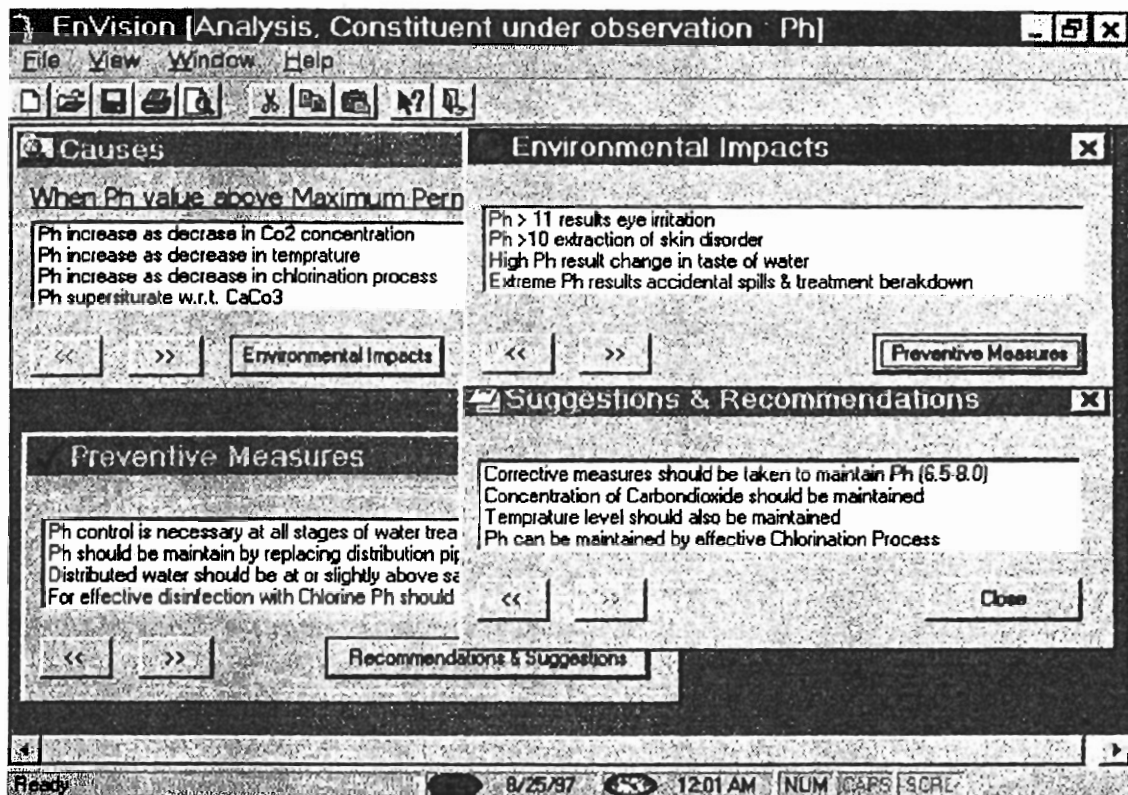


Fig. 5.17. EnVision showing information regarding causes of contamination, environmental impacts, preventive measures and suggestions and recommendations.

System Outputs

EnVision redefines output horizons. Through Print Workshop Component quick output of project work is possible (Fig. 5.18).

EnVision Help

EnVision provides standard Windows 95 based help system. Help is accessible all around the applications (Fig. 5.19 & 5.20).

Concisely Integrated Environmental Control System (EnVision) has the capability of producing spreadsheet, graphical views, detection of contamination and its causes, prediction of environmental impact, evaluation of preventive measure and framing of recommendations. EnVision can also be utilized at exploration and production location for monitoring and modeling of water quality parameters.

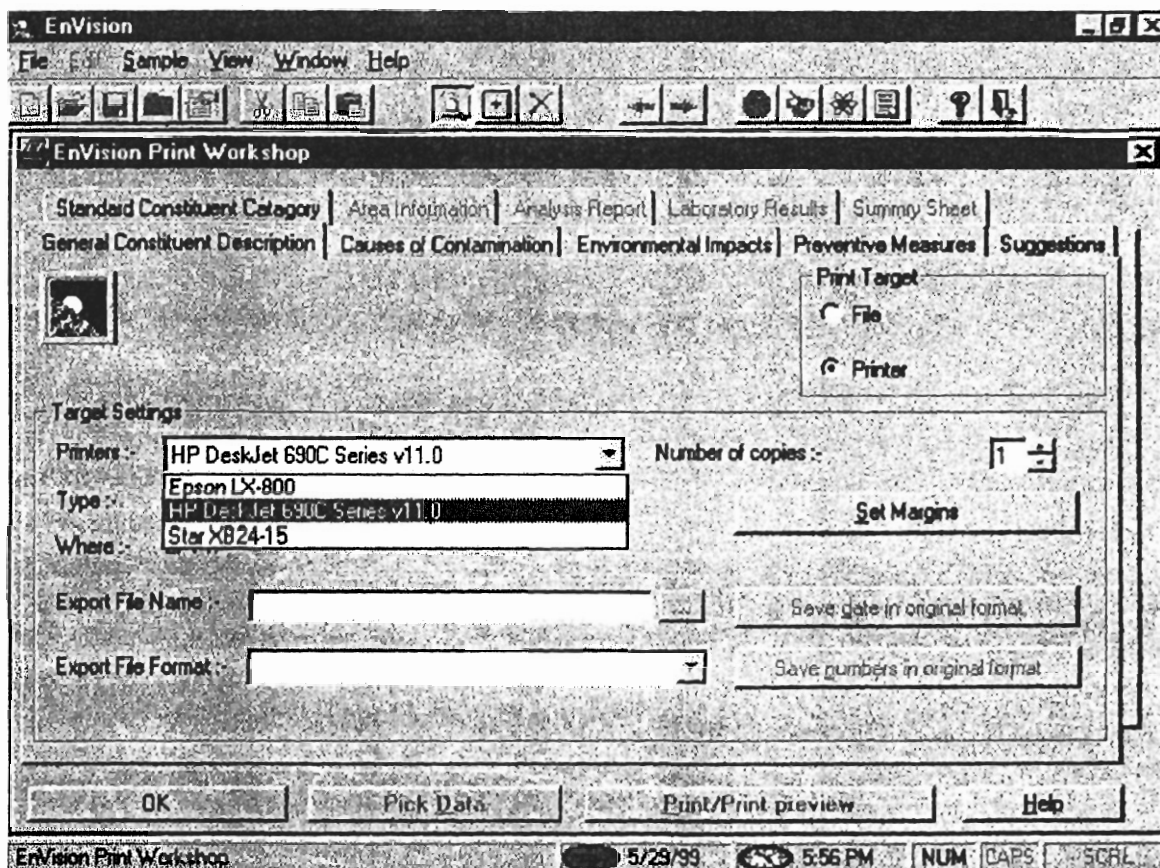


Fig. 5.18. EnVision print workshop component for getting outputs of highlighted features in the Project.

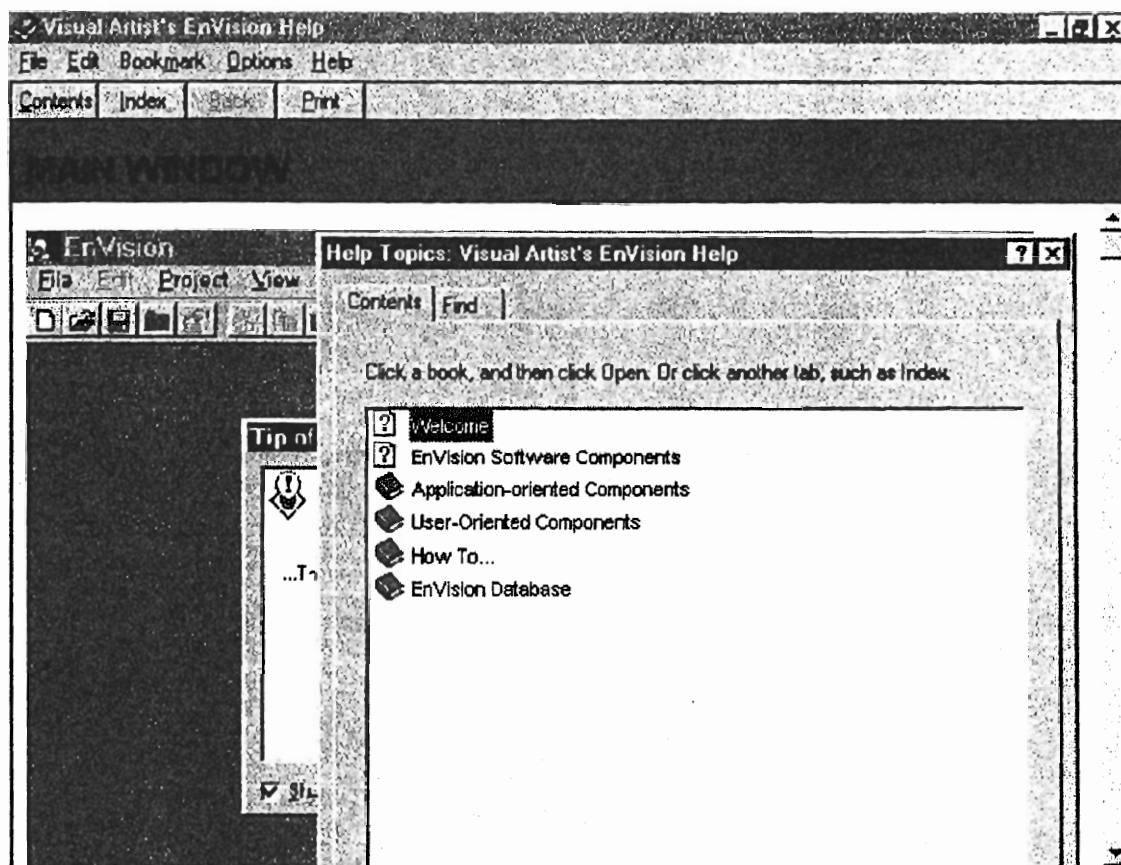


Fig. 5.19. EnVision Windows 95 based Help with help topics.

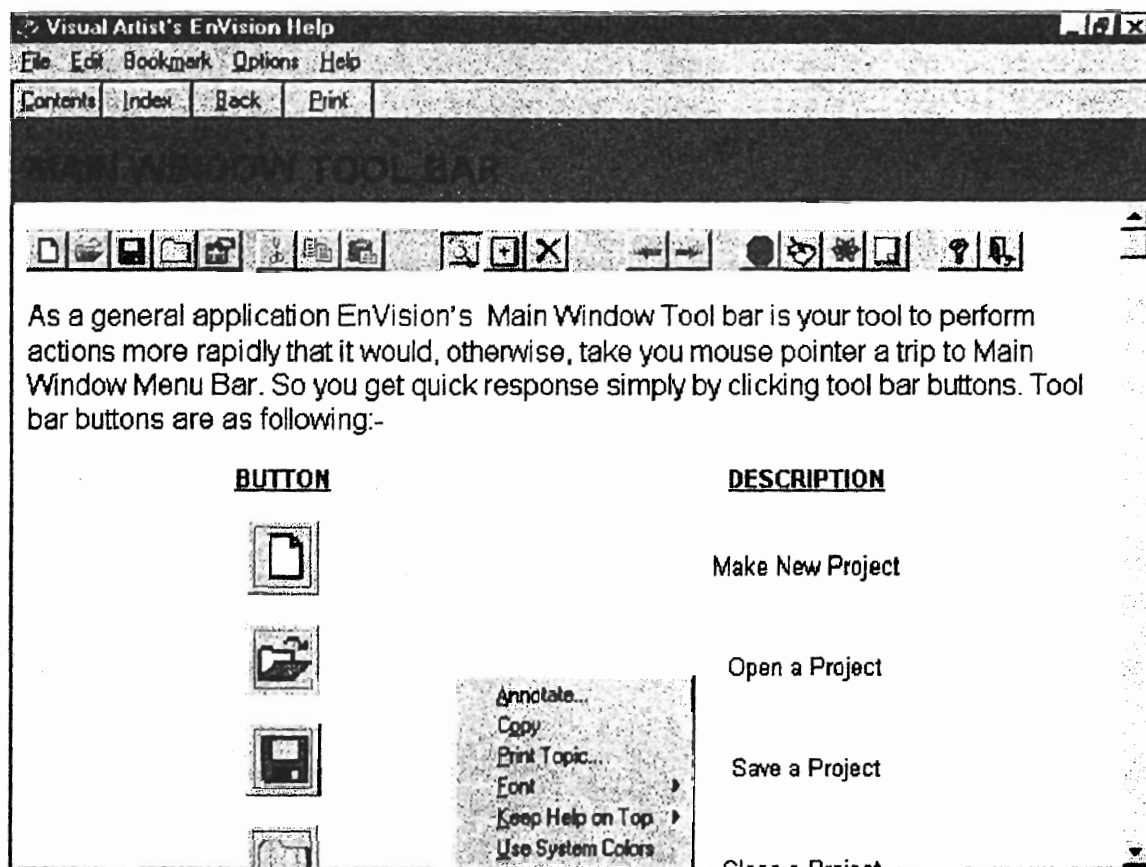


Fig. 5.20. EnVision Help with additive features.

CHAPTER - 6

EnVision USER MANUAL

Introduction

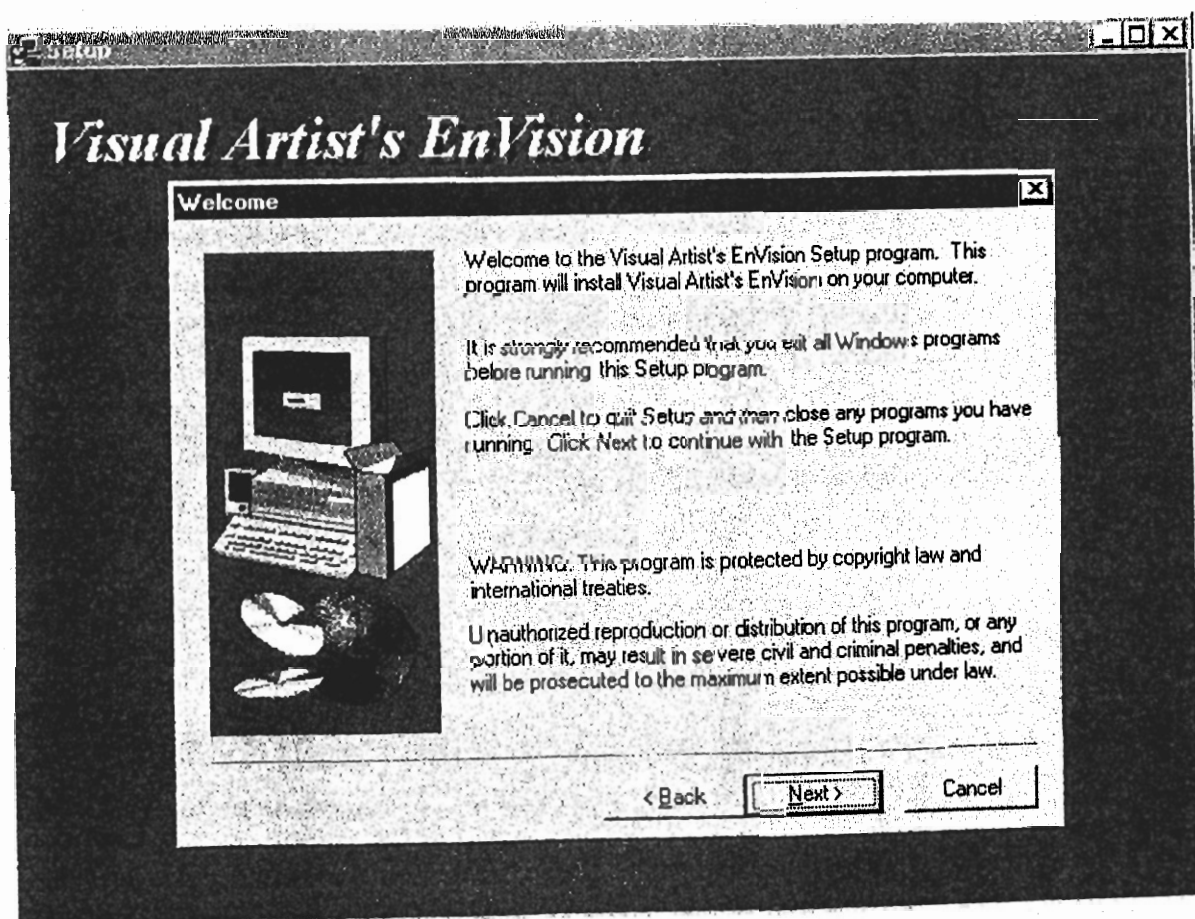
Thank you for selecting **Visual Artist's EnVision** as your powerful ally against deadly water contamination phenomenon, we provide you with today's hottest and market demanding, cutting-edge tools and technologies so that you can equip yourself prior to your crusade against pollution World Wide.

EnVision is designed while keeping certain standards like Concentrate on you work, instead of software, and Minimize need of special software. That is these standards apply to your computing pace as Windows™ 95 user. So as a **32-bit User** you deserve the following: -

- Excellent workspace environment
- Consistent interface with Windows 95
- Easy to use tools and
- Much much more!!!!!!

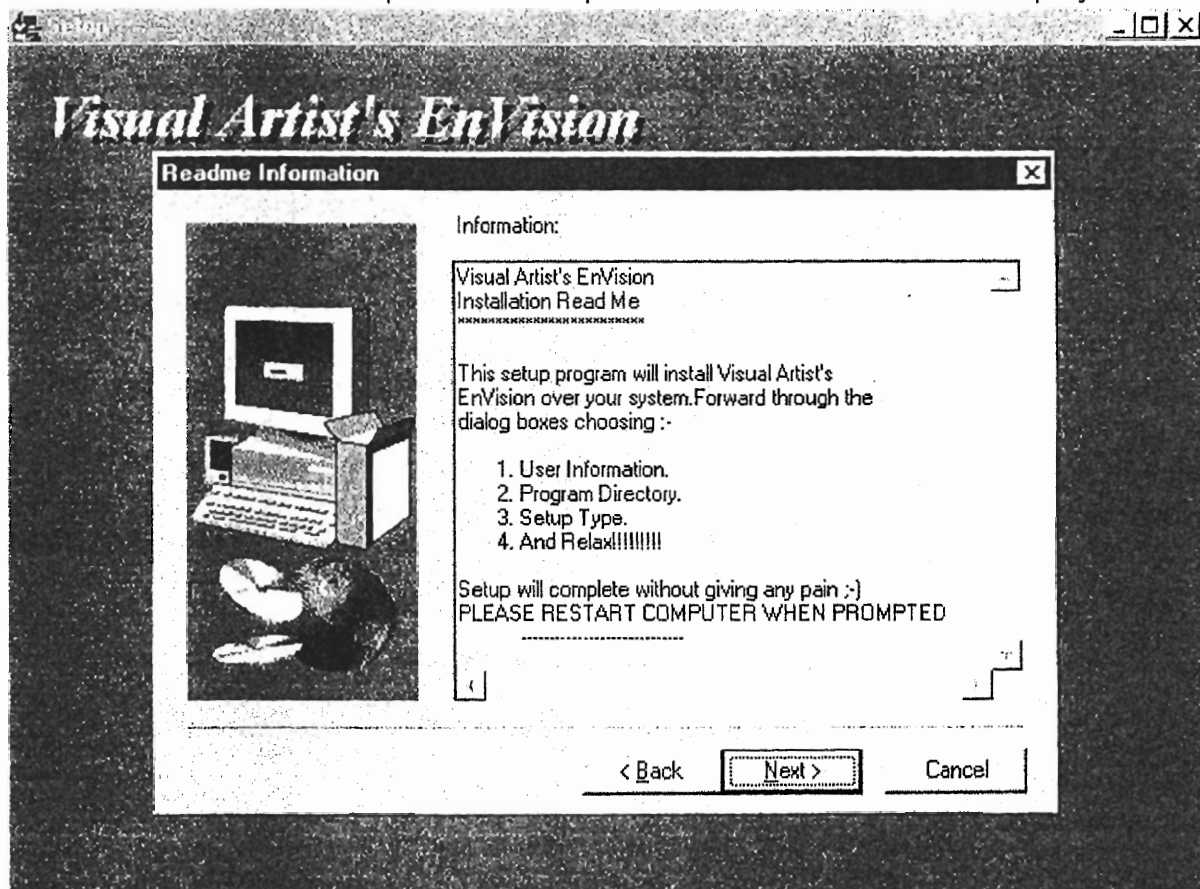
We hope you enjoy and appreciate our humble efforts taken as a part of your struggle against water contamination. Enjoy!

Installing EnVision

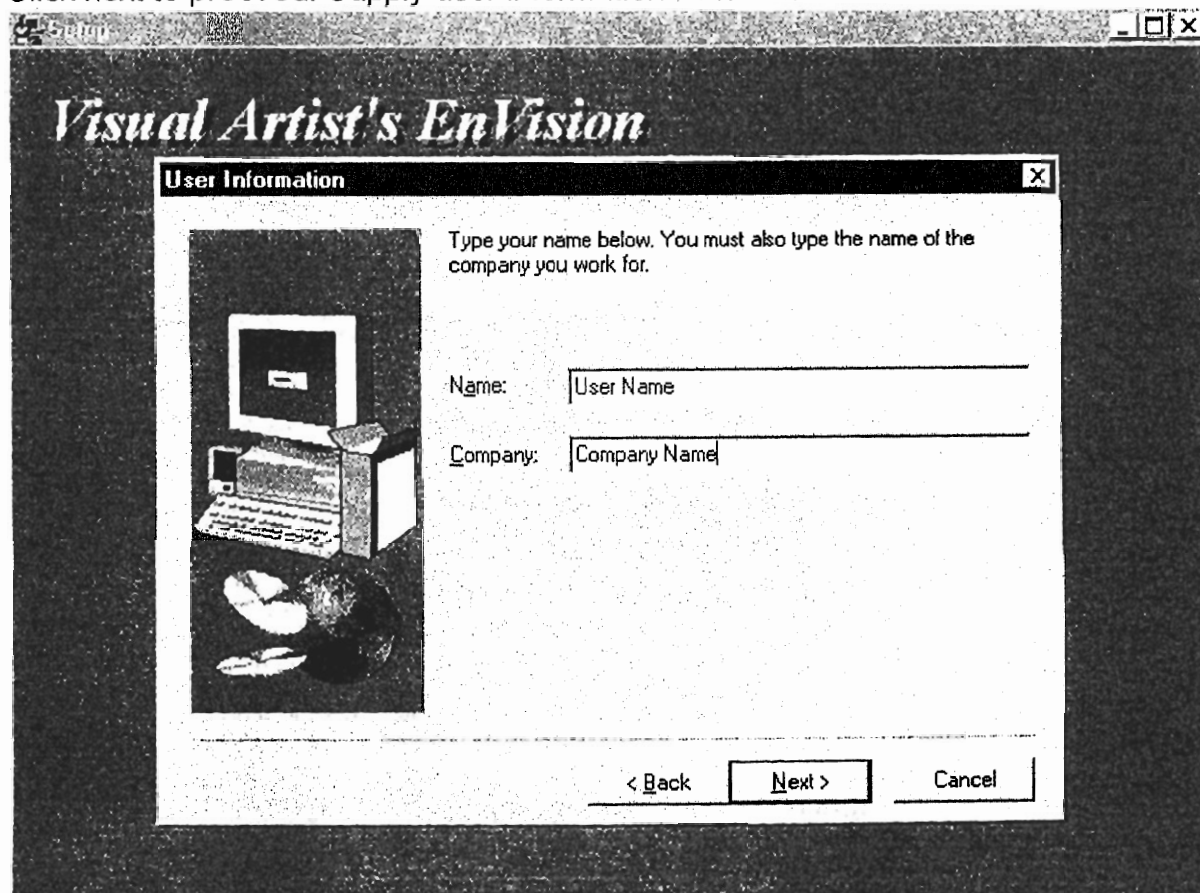


Installing EnVision is an easy process, simply select **Setup.exe** from Disk1 of the package, setup process will initialize and start automatically.

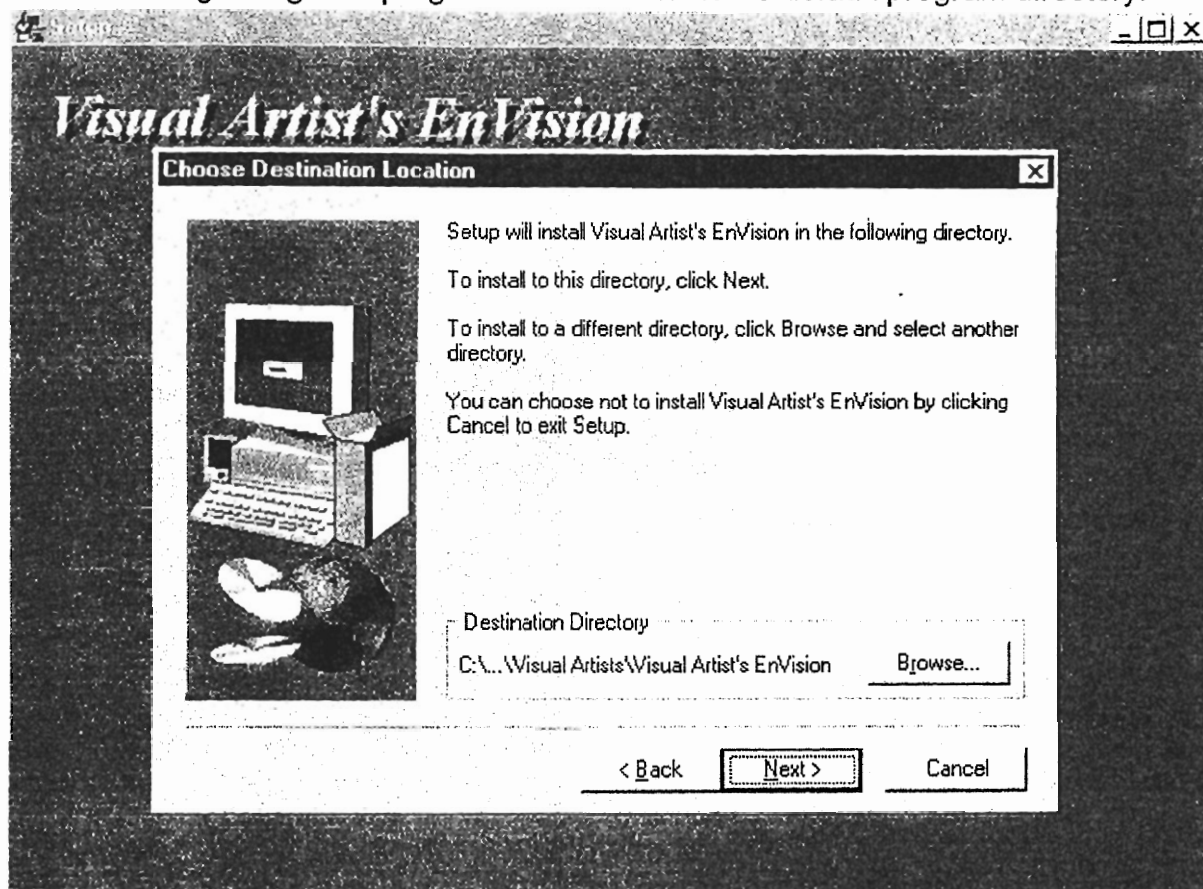
Click on the next button to proceed. Setup information readme will be displayed: -



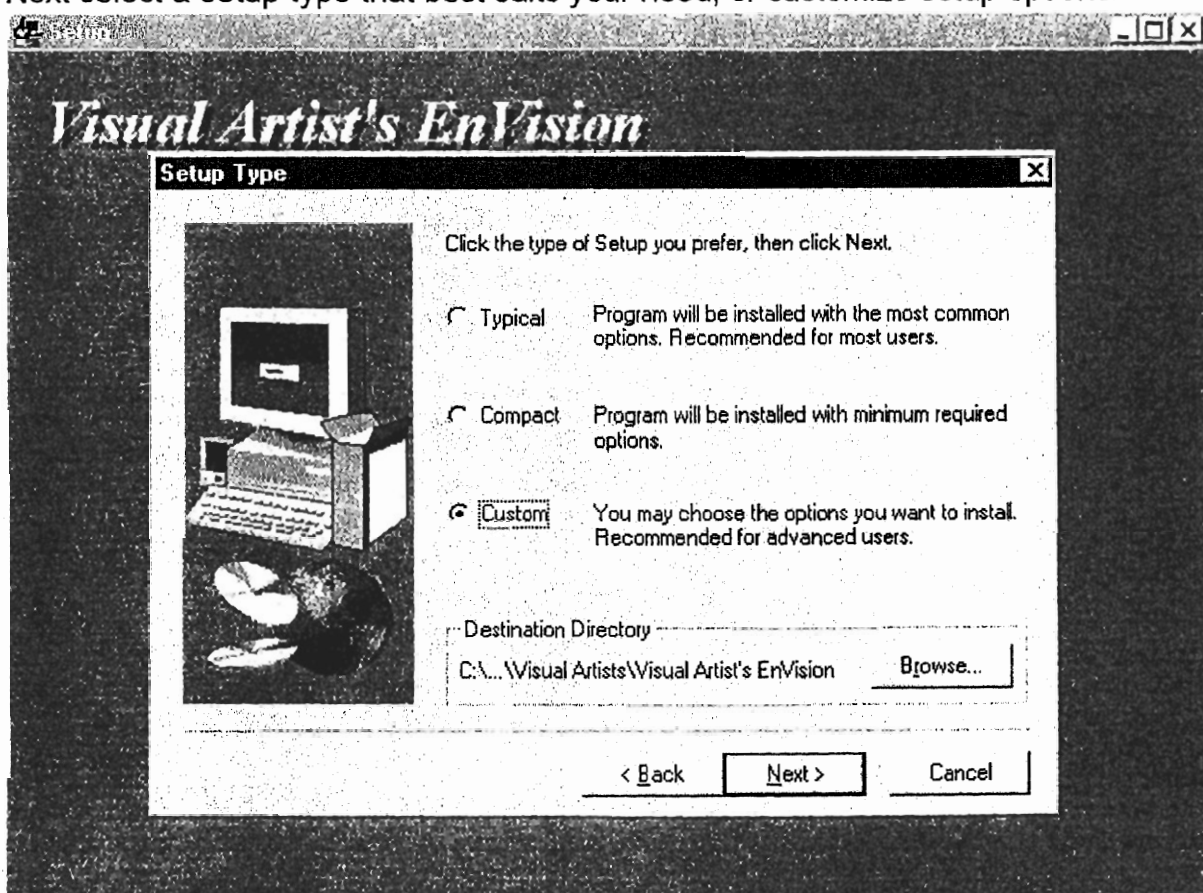
Click next to proceed. Supply user information as needed: -



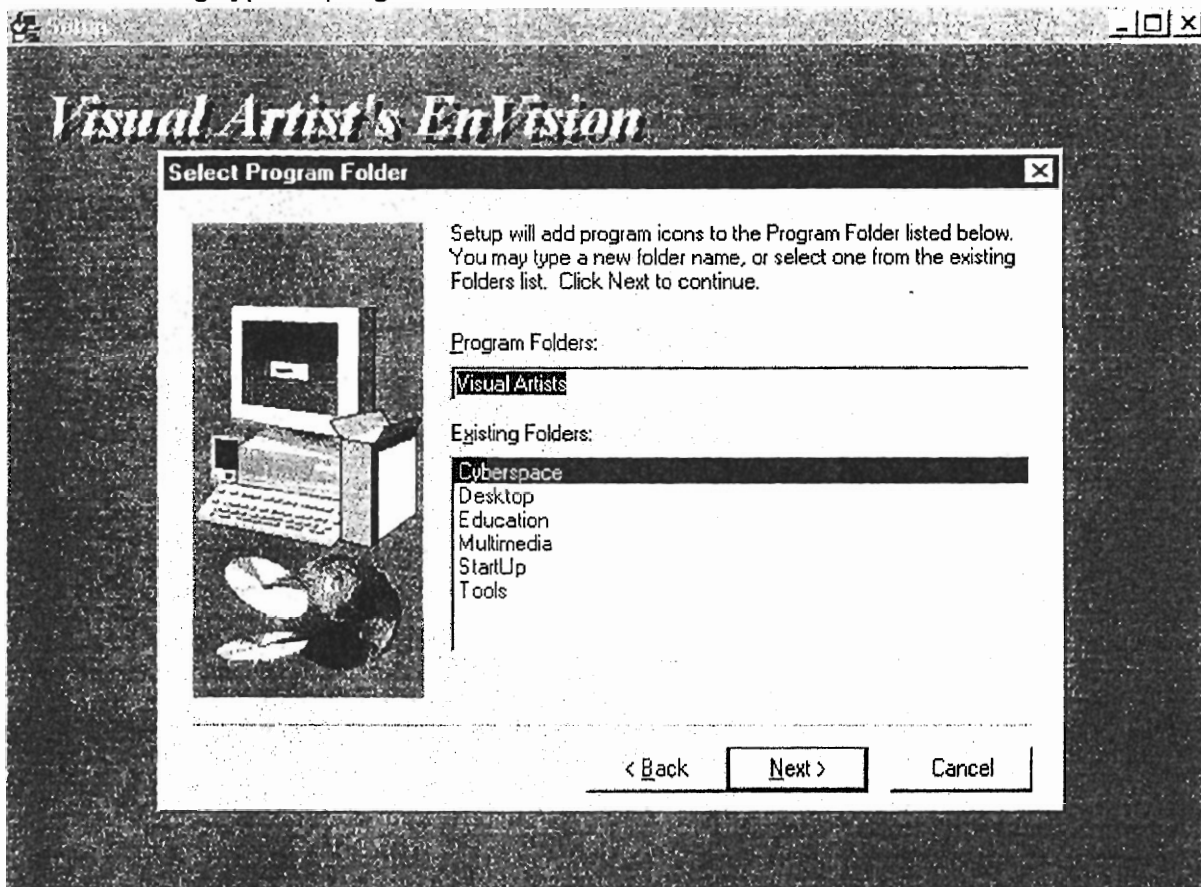
On next dialog box give a program folder or select the default program directory: -



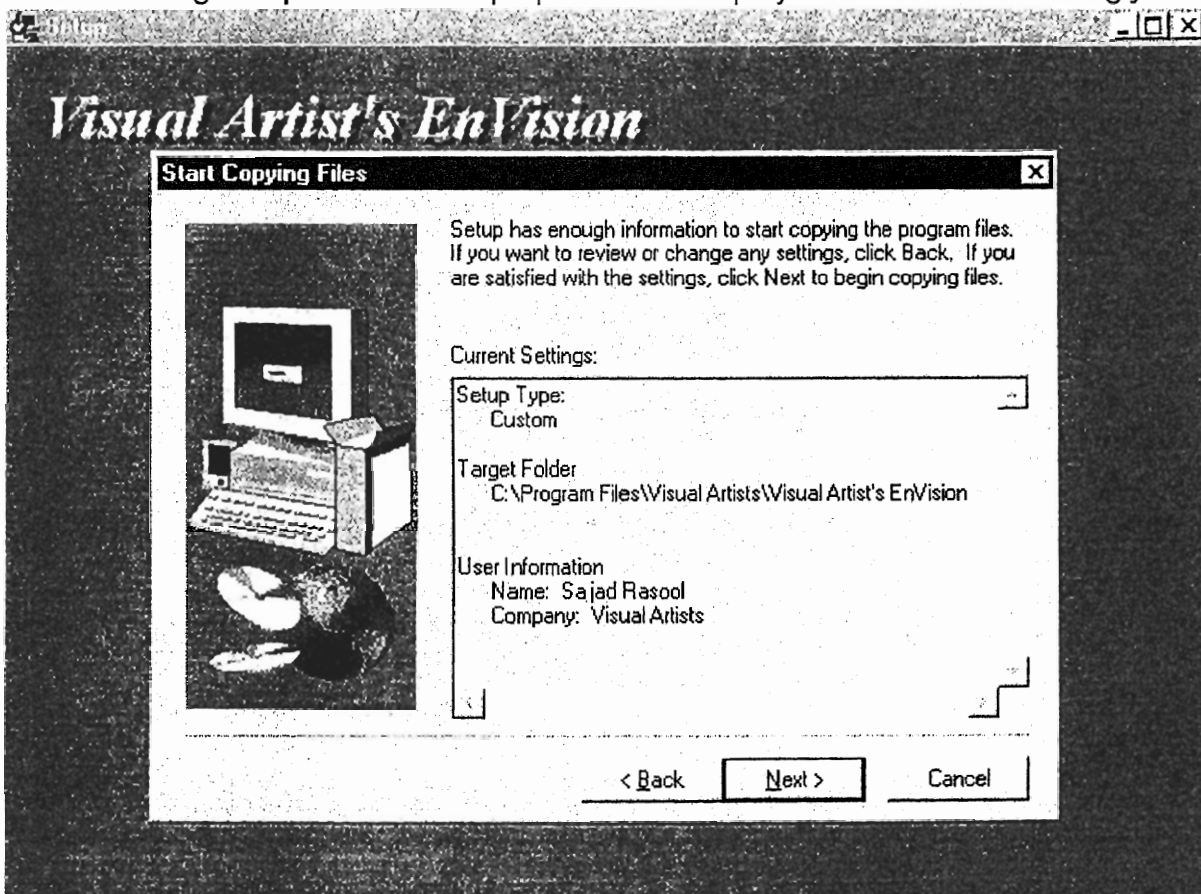
Next select a setup type that best suits your need, or customize setup options: -



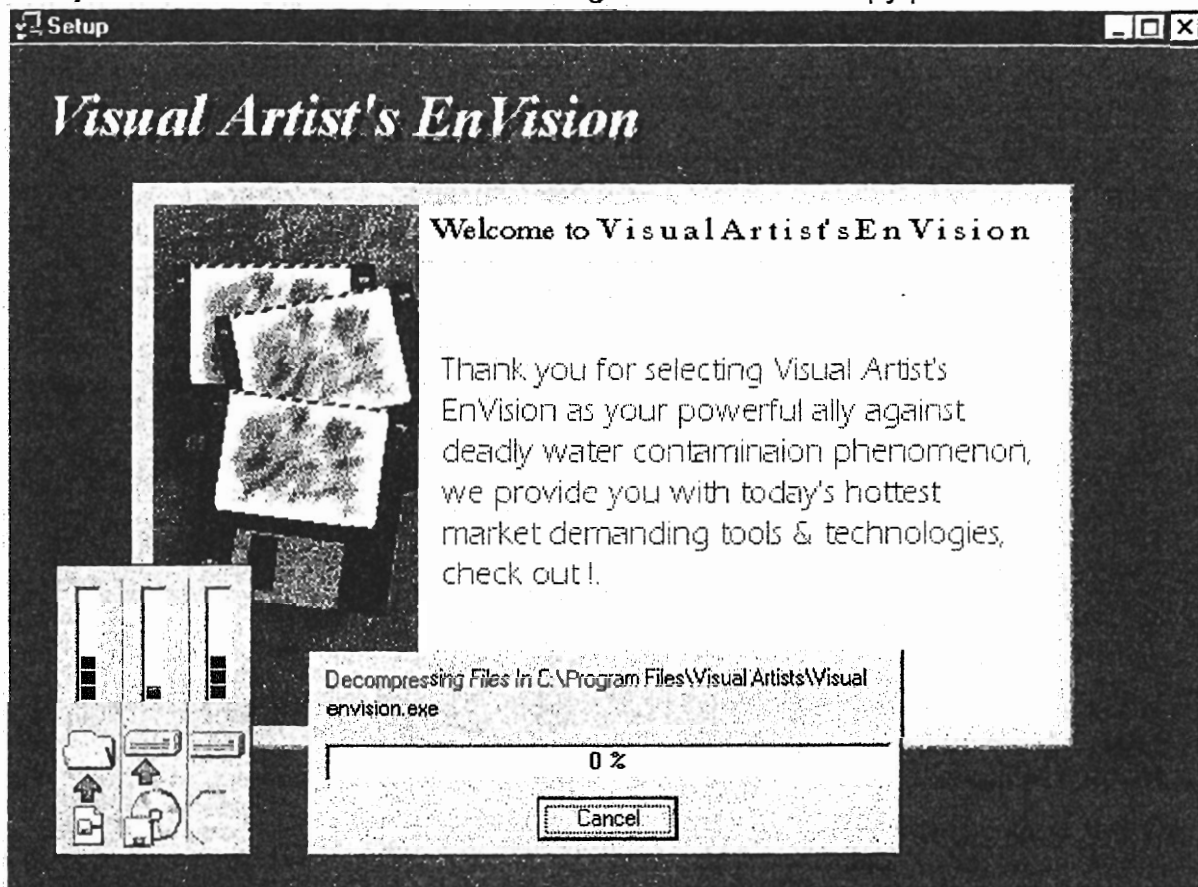
On next dialog type in program folder or select **Visual Artists** as default: -



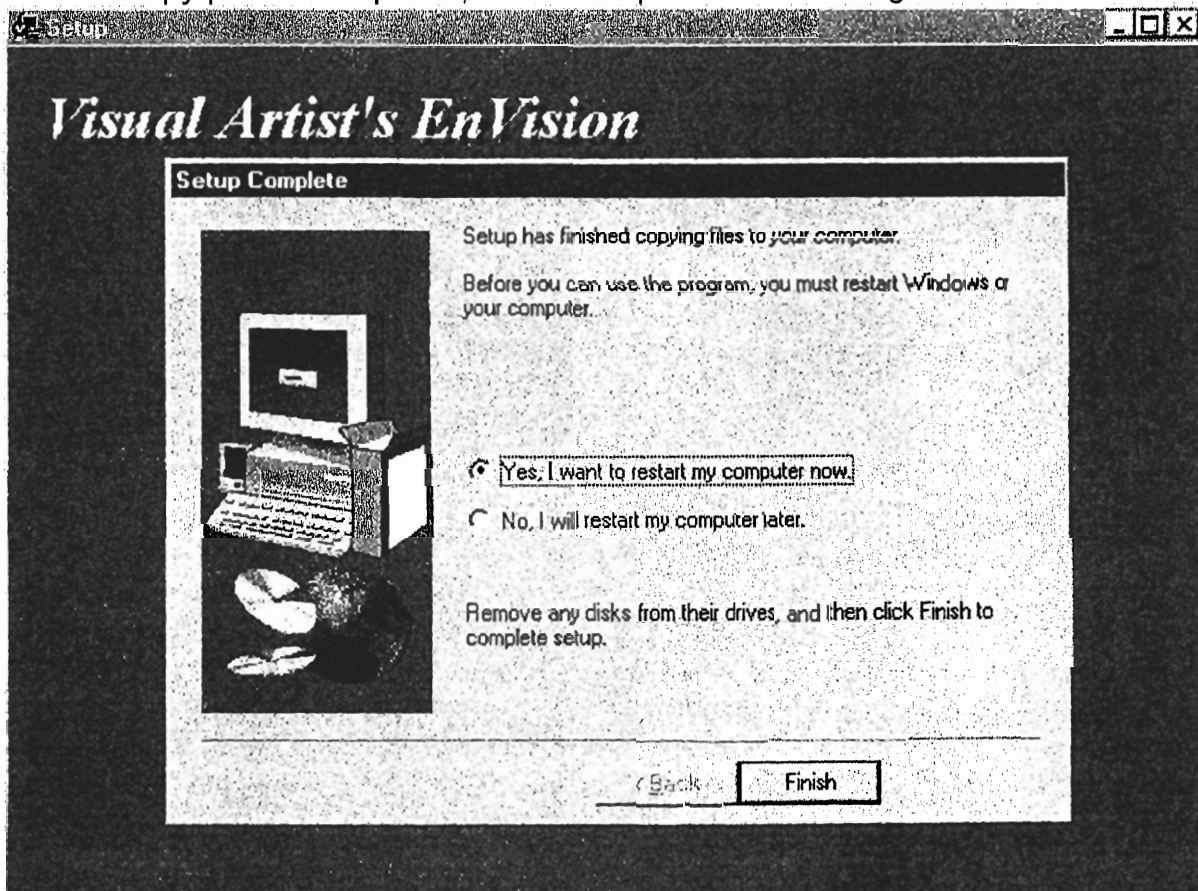
On next dialog setup reviews setup options and displays information accordingly: -



Now just sit back and relax while watching the intuitive file copy process: -



After file copy prcess completes, restart computer for the changes to take effect: -

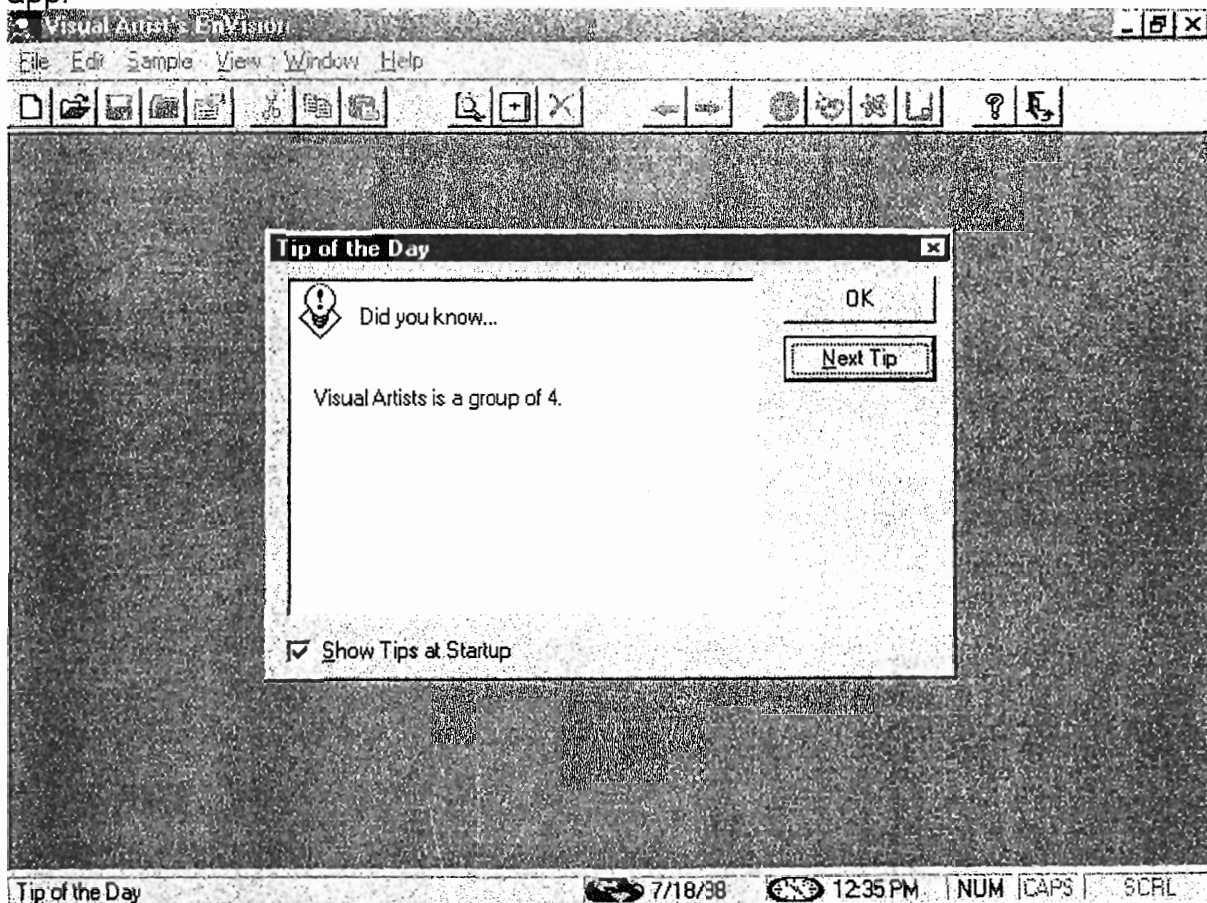


Getting Started

This section explains the intuitive workaround of the application. So let's move.

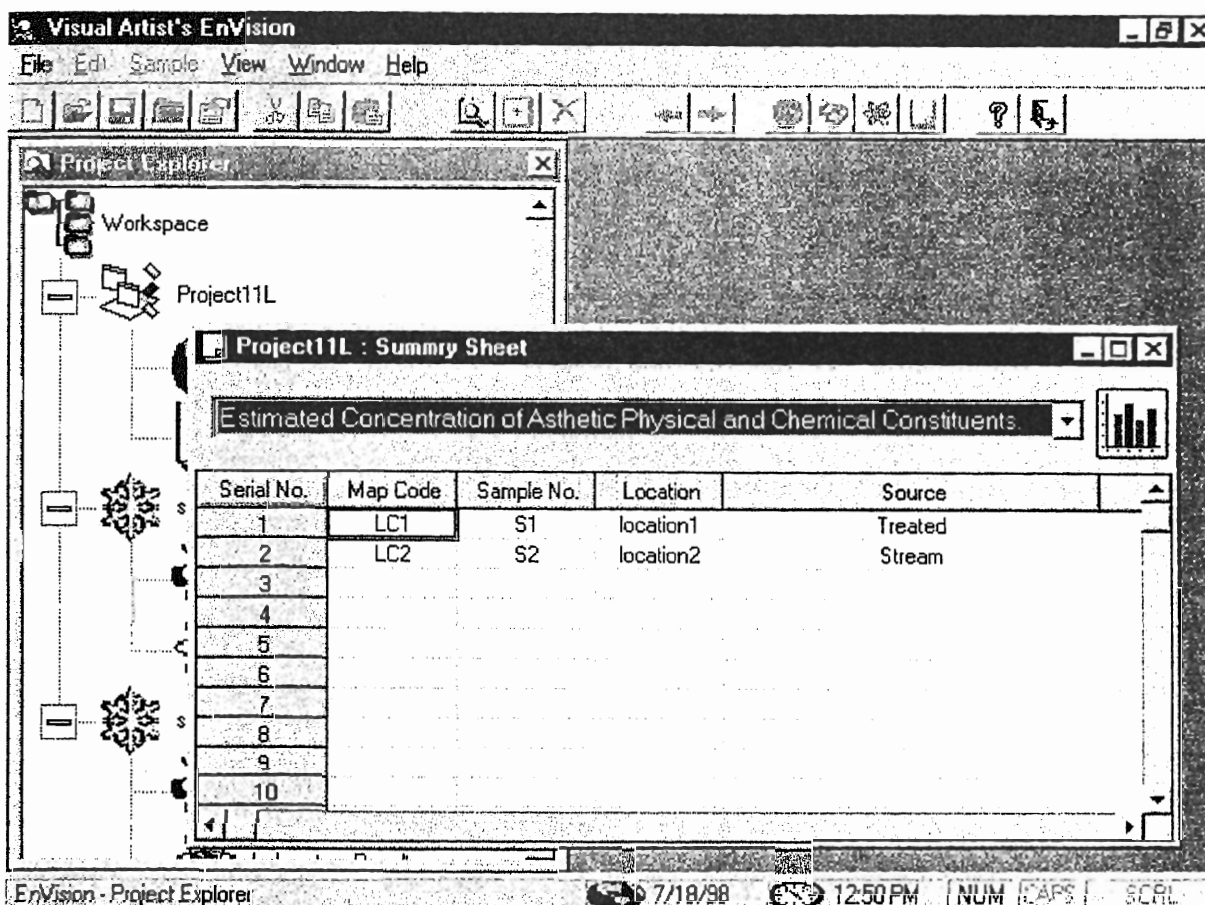
Knowing EnVision Workaround

When you start application you will be presented with a multi layered window interface, standard tool bar and menus and other components of a Windows 95 app.



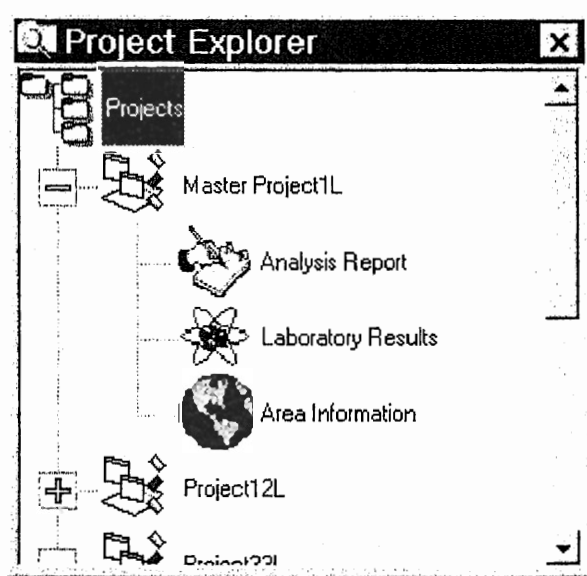
Main Window

Most of the time you will be dealing with a group of multiple windows, which are intractable individually, a main or background window will be hosting all others, as shown on the following page: -



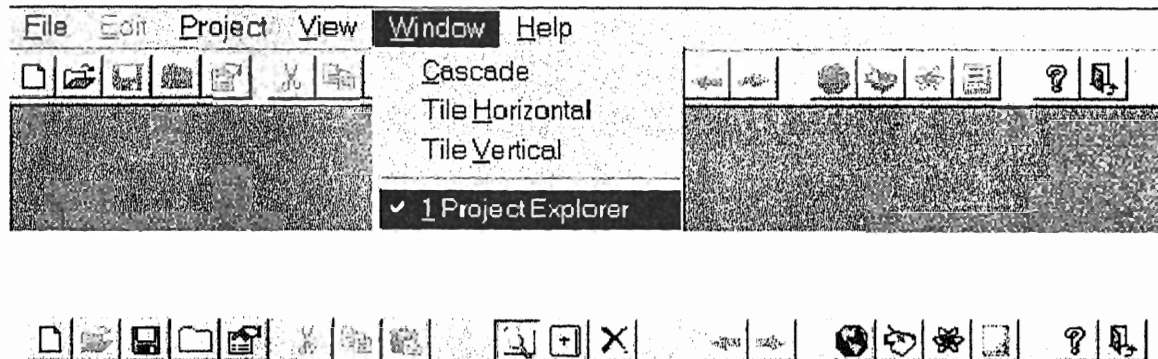
Project Explorer

Project Explorer is a special window, which serves as a hub to all the interactive operations involved in contamination analysis process. It has a hierarchical tree like interface: -



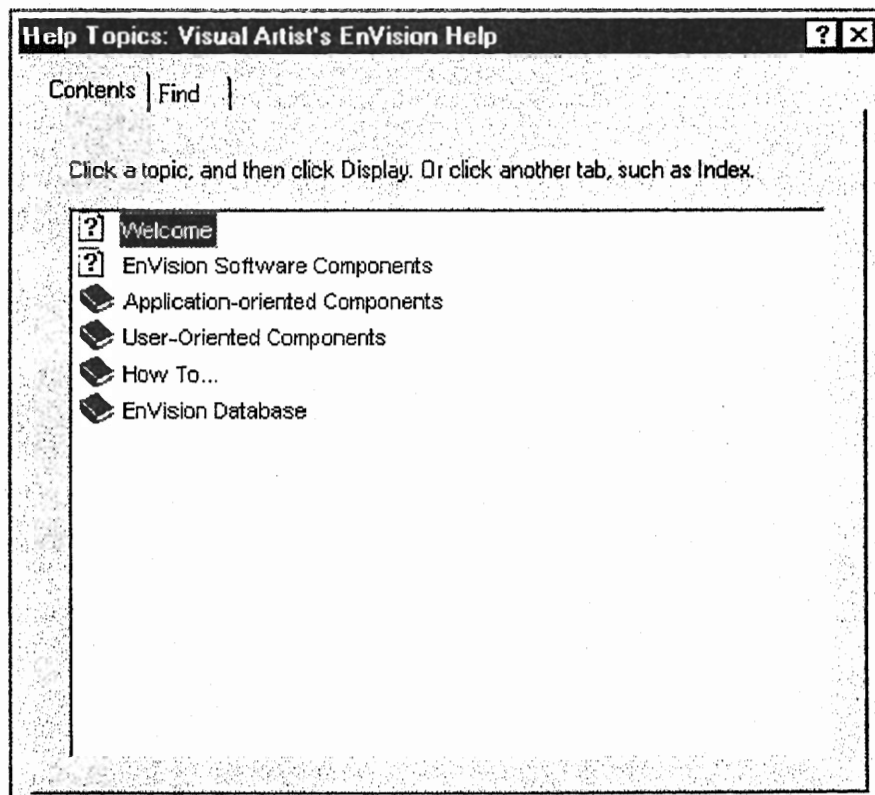
Menu & Tool bar

As standard windows based application, EnVision enjoys standard menus and a related tool bar as a graphical alternative to the menus. These components are shown below: -



Accessing Help

EnVision provides standard Windows 95 based help system. Help is accessible all around the application, and entire help contents are shown from the Help menu.



Setting EnVision Options

Customize EnVision to fit your needs and requirements is an easy process. Select EnVision Options from **View** ☐ **Options**, as shown on the following page: -

Options [X]

Projects | Laboratory Results | Chart | Scrolling

Initial Project name :- Project1

Minimum projects required for Summary Sheet component :- 2

☐ Make Project Set consisting of minimum projects required at start up.

Save Projects which are :-

- ☒ Currently present in the Project tree of Project Explorer
- ☐ Selected projects currently present in the Summary Sheet component

Apply Cancel Help

Print Workshop

EnVision's Print Workshop is your tool to be productive in output. This features-enriched component is accessible from **File** **Print Workshop** command: -

Visual Artist's EnVision [X]

File Edit Sample View Window Help

EnVision Print Workshop [X]

General Constituent Description | Causes of Contamination | Environmental Impacts | Preventive Measures | Suggestions

Standard Constituent Category | Area Information | Analysis Report | Laboratory Results | Summary Sheet

Print Category

- ☒ Asthetic Physical and Chemical Parameters
- ☐ Water Quality Standards for Bacteriological Parameters
- ☐ Water Quality Standards for Trace Metal and Inorganic Parameters

Print Target

- ☐ File
- ☐ Printer

Target Settings

Printers :- [] Number of copies :- []

Type :- [] Set target options

Where :- [] Set Margins

Export File Name :- [] Save date in original format

Export File Format :- [] Save numbers in original format

OK Pick Data Help

EnVision Print Workshop 7/18/98 1:29 PM NUM CAPS SCRL

How To...

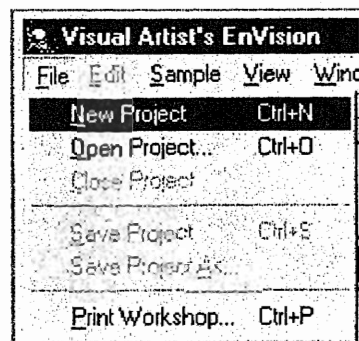
This section explains graphically "How To" perform certain application operations, which can be grouped under following titles: -

Project How Tos...

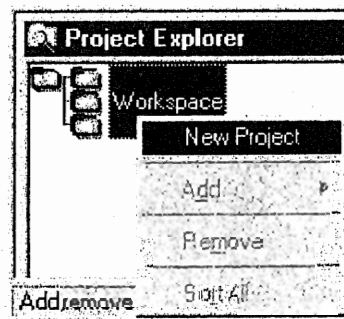
Add a Project

To add a project, do any of the following: -

- Select **File** □ **New Project**



- Right click 1st node of the Project Explorer tree choose **New Project**



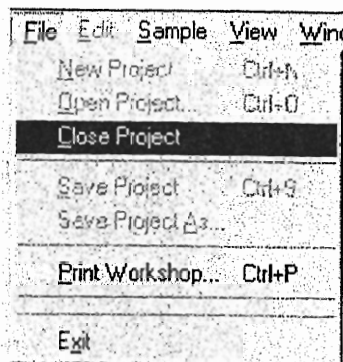
- Click following button on the tool bar to add a new project:-



Close a Project

To close a project, do any of the following: -

- Select **File** □ **Close Project**



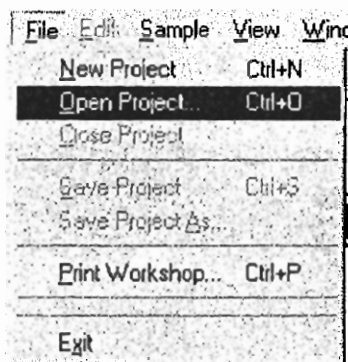
- Click the following button on the tool bar to close a project:-



Open a Project

To open a project, do any of the following: -

- Select **File** □ **Open Project**



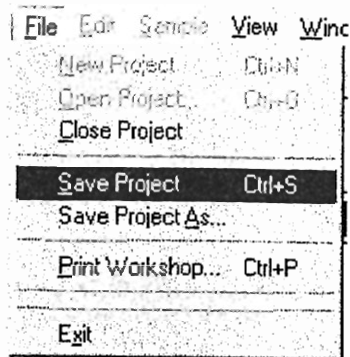
- Click following button on the tool bar to open a project:-



Save a Project

To save a project point to the project node in the Project Explorer tree and do any of the following: -

- Select **File** □ **Save Project**



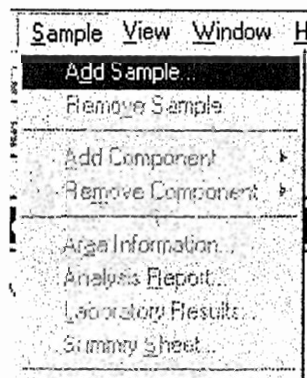
- Click following button on the tool bar to save a project:-



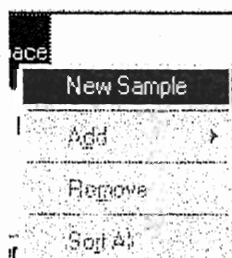
Add a Sample

To add a Sample component, do any of the following: -

- Select **Sample** ▢ **Add Sample**



- Right click 1st node of the Project Explorer tree choose **New Sample**



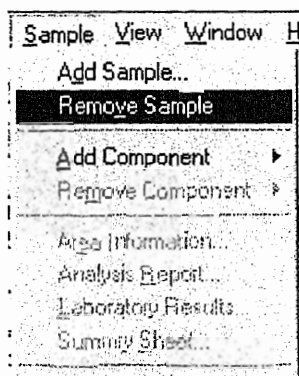
- Click following button on the tool bar to add a new sample component:-



Remove a Sample

To remove a sample while its node is selected in Project Explorer, do any of the following: -

- Select **Sample** ▢ **Remove Sample**



- Click following button on the tool bar to remove a sample:-

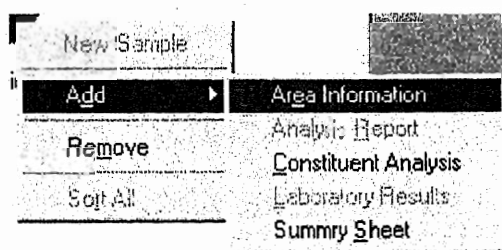


Project Component How Tos...

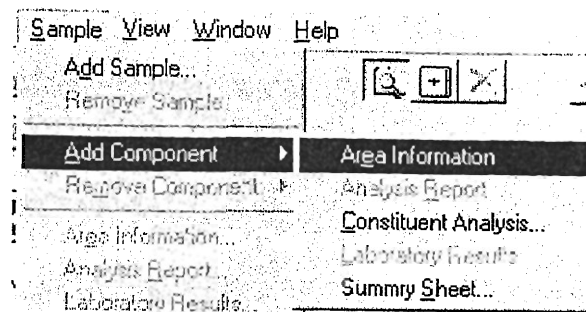
Add Area Information component

To add Area Information component, point to the project node in the Project Explorer tree and do any of the following: -

- Right click on Project node and select **Add** ▢ **Area Information**



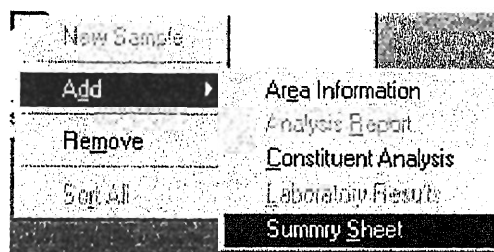
- Right click on Project node and select **Samples** ▢ **Add Component** ▢ **Area Information**:-



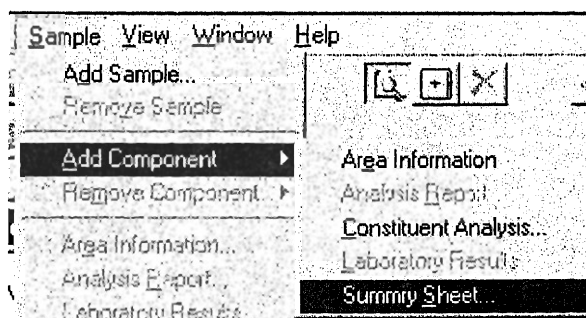
Adding Summary Sheet component

To add Summary Sheet component, while Project Node is selected clicked in Project Explorer tree, do any of the following: -

- Right click Project Node and select **Add □ Summary Sheet**



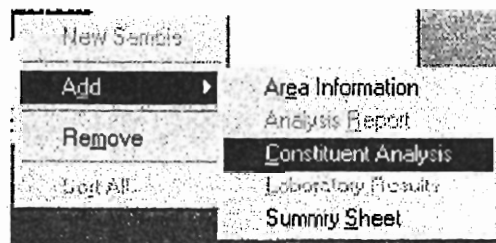
- While project node is selected, choose **Sample □ Add Component □ Summary Sheet**



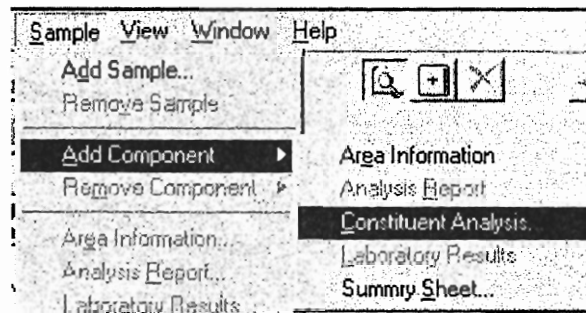
Adding Constituent Analysis component

To add Constituent Analysis component, select the project node in the Project Explorer tree and do any of the following: -

- Right click project node and choose **Add □ Constituent Analysis**



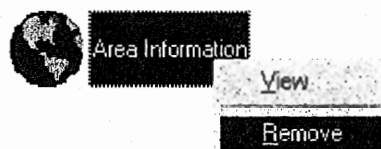
- While project node is selected, select **Sample** ▢ **Add Component** ▢ **Constituent Analysis**



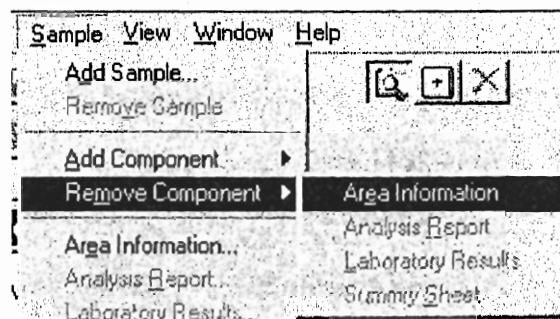
Removing Project components

To remove project components, i.e. Area Information, Summary Sheet or any Constituent Analysis component, do any of the following: -

- Right click the component to be removed choose **Remove**



- While project node is selected, choose **Sample** ▢ **Remove Component** ▢ **<Component>** e.g.:-

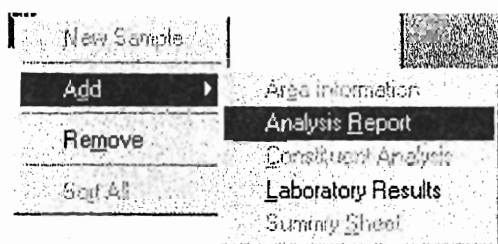


Sample Component How Tos...

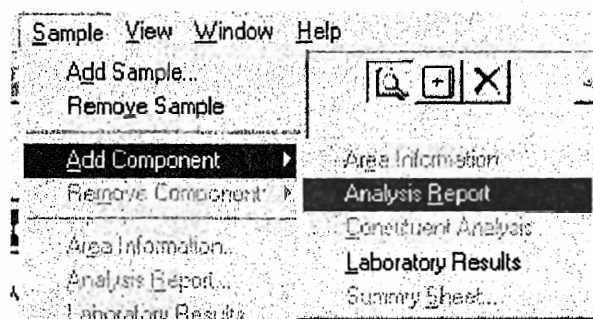
Adding Analysis Report component

To add Analysis Report component to a sample, point to the sample node in the Project Explorer tree and do any of the following: -

- While sample node is selected, right click and choose **Add ▢ Analysis Report**



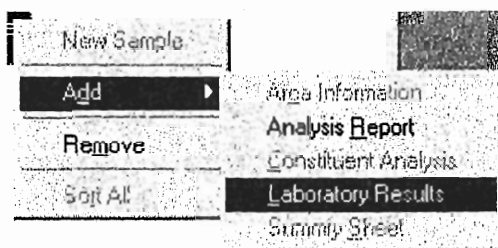
- Select the sample, select **Sample ▢ Add Component ▢ Analysis Report**



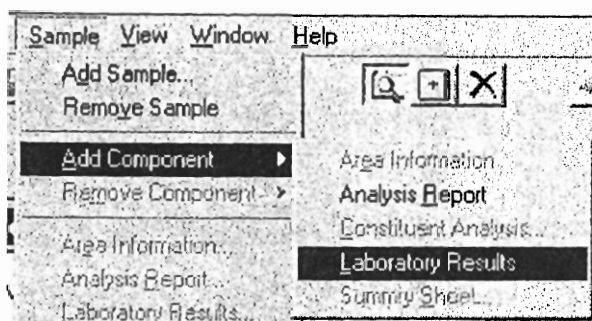
Adding Laboratory Results component

To add Laboratory Results component to a sample, point to the sample node in the Project Explorer tree and do any of the following: -

- While sample node is selected, right click and choose **Add ▢ Laboratory Results**



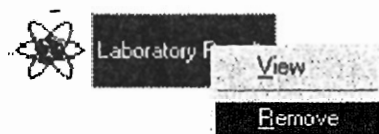
- Select the sample, select **Sample ▢ Add Component ▢ Laboratory Results**



Removing Sample components

To remove Sample components, i.e. Analysis Report & Laboratory Results, point to the component and do any of the following: -

- Right click the component to be removed and choose **Remove**



- While sample is selected, choose **Sample** ☐ **Remove Component** ☐ **<Component>** e.g.:-

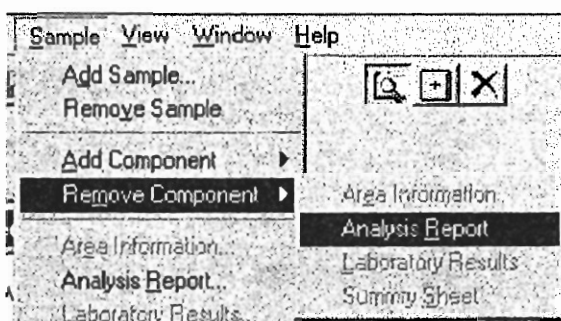
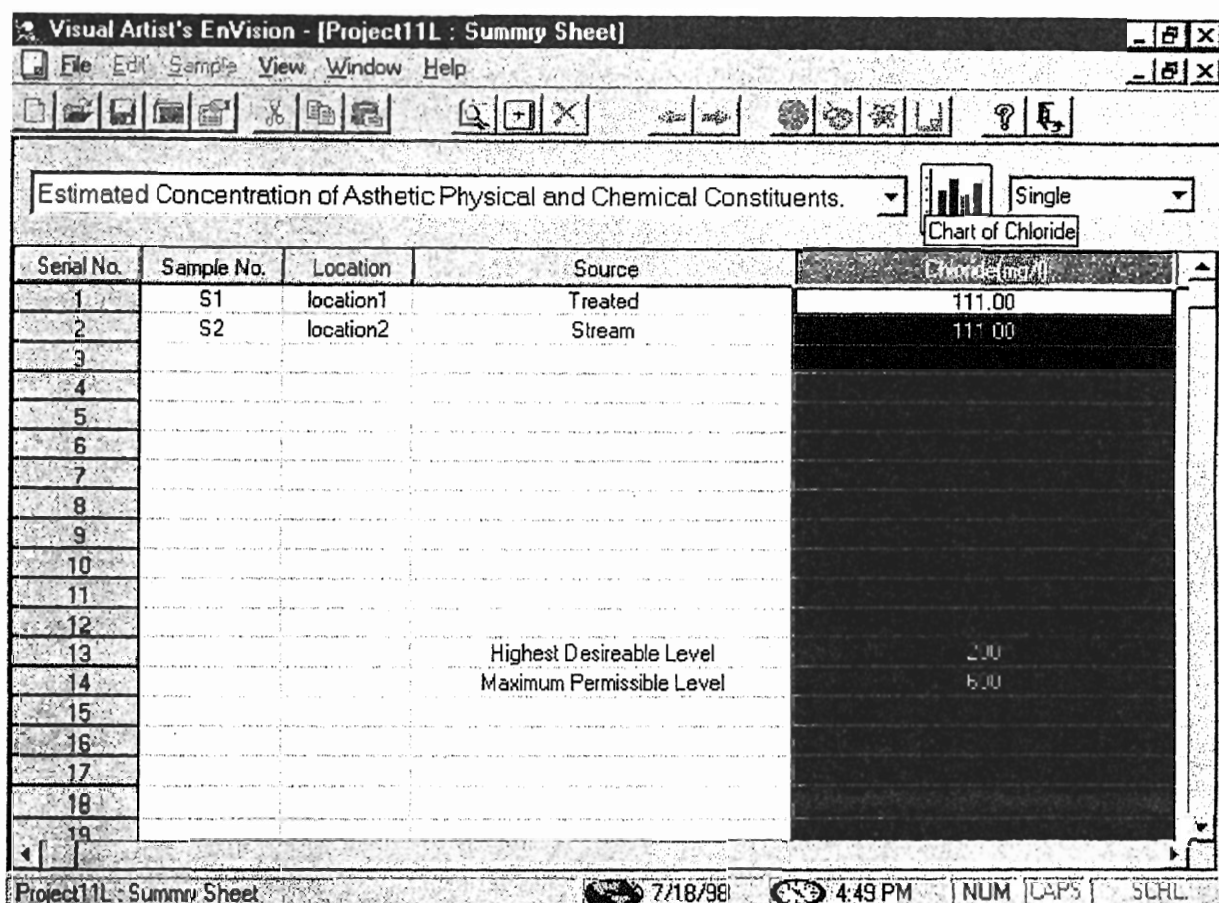


Chart How Tos...

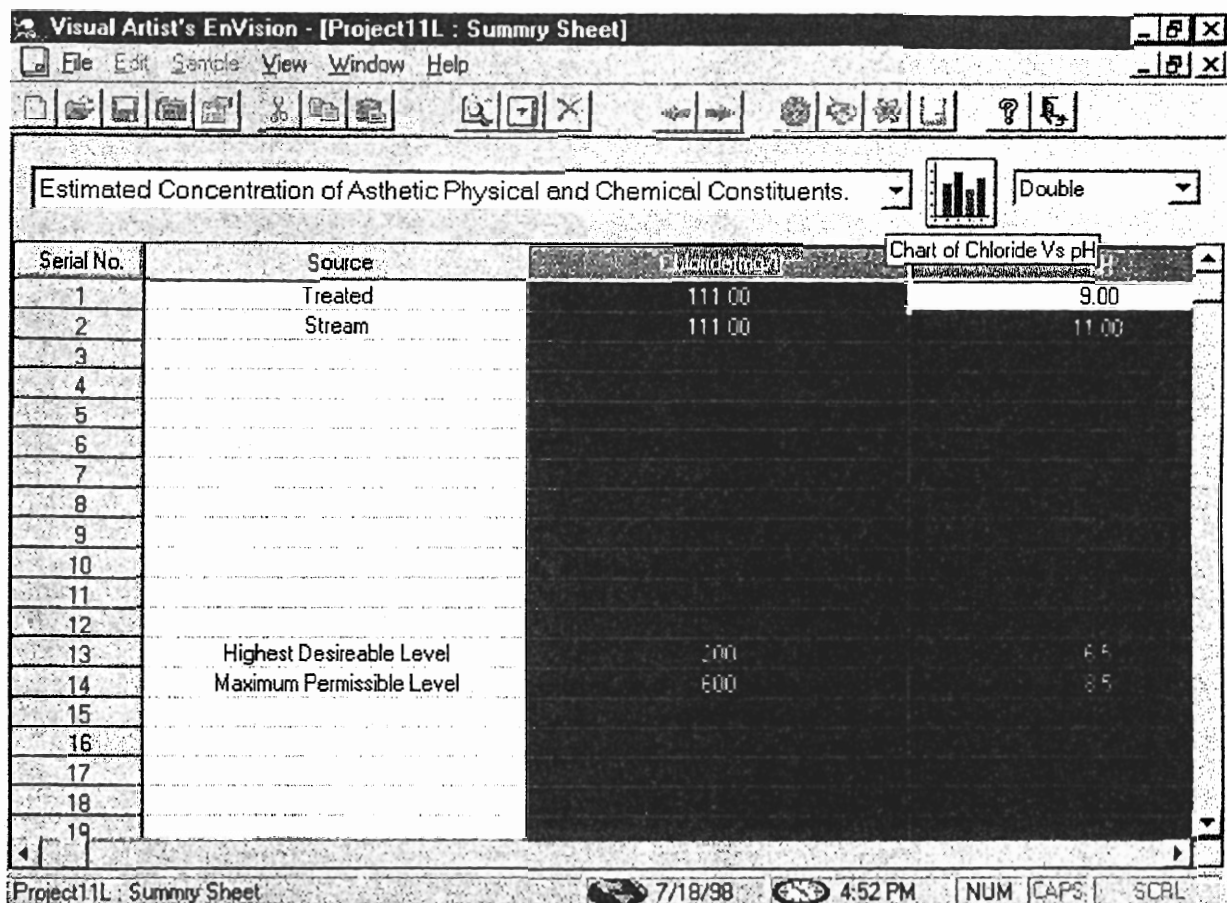
Generating Single Chart

To generate single chart, first select **Single** from the combo box at the top right of Summary Sheet window, click the header of the constituent over which chart is to be generated and click the chart button located in between the tow combo boxes as shown in the figure on the following page: -

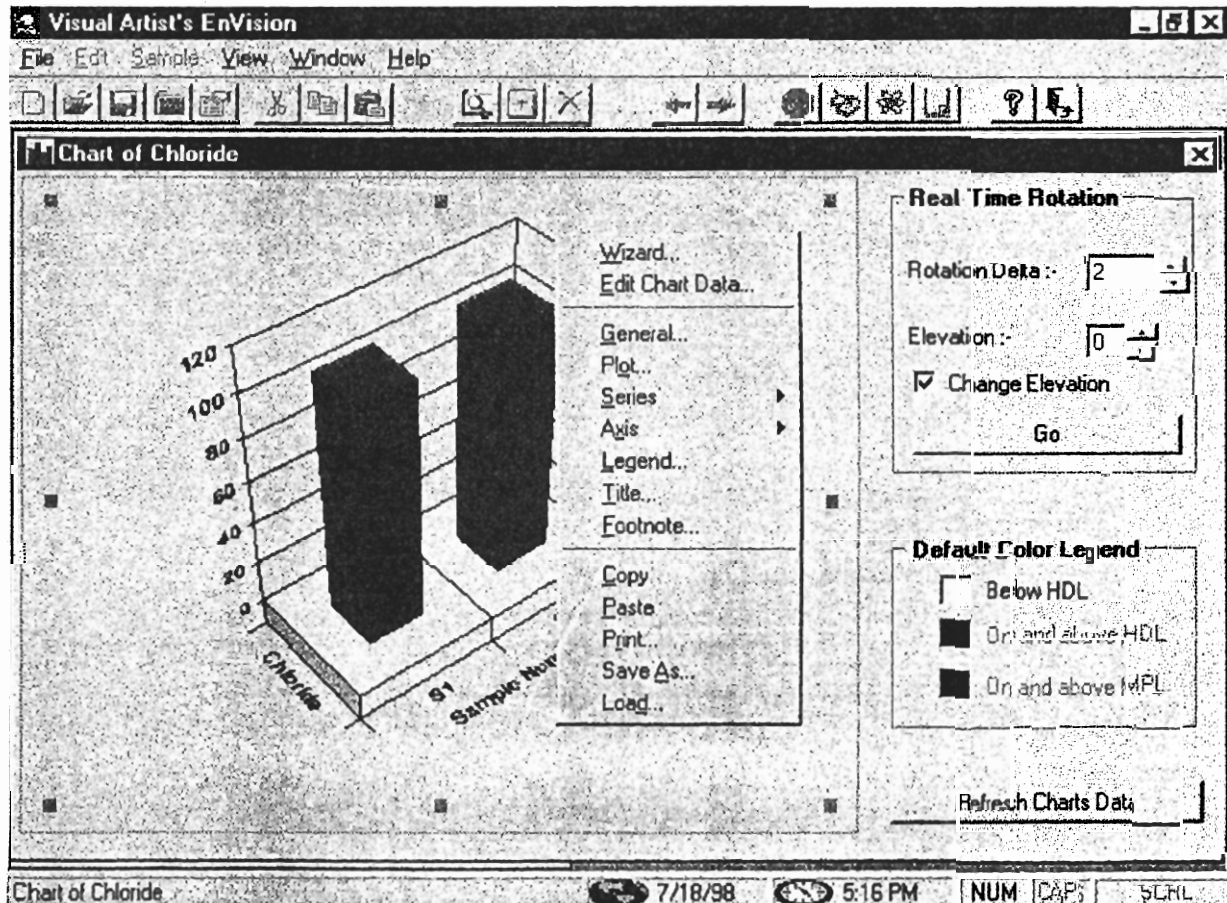


Generating Double Chart

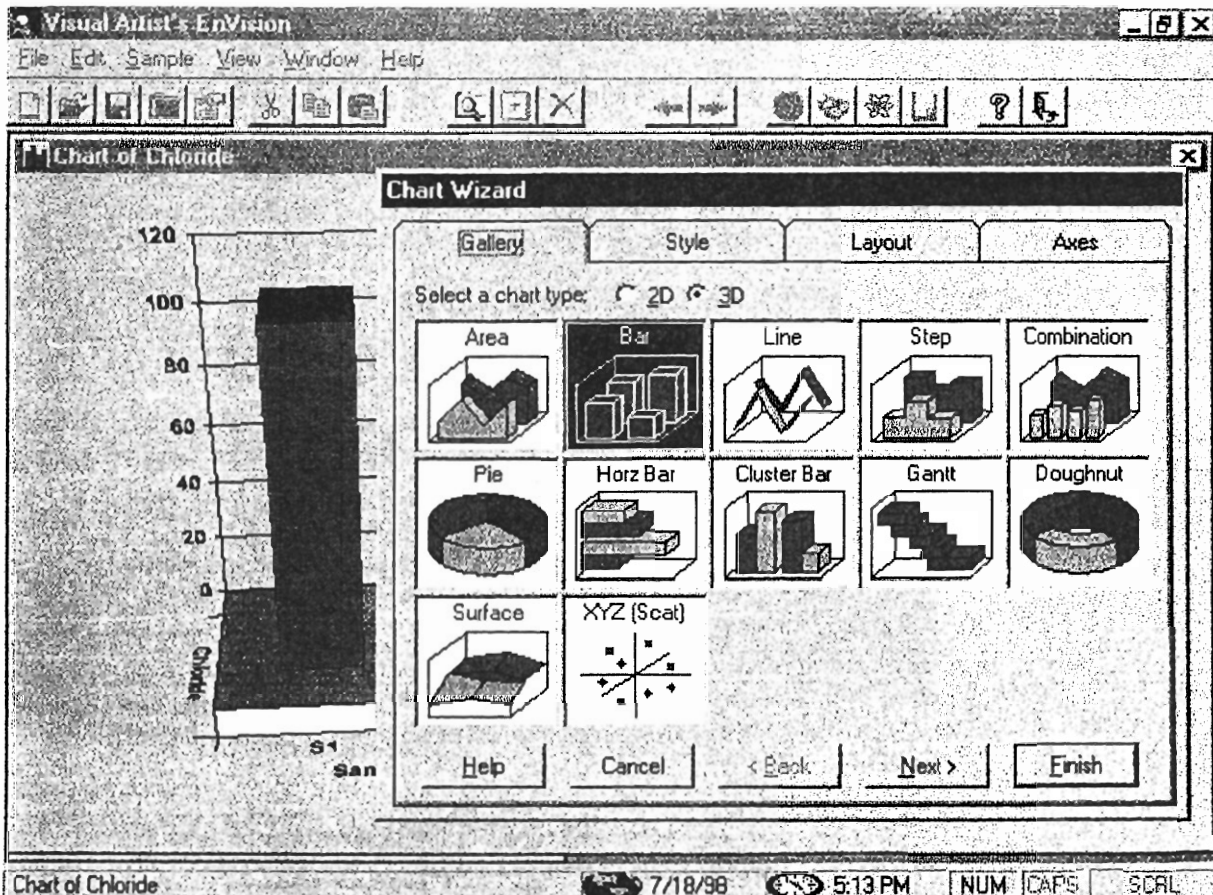
Generating double chart is an easy process, simply scroll to the two constituents for the values of which comparison chart is required, first select **Double** from the top right combo box, click the header of 1st constituent, press and hold down the **Control (Ctrl)** key on the keyboard, again click the header of second constituent and then click the chart button to bring up the chart window. All this process is shown in the figure on the following page:-



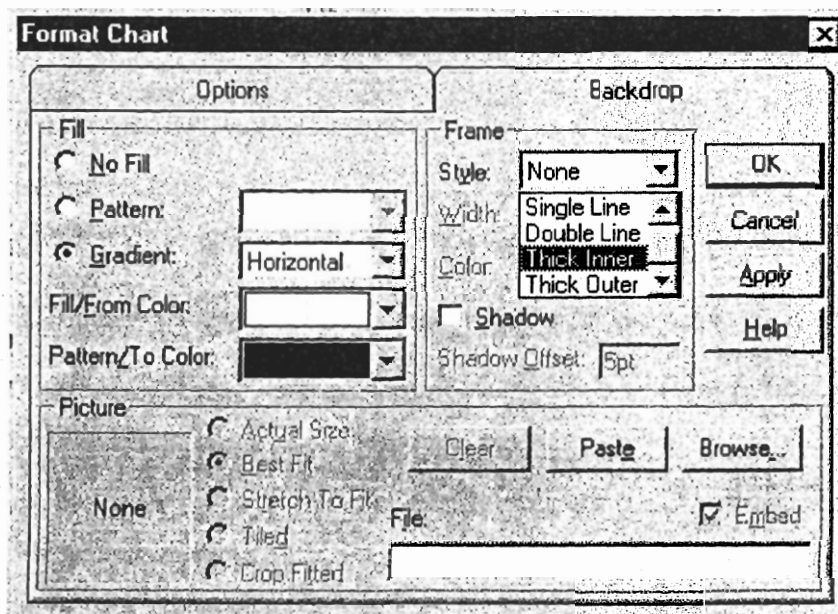
Customizing Chart Options



EnVision provides you with the ultimate in control over the charting. Right clicking the chart object brings up its context menu as shown in the figure on the previous page. You can set certain cool options, **Edit Chart data** over, which chart will be regenerated. This is another interactive tool called **Wizard** that can walk you through certain steps to customize the chart as shown: -



Setting general options is any easy one, simply select **General** from the context menu and here you have a whole suite of tools waiting for you to adjust you needs.



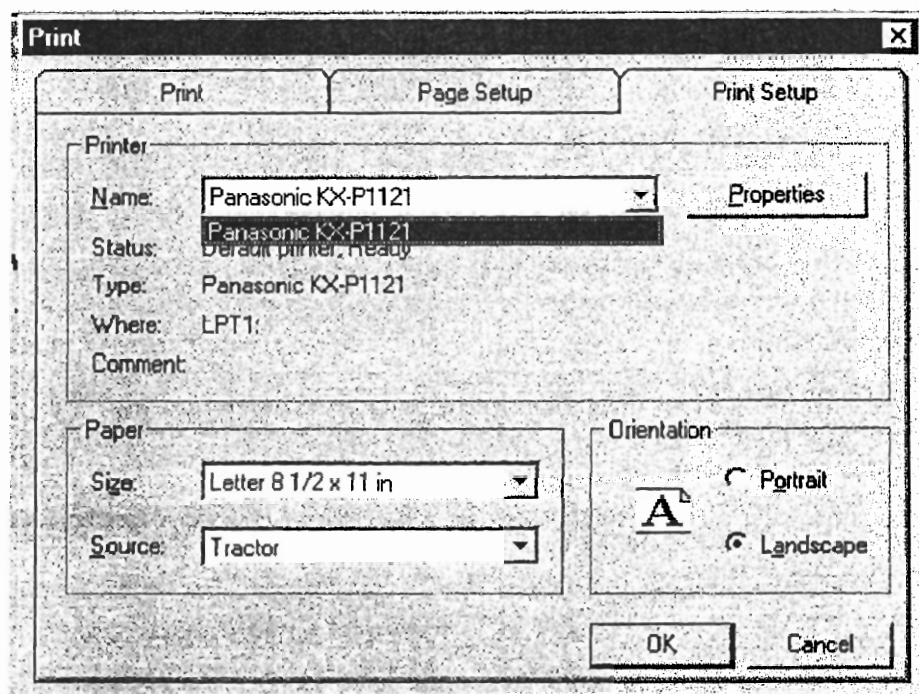
Real Time Rotation

To entertain yourself and as an add on, Visual Artists have provided you with this cool feature over the chart. Just set **Angle** of the chart, **Elevation**, click **Go** button and check out yourself!

(Try clicking **Change Elevation** checkbox)

Printing Charts

Printing of charts is also intuitive. Right click the chart object to bring up its context menu and select **Print...** following dialog box appears: -

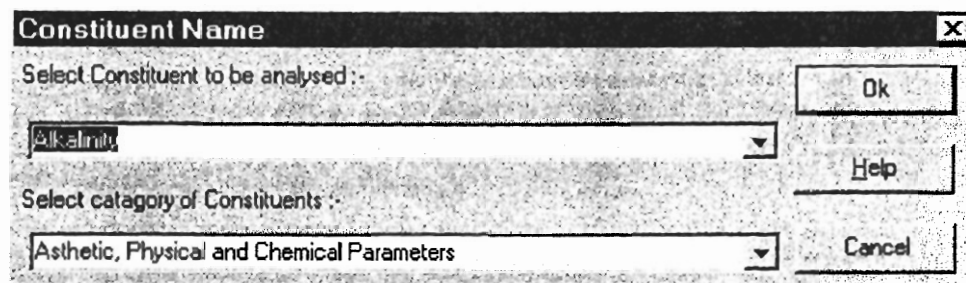


From this dialog you can select certain printing options.

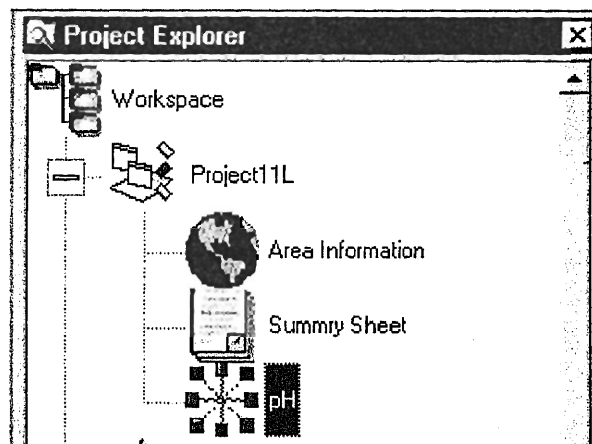
Analysis How Tos...

Adding Constituent Analysis component

After selecting **Constituent Analysis** component following dialog box appears: -

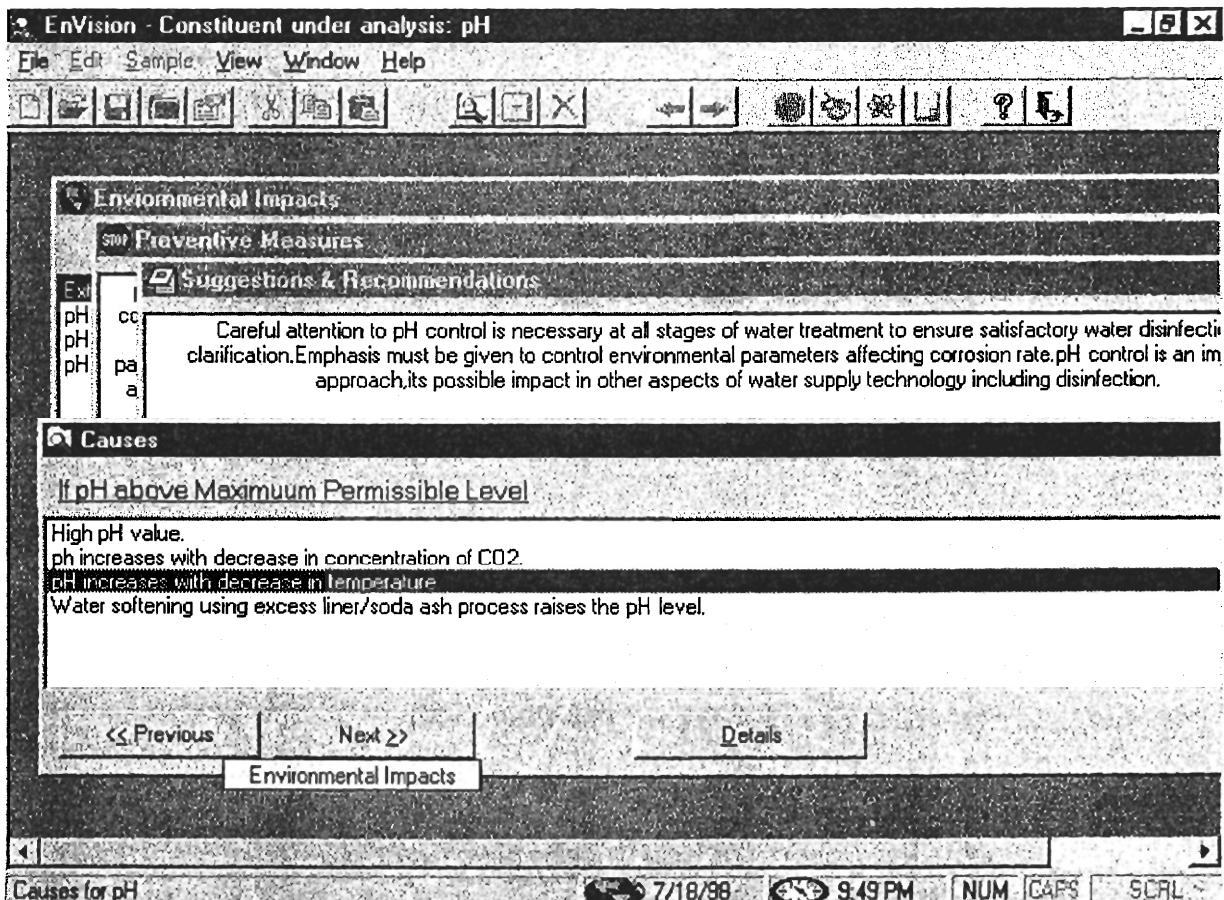


Drop down the constituent category, which will be currently active in the Summary Sheet component. Constituents from that category will be listed in top combo box from which you can select any constituent. An analysis component will be added to the Project node in the Project Explorer tree as: -



Browsing Analysis Literature

Analysis literature is displayed into four windows intractable individually. Every window contains navigation buttons. Clicking these buttons displays analysis windows back and forth as: -



Removing Analysis component

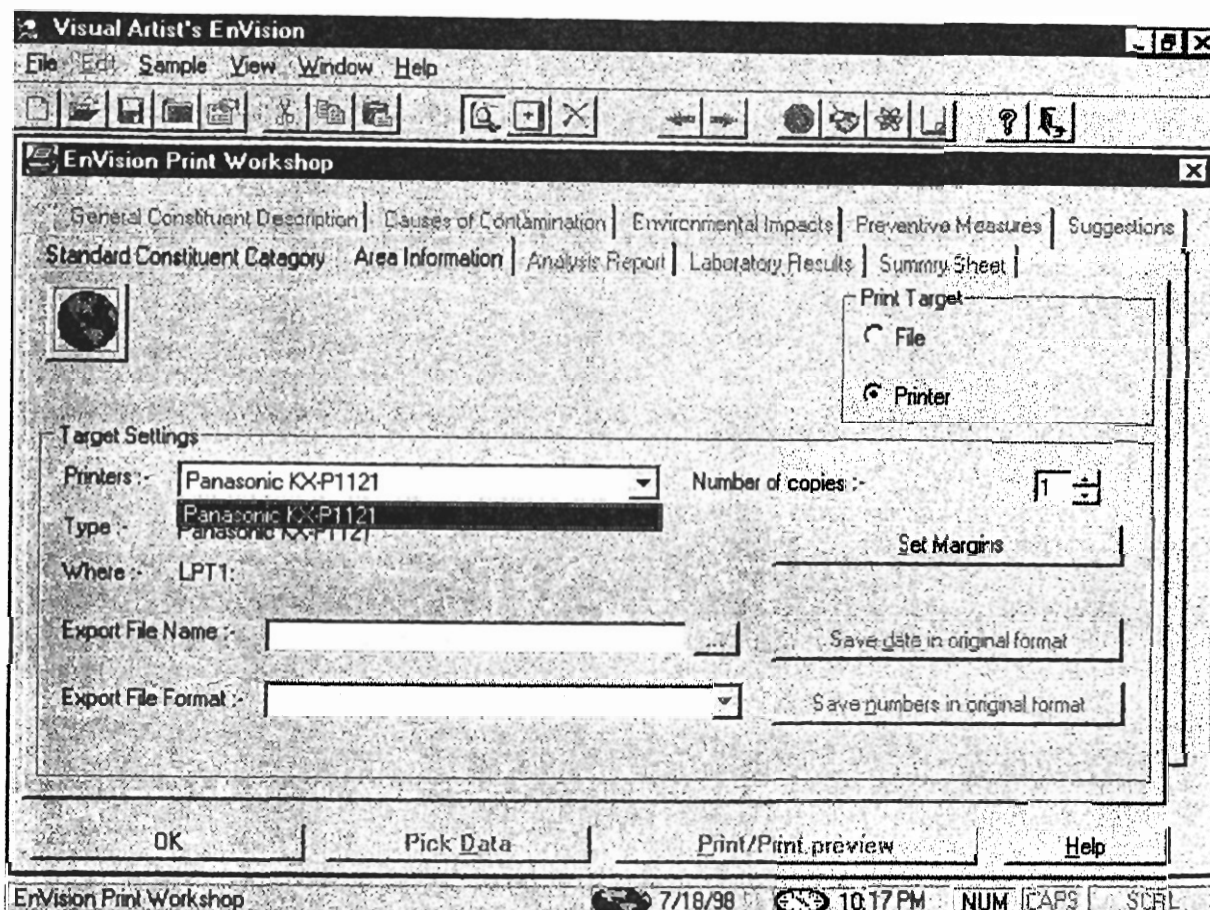
Removing analysis components is the same and consistent with that of other project / sample component, simply point to the component and select **Remove**.

Getting output

Visual Artist's EnVision redefines output horizons. Through **Print Workshop** component, simple point n click interface strengthens you to get quick output of your work.

Printing components

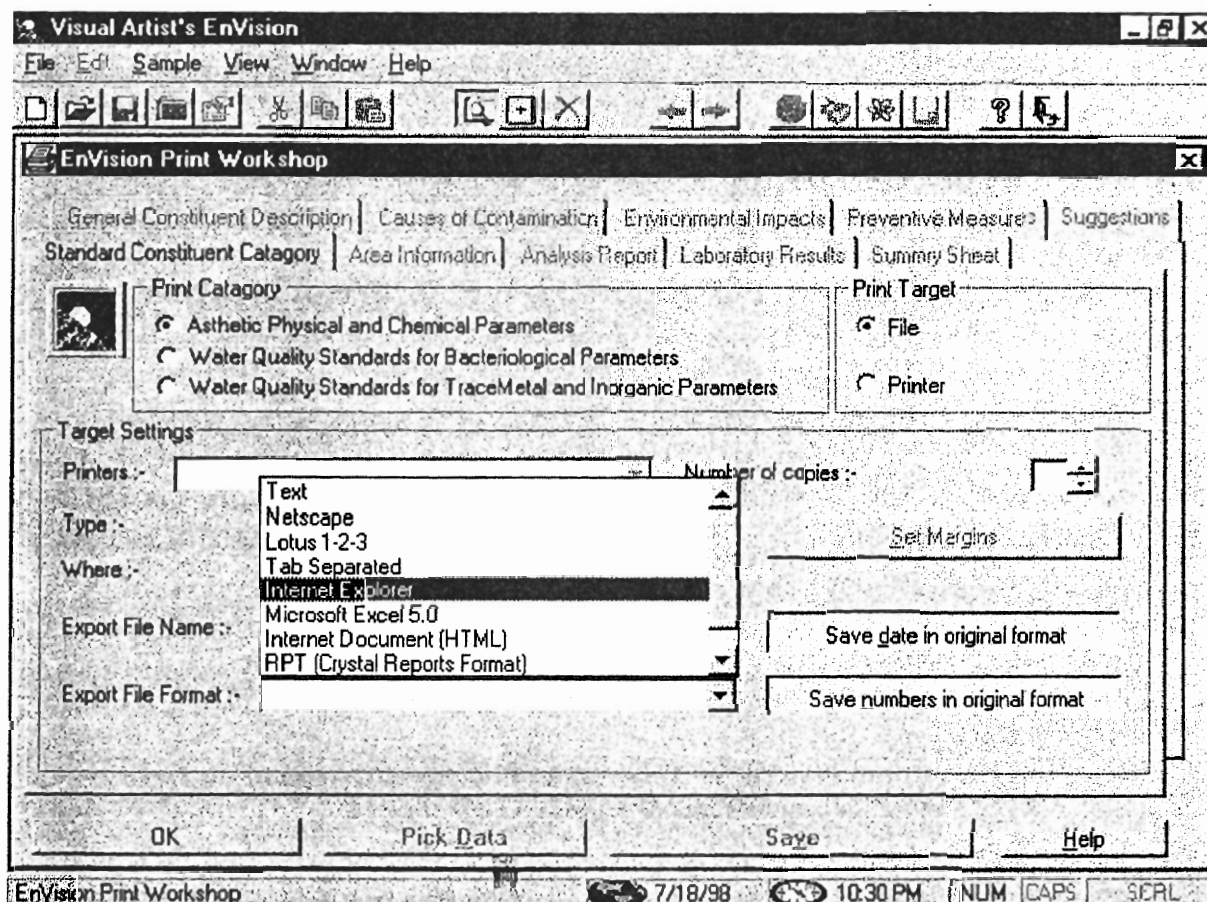
Just click any of the project or sample component, load Print Workshop, corresponding component tab on the Workshop window will be enabled as: -



Here on this page Area Information component tab is enabled, set print target as printer, select the desired printed, set margins. After settings these options click **Pick Data**, data from the component will be injected into the database, and then click **Print/Preview**.

Exporting components

Exporting components as any one, simply click the component you need to print, bring up **Print Workshop**, select File as **Print Target**, select desired format as **Export File** format, set export location from the ellipses buttons (...) and provide **Export File Name**. Click again **Pick Data** and then **Save** the data or export in the format you selected.



CHAPTER - 7

INTEGRATED ENVIRONMENTAL CONTROL SYSTEM OUTPUTS

SYSTEM OUTPUTS

Spreadsheets

2D/3D Charts

Contamination Reports

Spreadsheets

6/25/99

Local Information System

Geography

Visual Artist's EnVision

Country :

Pakistan

Province / State :

sindh

District / County :

sindh

Area :

Thar

Temperature : 45.00 °C

Precipitation : 3.0000

Relative Humidity : 68.00 %

Wind Speed : 45.0000 mph

Surface Wind Direction : North East

Weather Events:-

normal

Living Conditions :-

moderate

Floody Conditions :-

Rare floods

Topographical Influence :-

None

Hydrogeology

Depth : 300.00 m

Source of Water Sample : Hand pump

Flow Rate : 20.00

Water Utilizations :-

Agricultural : Yes

Commercial : No

Domestic : No

Formation :-

Nagar Parker

Rock Type :-

Rhyolite

Hardcopy. 7.1. Local Area Information System.



Standard Catagory Constituents

6/25/1999

Visual Artist's EnVision®

Category Name = Water quality standards for TraceMetal and Inorganic parameters

<u>Constituent</u>	<u>Unit</u>	<u>Highest Desirable Level</u>	<u>Maximum Permissible Level</u>
Arsenic	mg/l	5	15
Calcium	mg/l	75	NGVS
Chloride	mg/l	200	600
Chromium	mg/l	0.05	NGVS
Copper	mg/l	0.05	NGVS
Flouride	mg/l	1.0	1.5
Hardness as CaCo3	mg/l	200	500
Iron	mg/l	0.1	1.0
Lead	mg/l	0.05	0.05
Lithium	mg/l	NGVS	NGVS
Magnesium	mg/l	30	150
Manganese	mg/l	0.05	0.5
Nickle	mg/l	5	NGVS
Nitrate	mg/l	10	45
Ph		6.5	9.2
Potasium	mg/l	NGVS	NGVS
Sodium	mg/l	30	200
Sulphate	mg/l	200	400
T.D.S	mg/l	500	1500
Turbidity	NTU	2.5	5
Zinc	mg/l	5	15

Hardcopy. 7.2. Standard Category Constituents.



6/26/99

Analysis Report

Visual Artist's EnVision®

Name of Collector : Rashid Jamil

Name of Department : Peshawar University

Date of Collection : 12/11/99

Time of Collection : 12:12 AM

Sample Number : Naukot_01

Sample Code : 303map

Source of Water Sample : Hand Pump

Location : Naukot

Temperature of water sample : 45.00

°C **Location Code :**

Remarks :-

Hardcopy. 7.3. Analysis Report.



Laboratory Results

Visual Artist's EnVision®

Catagory :-Asthetic Physical and Chemical parameters

Sample Number :- iba001

Constituent	Unit	Highest Desirable Level	Maximum Permissible Level	Observed Value
Alkalinity	m/mol/l	50	500	19.00
Chloride	mg/l	200	600	24.00
Colour	TCU	5	15	colourless
Conductivity	micro-sec	500	NGVS	285.00
Density	gm/ml	NGVS	NGVS	1.00
Free CO ₂	mg/l	NGVS	NGVS	0.39
Hardness as CaCo ₃	mg/l	200	500	202.00
Nitrate	mg/l	10	45	11.65
Odour				odourless
pH		6.5	8.5	9.70
Phosphate	mg/l	1	5	0.08
Sulphate	mg/l	200	400	0.04
T.D.S	mg/l	500	1500	176.00
Taste				unobjectionable
Temperature	°C			26.00
Turbidity	NTU	2.5	5	0.44

Hardcopy. 7.4. Laboratory results.



1/25/98

Summary SheetVisual Artist's EnVision®**Catagory Name :***Asthetic Physical and Chemical parameters*

Serial No	Sample No	Location	Source	
1	iba025	Chak Shahzad	Well	
For Sample No	Constituents	Highest Desirable Level	Maximum Permissible Level	Constituent Value
iba025	Alkalinity(m/mol/l)	50	500	19.00
iba025	Chloride(mg/l)	200	600	24.00
iba025	Colour(TCU)	5	15	colourless
iba025	Conductivity(micro-sec)	500	NGVS	285.00
iba025	Density(gm/ml)	NGVS	NGVS	1.00
iba025	Free CO2(mg/l)	NGVS	NGVS	0.39
iba025	Hardness as CaCo3(mg/l)	200	500	202.00
iba025	Nitrate(mg/l)	10	45	11.65
iba025	pH	6.5	8.5	9.70
iba025	Phosphate(mg/l)	1	5	0.08
iba025	Sulphate(mg/l)	200	400	0.04
iba025	T.D.S(mg/l)	500	1500	176.00
iba025	Turbidity(NTU)	2.5	5	0.44
iba025	Taste			unobjectionable
iba025	Odour			odourless
iba025	Temperature(°C)			26.00

Serial No	Sample No	Location	Source	
2	iba024	chak shahzad	Well	
For Sample No	Constituents	Highest Desirable Level	Maximum Permissible Level	Constituent Value
iba024	Alkalinity(m/mol/l)	50	500	23.00
iba024	Chloride(mg/l)	200	600	14.00
iba024	Colour(TCU)	5	15	colourless
iba024	Conductivity(micro-sec)	500	NGVS	755.00
iba024	Density(gm/ml)	NGVS	NGVS	1.01
iba024	Free CO2(mg/l)	NGVS	NGVS	0.70
iba024	Hardness as CaCo3(mg/l)	200	500	300.00
iba024	Nitrate(mg/l)	10	45	1.55
iba024	pH	6.5	8.5	9.00
iba024	Phosphate(mg/l)	1	5	0.03
iba024	Sulphate(mg/l)	200	400	0.80
iba024	T.D.S(mg/l)	500	1500	470.00
iba024	Turbidity(NTU)	2.5	5	0.40
iba024	Taste			unobjectionable
iba024	Odour			odourless
iba024	Temperature(°C)			22.00

Hardcopy. 7.5. Summary Sheet for well samples



1/25/98

Summary Sheet**Visual Artist's EnVision®****Catagory Name :** *Asthetic Physical and Chemical parameters*

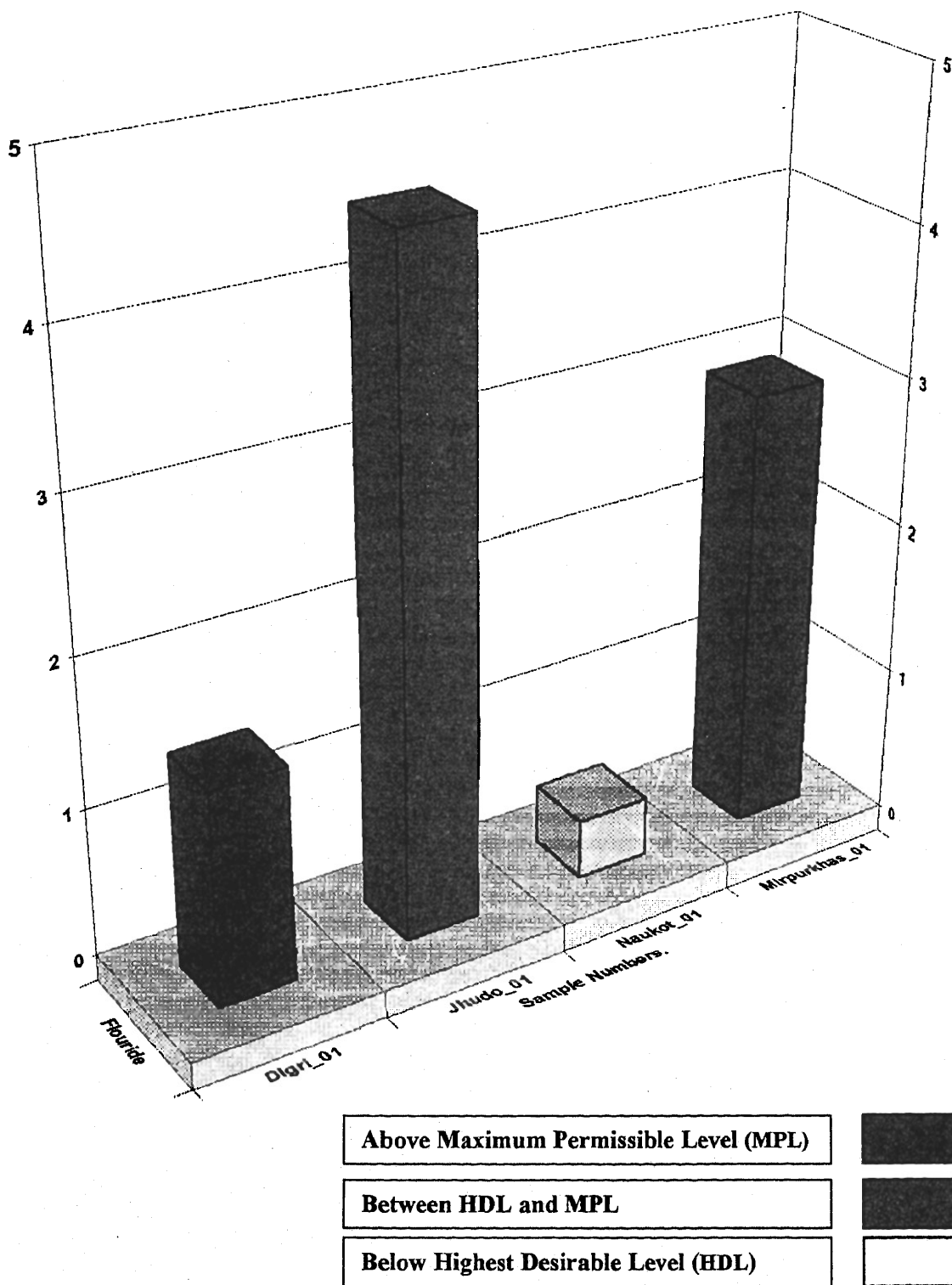
For Sample No	Constituents	Highest Desirable Level	Maximum Permissible Level	Constituent Value
iba022	Alkalinity(m/mol/l)	50	500	20.00
iba022	Chloride(mg/l)	200	600	14.00
iba022	Colour(TCU)	5	15	colourless
iba022	Conductivity(micro-sec)	500	NGVS	250.00
iba022	Density(gm/ml)	NGVS	NGVS	1.00
iba022	Free CO ₂ (mg/l)	NGVS	NGVS	0.40
iba022	Hardness as CaCO ₃ (mg/l)	200	500	201.00
iba022	Nitrate(mg/l)	10	45	0.03
iba022	pH	6.5	8.5	9.40
iba022	Phosphate(mg/l)	1	5	0.05
iba022	Sulphate(mg/l)	200	400	4.00
iba022	T.D.S(mg/l)	500	1500	152.00
iba022	Turbidity(NTU)	2.5	5	2.36
iba022	Taste			unobjectionable
iba022	Odour			odourless
iba022	Temperature(°C)			19.00

Serial No	Sample No	Location	Source	
4	iba021	I-9 UP Fac.	Tap	
For Sample No	Constituents	Highest Desirable Level	Maximum Permissible Level	Constituent Value
iba021	Alkalinity(m/mol/l)	50	500	19.00
iba021	Chloride(mg/l)	200	600	17.75
iba021	Colour(TCU)	5	15	colourless
iba021	Conductivity(micro-sec)	500	NGVS	590.00
iba021	Density(gm/ml)	NGVS	NGVS	1.00
iba021	Free CO2(mg/l)	NGVS	NGVS	0.75
iba021	Hardness as CaCo3(mg/l)	200	500	202.00
iba021	Nitrate(mg/l)	10	45	1.82
iba021	pH	6.5	8.5	9.80
iba021	Phosphate(mg/l)	1	5	0.04
iba021	Sulphate(mg/l)	200	400	3.00
iba021	T.D.S(mg/l)	500	1500	365.00
iba021	Turbidity(NTU)	2.5	5	0.46
iba021	Taste			unobjectionable
iba021	Odour			odourless
iba021	Temperature(°C)			24.00

Hardcopy. 7.6: Summery Sheet for tap samples

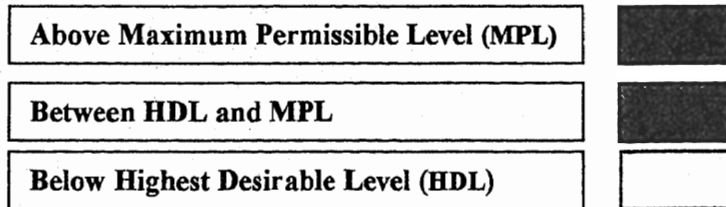
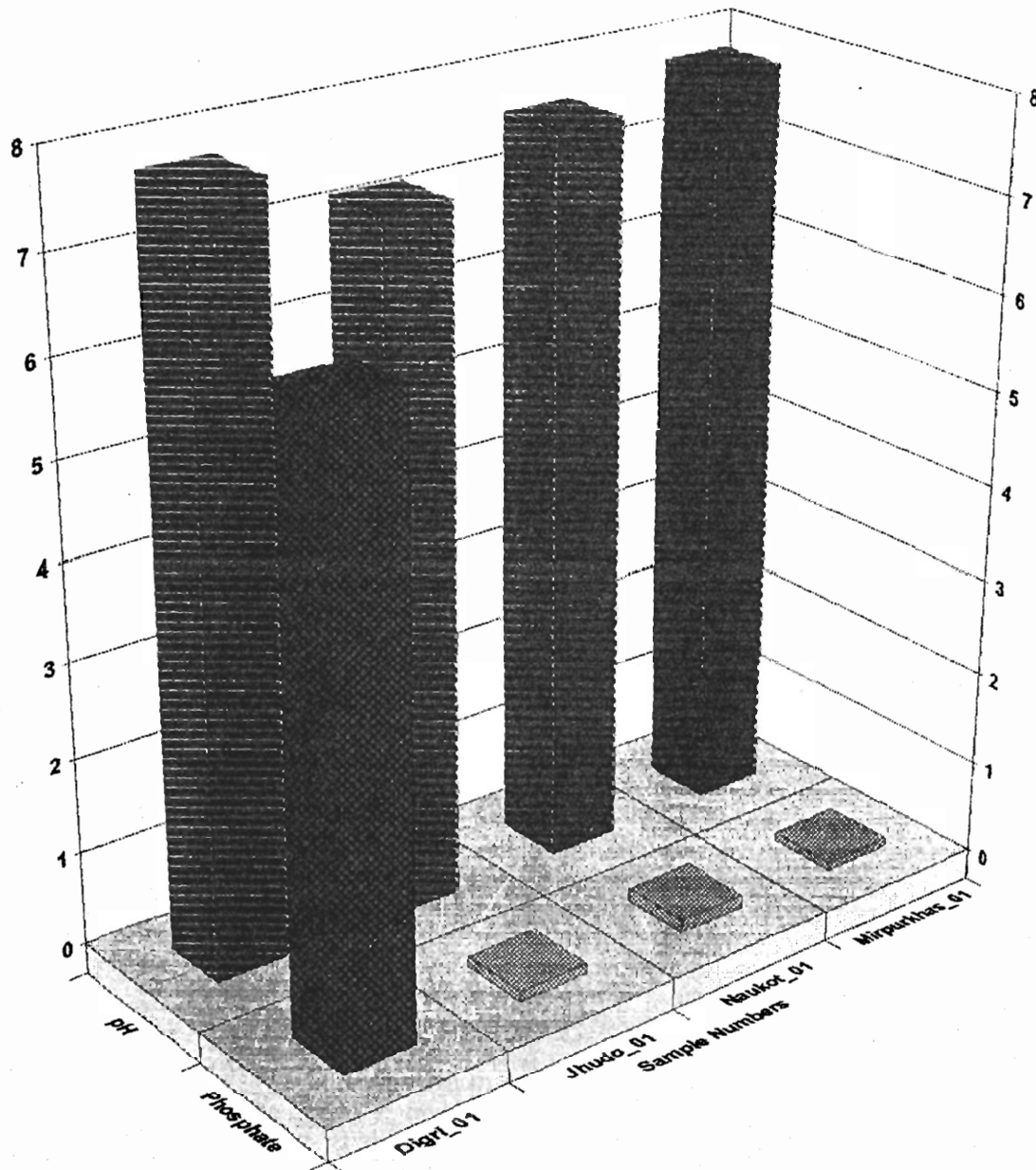
2D/3D Charts

Graphical Representation of Water Quality Parameters



Hardcopy. 7.7. Graphical representation of Fluoride with reference to its HDL and MPL levels.

Graphical Representation of Water Quality Parameters



Hardcopy. 7.8. Graphical representation of pH and Phosphate with reference to their HDL and MPL levels.

Contamination Reports



1/25/98

General Constituent Description

Visual Artist's EnVision®

Catagory Name :- *Asthetic Physical and Chemical parameters*

Constituent	Unit	Highest Desirable Level	Maximum Permissible Level
pH		8.5	8.5
Current Average Value :-		9.475	

Description :-

One of the most important water quality parameters. The pH of water is measured of the acid-base equilibrium achieved by various dissolved compounds and in most natural h₂O is controlled by CO₂, carbonate, bicarbonate etc. pH ranges (6.5-8.5).

Hardcopy. 7.9. General Constituent Description.



Causes of Contamination

1/25/98

Visual Artist's EnVision

Constituent : pH

Current State : *Below Highest Desirable level*

Cause :-

Low pH value.

Detail :-

pH is only one of variety of factors affecting corrosion. Corrosion is characterized by the partial solubilization of the material constituting the treatment & supply system, tanks, pipes, valves & pumps. It may lead to structure failure, leakages, loss of capacity and deterioration chemical & microbiological water quality. REASONS OF CORROSION:- a) Corrosion rate increases directly with increase in concentration of ions in water & also with degree of agitation. b) At very high velocity rate, corrosion may increase. c) Corrosion increases with increase in temperature. d) With pH below 6.5 & hardness < 6.0 mg/l are very aggressive to increase rate of corrosion. e) Lead corrosion tends to be maximum with low pH and low alkalinity. f) Dissolved oxygen have direct participation in the rate of corrosion.

Cause :-

pH decreases with increase in temperature.

Detail :-

Temperature also exerts significant impact on pH measurement. In pure water, decrease in pH of about 0.45 occurs as the temperature rises by 25°C.

Cause :-

pH decreases with increase in concentration of CO₂.

Detail :-

Cause :-

pH decreases with increase in chlorination process.

Detail :-



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Environmental Impacts

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Constituent : pH

Current State : *Below Highest Desirable level*

Impact :-

pH value < 6.5 gives rise to 1)eye irritation.2)skin irritation.

Detail :-

Impact :-

pH decreases with increase in temperature

Detail :-

High water temperature enhance the growth of microorganisms and may increase taste, odour, colour and corrosion.

Impact :-

pH value <4

Detail :-

Causes redness and irritation of eyes. The severity of which increases with decrease in pH.

Impact :-

pH value < 2.5

Detail :-

Causes damage to epithelium.

Impact :-

Lower pH value decreases disinfection efficiency.

Detail :-

It may have indirect effect on breath, taste, odour, appearance and results contamination.

Impact :-

Low pH value destroys the distribution system.

Detail :-

Hardcopy. 7.11. Environmental Impacts.



1/25/98

Preventive Measures

Visual Artist's EnVision®

Category Name :- *Aesthetic Physical and Chemical parameters*

Constituent	Unit	Highest Desirable Level	Maximum Permissible Level
pH		6.5	8.5
Current Average Value :-		5.475	

Preventive Measures :-

pH concentration should be maintained between 6.5-8.5. pH should be < 8 for effective disinfection with chloride. pH must be controlled to minimize corrosion of pipes in household water. pH should be > 6 to maintain household water system and to control water distribution system. Corrosion control is important aspect of water management. Water quality may involve many parameters, corrective measure should be taken. pH value of 8.5 may be necessary to control cement corrosion. pH should be above its saturated level for ideal distribution system. pH can also be controlled by replacing and maintaining distribution system.

Hardcopy. 7.12. Preventive measures.



1/25/98

Suggestions & Recommendations

Visual Artist's EnVision®

Category Name :- *Aesthetic Physical and Chemical parameters*

Constituent	Unit	Highest Desirable Level	Maximum Permissible Level
pH		6.5	8.5
Current Average Value :-		5.475	

Suggestions & Recommendations :-

Careful attention to pH control is necessary at all stages of water treatment to ensure satisfactory water disinfection & clarification. Emphasis must be given to control environmental parameters affecting corrosion rate. pH control is an important approach, its possible impact in other aspects of water supply technology including disinfection.

Hardcopy. 7.13. Suggestions and Recommendations.

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REFERENCES

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