The present investigation entitled “Assessment of surface and ground water quality in Buddha Nallah stream - A Tributary of River Sutlej” was carried out in Rupnagar and Ludhiana districts of Punjab. Buddha Nallah stream flows parallel to river Sutlej and originate near village Raipur in Rupnagar district. It passes through many villages and Ludhiana city before it joins river Sutlej near Wallipur and Manewal villages. Study was conducted to investigate physico-chemical and microbial parameters of surface and ground water of the villages located in the vicinity of Buddha Nallah. Water samples were collected from ten sites, i.e., Raipur, Birguru, Behlolpur, Machhiwara, Koomkalan, Dhanansu, Tajpur road, Salemtabri, Malakpur and Manewal. From each site ground water and surface water samples were collected in the months of August, 2013 (monsoon), November, 2013 (autumn), February, 2014 (spring) and May, 2014 (summer). Parameters such as pH, dissolved oxygen, total dissolved solids, oxidation reduction potential, electrical conductivity and temperature were measured on the spot using VS1007 water and soil analysis kit. Other parameters such as sulphate, phosphate, sodium, potassium, calcium, magnesium, chloride, total hardness, alkalinity, biochemical oxygen demand, chemical oxygen demand and microbial parameters were analyzed in the laboratory at Shoolini University, Solan. Determination of various heavy metals (cadmium, chromium, copper, cobalt, arsenic, molybdenum, lead, zinc, nickel) and iron was done using inductively coupled plasma (icp) method. From results of physico-chemical analysis, water quality index and suitability of surface and ground water for irrigation and drinking purposes was determined. Information about the health status of inhabitant of study area was also collected using survey method. The findings of current study are summarized below.

6.1 Surface water quality

- Average values of pH, total dissolved solids, temperature, oxidation reduction potential, electrical conductivity, dissolved oxygen, sodium, potassium, calcium, magnesium, chloride, total hardness, sulphate, phosphate, biochemical oxygen demand, chemical oxygen demand and alkalinity in stream water were 7.7, 3379mg/L, 24.9°C, 35.9mV, 1807µS/cm, 5mg/L, 459.4mg/L, 40.4mg/L, 101.9mg/L, 72.74mg/L, 561mg/L, 305.8mg/L, 196mg/L, 6mg/L, 112.5mg/L,
315mg/L and 316mg/L, respectively. It is pertinent to mention that values of these parameters are high in mid- and down-stream region compared to up-stream region.

- Average concentration of heavy metals, i.e., cadmium, arsenic, cobalt, chromium, copper, nickel, zinc, lead and molybdenum, and iron throughout the stream were 0.22mg/L, 0.29mg/L, 0.02mg/L, 1.11mg/L, 1.12mg/L, 2.2mg/L, 4.3mg/L, 0.901mg/L, 0.04mg/L and 3.18mg/L, respectively, and showed increasing trend as stream moved from point of origin to down-stream region.

- Seasonal variations showed that concentration of organic and inorganic constituents in stream water were maximum during summer and minimum in monsoon season. This is attributed to dilution of pollutants in rainy season. Variations in physico-chemical parameters in stream water during different seasons were significant.

- The microbial analysis showed that microbes were present in stream in all the sites and during monsoon the intensity of microbial population was more than other seasons.

- The water quality index showed that stream water, except at site Raipur, is not at all suitable for drinking purpose. It was also found that stream water is suitable for irrigation only up to site Birguru, after that pollution level in the stream was higher and should not be used for irrigational purposes.

- As stream moved downwards, the water quality index increased indicating an increase in pollution. At Ludhiana city the pollution of stream increased to such an extent that self-purification capacity of stream seems to have been lost.

- The high pollution in Buddha Nallah stream also pollute the Sutlej river.

### 6.2 Ground water quality

- Average value of parameters such as, pH, total dissolved solids, oxidation reduction potential, electrical conductivity, sodium, potassium, calcium, magnesium, chloride, total hardness, sulphate, phosphate and alkalinity in ground water was 7.79, 1516.7mg/L, 208.5mV, 425.19µS/cm, 134mg/L, 11.15mg/L, 72.17mg/L, 48.9mg/L, 261.6mg/L, 1513.6mg/L, 123.9mg/L, 0.79mg/L, and
The physico-chemical parameters in mid- and down-stream region were quite high as compared to up-stream region.

- The average value of cadmium, arsenic, cobalt, chromium, copper, nickel, zinc, lead, molybdenum and iron in ground water of study area was 0.006mg/L, 0.076mg/L, 0.043mg/L, 0.00064mg/L, 0.104mg/L, 0.10mg/L, 0.015mg/L, 0.017mg/L and 0.67mg/L, respectively, and these also increased in mid- and down-stream region compared to up-stream sites.

- The water quality index revealed that ground water at Raipur, Birguru and Behlolpur was of good quality, while at other sites it was marginal and poor, hence not recommended for drinking purposes without prior treatment.

- From Raipur to Koomkalan ground water is suitable for irrigation purposes, but mid- and down-stream sites had ground water of poor quality that might not be suitable for irrigation purposes.

- The microbial analysis showed that microbes were present in ground water in all the villages and *E.coli* was present in all the sites except Raipur, Birguru and Tajpur road.

- Results indicate that as stream pollution increased from up-stream towards down-stream, ground water pollution also increased. There seems to be a link between surface and ground water quality.

- Seasonal variations in ground water were non-significant. However it was noted that there was an increase in chemical constituent of water during monsoon due to percolation of runoff water containing ionic constituents.

### 6.3 Health status

- The health survey revealed that inhabitants of up-stream region were facing less health problems as compared to inhabitants from mid- and down-stream region.

- Major health issue in the study area was diarrhea, but it was also noticed that joint problem was common among inhabitants at all the sites.

- The survey revealed that maximum inhabitants blamed polluted water responsible for health related issues.
CONCLUSIONS

Quality of surface and ground water was evaluated using physico-chemical and microbial parameters. Buddha Nallah stream has lost its self-sustaining capacity due to heavy pollution load and at present it is difficult to restore the stream to its natural conditions without pollution control measures. The heavy load of pollutants is due to anthropogenic activities like, industrial discharges from hosiery, dairy, agricultural runoff etc, in to the river without pretreatment. Among different seasons of the year the pollution load was more prominent in surface water during summer season. However, ground water quality did not vary significantly in different seasons. Polluted stream had deteriorated ground water quality in its vicinity. Water of stream is unfit for human consumption on the basis of physico-chemical and microbial analysis. The increased biological oxygen demand value (also crossed the permissible limit) and decreased dissolved oxygen showed the contamination of water; which affect the sustainable life of plants and animals into the stream. The water quality index in mid- and down-stream region indicated that surface and ground water is not suitable for irrigation purposes. Due to poor ground water quality the health status of inhabitants is also affected. Buddha Nallah stream has lost the self-purification capacity and it is suggested that strict measures should be taken against industries and other sources polluting the stream. Based on the present studies short term and long term water quality management and restoration programs could be designed as the surface water is causing harmful effects on the health of inhabitants.