Irrigation Modernization and Design of Pipe Distribution Networks

SUMMARY OF WORKSHOP

nhc
northwest hydraulic consultants
water resource specialists

PDN Design Process

- Design discharge (precipitation deficit, efficiencies, flexibility factor) – FAO CROPWAT8
- Appreciation of command area (boundaries, topography, hydraulic boundaries)
- Layout planning, 2-, 3-, 4- tiers with zones, subzones, chaks, field units, etc. Adoption of suitable chak size is important. Consider pressure zones.
- Preliminary layout planning: google-earth, GIS software, autoCAD.
- Field surveys and stakeholder discussions (existing irrigation practices, use of groundwater, irrigator flows & pressures, land holdings, topographic and landownership surveys)
- Adopt suitable level of service
- Epanet design and evaluation
  - Outlet pressures (max, min, range)
  - Flow velocities (max and min)
  - Costs
- Head requirements for filters, control hubs, to be added
- Design optimization

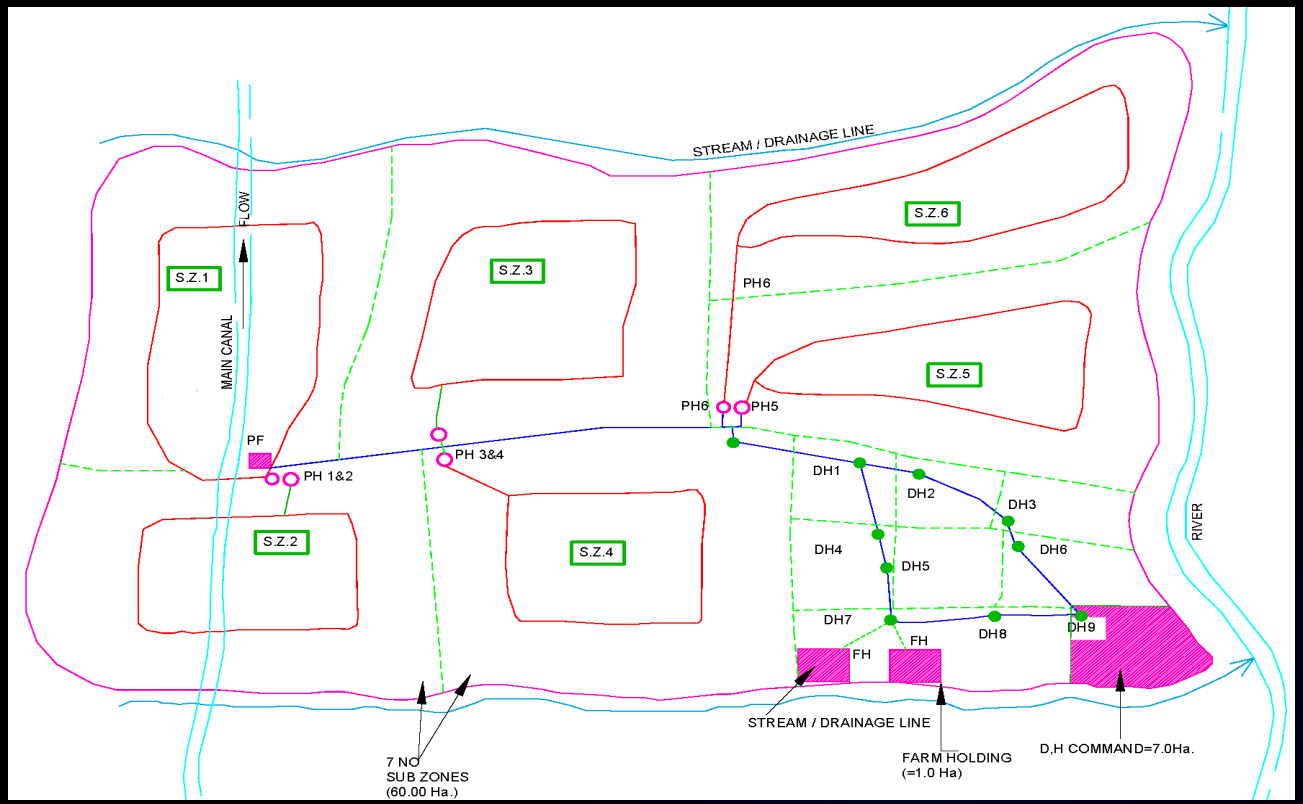
Pipe system designs to fit in with farmer on-farm investments

Level of Service, Layouts, other considerations

- Pipe systems should be for a medium to high LOS which supports drip/ sprinkler irrigation (except for paddy). i.e., irrigator flows of 4-6 l/s (non-paddy) and distance from distribution hub to farmers fields not more than about 300 m (say). For drip/ sprinkler, provide 20-25 m pressures at Outlets and adopt filters.
- Tiered layouts should be adopted with uniform sized hydraulic units, with devices for pressure and flow control.
- Pipe loops(rings) aid uniform heads at hydrants, and provide an alternative flow route in case of pipe blockages
- Control devices are needed to control flows and pressures and for air management
- Adopt SCADA with reliable data communications.
- 24/7 power would be an advantage – consider solar.
- WUAs and PIM are important – pay attention to buildings, facilities, equipment, and capacity development
- Private sector to be involved for MOM. Adopt DBO / turnkey contracts.

- For each zone, fix primary hubs, connect with primary pipelines
- Within each zone, fix secondary hubs for subzones and connect with secondary pipelines
- Within each subzone, fix outlet junctions for each chak and connect with tertiary pipelines

Junctions & pipelines for each tier



PDN Design Optimisation

- Consider layout alternatives – uniform areas lower costs for fittings and devices and facilitate O&M.
- Consider different ways to connect the junctions.
- Consider pipe types and class alternatives.
- Cost of gravity systems vary with slope and are expensive for low slopes (0.3-0.7%) due to low flow velocities.
- For low land slopes consider pumped PDN alternatives
- Calculate total life cost (for pumped systems), i.e., capital cost plus discounted energy cost for ~30 years. Adopting pipe flow velocities of 1-1.2 m/s will probably give the minimum total life cost.
- Carry out and cost several different layouts and designs
- Consider arrangements for sediment and trash management
- Pumps – adopt variable frequency drive pumps
- SCADA – adopt remote monitoring as a minimum. The degree of remote actuation justified depends many factors (scheme size, etc)

Adopting pipe distribution is relevant for both new schemes and for modernisation of existing MM schemes.

In addition to PDN, other works may include:

- Canal lining
- Overshot gates
- Ground water recharge
- Pumping facilities
- Dedicated power
- All-weather roads
- Telemetry/ SCADA

Thank you