### Experimental Design

- These sections were individually photographed for further analysis.
- Five vertical slices, spaced 8 cm apart, were excavated behind the original profile. This was done in order to study the stained subsurface flow patterns.

### Data Processing

- The images of the vertical soil profile slices (or excavations) were processed using Adobe Photoshop and MATLAB using a colour clustering code in order to make the dyed subsurface flow patterns easier to distinguish visually, and to prepare them for future quantitative analysis. Slices were clustered into 3 different colours, except for the final excavation which required 4 separate clusters to accurately isolate the dye stains from the undyed profile.

### Results & Discussion

- The five excavated vertical slices showed very different stained patterns, indicating that subsurface flow type varied greatly even within such a limited space (40 cm x 40 cm plot). By following the definitions of flow types distinguished by dye pattern laid out by Wieler & Hannes (2003), the distinct flow types present in each excavation were categorized.
  - **Original face of the soil profile**: there was evidence of heterogenous matrix flow and fingering, which is indicative of spatially heterogeneous soil properties and somewhat permeable soils (Figure 3A).
  - **First, second and fourth slices** (8 cm, 16 cm and 32 cm behind the original face of the soil profile): there was macropore flow with mixed interaction, which Wieler & Hannes (2003) suggest could indicate the presence of macropores within a heterogeneous soil matrix or simply macropores with variable flow (Figure 3B, 3C, 3E).
  - **Second slice** (16 cm behind the original profile face): there was evidence of lateral flow, as indicated by the elongated pocket of dye towards the top left of the image (Figure 3C).
  - **Third slice** (24 cm behind the original profile face): the dye patterns matched the defined pattern for highly interactive macropore flow in a permeable soil matrix, which contradicts the prior patterns indicating the presence of heterogeneous soil properties (Figure 3D).
  - **Fifth slice** (40 cm behind the profile face): patterns indicated macropore flow with low interaction, indicating the presence of a saturated or low permeability soil matrix (Figure 3F).

### Conclusion

- Despite flooding the study plot with more than 40 L of water, overland flow was never observed at the site. The absence of overland flow despite extensive flooding of the study plot is a significant demonstration of the importance of subsurface flow in typical Manitoba unfractured soils. The fact that there were many different interactions occurring within a 1 m x 1.5 m x 0.4 m profile indicates that subsurface flow patterns are extremely variable within the soil matrix in the South Tobacco Creek watershed. This carries the implication that, when analyzing flooding or heavy rainfall events, quantifying watershed-scale dynamics based on information gained from single-point analysis may not accurately represent the subsurface flow dynamics of the greater area. In order to gain a more complete view of the subsurface flow patterns which occur within a watershed, it would be advisable to conduct multiple plot scale tests throughout the watershed in order: (1) to capture as much of the subsurface flow pattern variation as possible; and (2) quantify the volume of water potentially carried by each subsurface flow type (lateral versus vertical, macropore-driven). Ongoing research into these issues is underway.