SUMMARY OF MAJOR CIVIL CONSTRUCTION DEFICIENCIES

1. DUCT BANKS

As discussed at the July 7, 2015 City Council meeting, issues with duct banks were identified during the course of construction. This includes drainage issues, one blocked conduit (out of the 468 conduit runs that make up the main communication duct bank) and some variances in conduit size. It is extremely difficult to make duct banks, pull boxes and vaults water tight given their buried exterior location. Therefore the designers attempted to solve the problem by building them with humps between vaults and pull boxes. This would allow them to drain to a vault as the water table drops prior to freeze up and allow better access in winter conditions. Due to many unforeseen utilities at shallow depths (gas service lines, electrical services, storm leads etc.) the contractor chose to go under rather than over the conflicting utilities.

Duct Bank Resolution:

Duct bank issues were given a high priority by all three parties (City, Contractor, Owner's Engineer). The parties signed an agreement for how to rectify the drainage concerns, which included extra cleaning, video camera inspection as needed and the addition of special seals to the ends of the conduits after cleaning. These seals allow wires and cables to pass through but can be tightened for relatively effective sealing. It should also be noted that a high strength "mine-rated" cable was used by the contractor and all cables were thoroughly tested. Conduit size variances were reviewed and approved by the Engineer and the sizes installed were appropriate for the cables required. The single blocked conduit remains an outstanding issue at this time. Although this conduit is a spare – that is, a purposefully constructed redundancy that will not likely be used until future expansion of the Metro Line – the City has received a quote from a third party to install an extra conduit and will offset this cost from the contractor's final invoices. The value of this item is expected to be approximately $30,000.

Duct Bank Lessons Learned

Administration will consider designing or specifying water tight vaults, drainage connections from vaults to the storm drainage system where possible and add a specific payment item for duct bank specifications to ensure proper construction.

2. MACEWAN STATION PLATFORM

This platform was built too high due to the contractor's survey error and the contractor was required to hammer down the surface to allow a recasting at the proper height.

Resolution

The contractor repaired the platform – at their own expense – utilizing methodology discussed and agreed upon by the Engineer.

Lessons Learned

Administration will consider hiring a third party surveyor to check all critical elements prior to casting. This option could add cost and time to the project and result in the city taking on greater liability. Another option would be to allow for a 100 mm topping slab to correct the small height errors that can occur in the field.

3. GUARDRAIL HEAVING

The embedded slab for NLRT is the first cast-in rail usage on the Edmonton LRT system. Many of the corners have a tight radius and the design guidelines call for a *wearing rail* type guard rail at these corners, where the guard rail is expected to be worn down over time by repeated passage of trains. This guard rail is designed to wear out first, so that the expensive main rail is protected for a longer period. The wearing rail is also designed to be easily replaceable, using an embedded plastic bushing to provide attachment and electrical isolation from stray current losses. The rail went in without coating (missed by the contractor and Owner's Engineer during shop drawing review) and substituted a fastener that proved too weak for jointing. The guard rails were removed and coated; however, the coating was problematic and created a small void beneath the guard rail. Minor movement naturally occurs when a wheel passes over the guard and water can rush into the small gap and freeze. This action causes the guard rail to heave upwards and the bushings were not strong enough to resist the ice forces.

Resolution

Replacement of all anchors (embedded plastic bushings) with a more robust anchor that can better resist ice forces.

Lessons Learned

Administration will consider using a stiffer guard rail; girder railings (attaching the guardrail to the main rail); use of a more flexible coating for stray current isolation; minimize use of embedded rail; and avoid, when possible, track curves through roadway intersections.

4. GUARDRAIL BONDING

Guardrails need to be bonded to the main rail to avoid voltage differences and minimize stray current. This was missed during the design stage due to poor communication between the consultants involved.

Resolution

Guardrail bonding was added to the contract through a Site Instruction.

Lessons Learned

Make one contract firm responsible for all stray current issue identification, mitigation, and monitoring.

5. TRACK SLAB PONDING

The track rises and falls with the existing grade and at high points the track is flat. It is very difficult to pour flat concrete work without some ponding and, in fact, the specified tolerances of 8 mm in 3 m were generally met by the contractor. However, given the large room for error in 3 km of outside track, there are a number of shallow ponds.

Resolution

The contractor has rectified most of the out-of-tolerance ponds by adding extra drainage channels. However, more work may be required. It is expected that most of the ponding will be alleviated once trains are running as the wheels will keep the flangeways clear providing additional drainage paths in the track slab.

Lessons Learned

Provide more complex (bi-directional) cross fall designs at high points. Maximize the use of tie and ballast track construction.

Issue 6 - Rail hump at 105 Avenue

The contractor cast the embedded rail too high at 105 Avenue, possibly due to thermal shifting during the pour as this is a tight corner.

Resolution

Rail casting was close to tolerance and through the commissioning process it was found to be acceptable. The City has accepted an extended warranty on the rail to mitigate potential premature wear.

Lessons Learned

Ensure the contractor has procedures for holding rails in place during the pour.