HORROCKS ENGINEERS

To: Jonathan Clegg

From: Dustin Richins

Date: May 14, 2008 Memorandum

Subject: Geneva Road Storm Drain Evaluation for EIS

The proposed Geneva Road improvements will increase the impervious area along Geneva Road from 65 acres to 95, a difference of 30 acres. Increases in discharge rates at the main outfalls range from 1 to 25 cfs, with the majority of the increases being less than 10 cfs. The average increase in discharge rates at the outfalls is 5 cfs. Calculated discharge rates are shown in the table below. The outfall locations are shown on the map in Figure 1 (page 5). Throughout the report, numbers refer to points on the map.

Storm Water Discharge at Main Outfalls
(from Geneva Road impervious area only)

Region/Outfall Location	Existing Discharge (cfs)	Proposed Discharge (cfs)
1. Provo River (350 N. Provo)	11	12
2. 1390 N. to 2000 N. Provo	9	12
3. 1800 S. Orem (Taylor Drain region)	5	13
4. 1330 S. Orem (Business Park region)	7	12
5. Business Park Drive - Orem (Business Park region)	3	4
6. 1150 S. Orem (Business Park region)	3	4
7. 1000 S. Orem (Springwater region)	-	-
-Flows in Geneva Rd. EIS area	12	24
-Flows in RR Bridge Project area*	4	8
8. 300 S. Orem (Lake Bottom Canal region) - Geneva RD EIS	-	-
-Flows in Geneva Rd. EIS area	9	10
-Flows in RR Bridge Project area*	6	12
9. 400 S. Lindon (Lindon Hollow canal region)	15	40
10. 150 N. Lindon	15	18
11. 325 N. Lindon	9	Unchanged
12. 1000 S. PG	10	Unchanged

*Increases due to the 400 South Railroad Grade Separated Project. This project is in the environmental phase and includes building a bridge on Geneva Road that will enable vehicle traffic to travel above the railroad tracks. All upgrades in this area will need to be coordinated between both projects.

Peak discharge rates for the impervious area along Geneva Road were calculated based on the Rational Equation. Calculation assumptions were based on a 10-year storm with a runoff coefficient (c) of 0.9. Precipitation values were taken from an intensity-duration-frequency curve from the NOAA atlas (see Table 1). Roadway sub basins were developed based on profile highs and lows and a 300 foot inlet spacing.

Analysis and recommended upgrades for each city:
(based on calculations and meetings with representatives of each city)

Provo:
Provo City lacks an adequate storm drain system to handle any additional storm water that will be added by the Geneva Road project. Provo is already limited on their storm drain pipe and pump capacities west of Geneva Road. Because of these limitations, all storm water south of 1390 North should be taken south, back to the Provo River. This will require a new storm drain line to be installed from about 1390 North all the way down to the river. A new storm drain line will also be required to handle the additional storm water north of 1390 North. There is however a storm drain system in Lake View Fields (2000 N 3090 W) that flows to Utah Lake. The new storm drain needed north of 1390 North could possibly tie into this line. This would have to be coordinated with Nathan Murry (801-852-6408).

If possible, the new storm drain systems along Geneva Road need to be designed large enough to handle storm water without detention. The ground water table in the western part of Provo is very high, especially when the lake is high, limiting the ability to construct detention basins. The problem increases the further west you go towards the lake. The best way to handle the storm water without using detention is to take the storm water between 1390 North and 2000 North due west out to the lake. The new storm drain lines will need to have a pre-treatment process included in order to alleviate pollutants. Provo City would like to be included when planning and designing the new storm drain lines.

There are a number of clay tile drains throughout the fields near Geneva Road in Provo. When and if any of these lines are encountered during construction, they need to be marked and then protected. Also, the storm drain lines and irrigation lines in Provo should be kept separate where possible. Any interference with the irrigation lines need to be addressed with the private irrigation companies.

Orem:
Throughout Orem, any new asphalt beyond the original plan of 66' of asphalt (5 lanes) will have to be detained. The Orem City standard for detention is 60 gpm/acre release rate. If unable to detain the storm water to this level, then the downstream facilities need to be upsized. In some areas where the existing system is already over taxed, we should consider detention for the existing asphalt in addition to new asphalt beyond 66 feet. One such area is Business Park Drive, including the drainage from University Parkway west of the railroad overpass. The rule of thumb agreement between UDOT and Orem is UDOT installs pipelines, Orem maintains and takes care of the outfall.

Orem City has five regions of discharge:

- Taylor Drain (2000 S. to 1600 S.)
  The existing 24" pipeline crossing Geneva Road near 1800 South (outfall 3) either needs to be upsized or detention is needed in the area. Upsizing would cause a lot of issues, so adding detention is preferred. The amount of water in the system will require a fairly good size detention basin.

- Business Park Drive (1600 S. to 1100 S.) (outfalls 4 - 6)
  Business Park has no capacity for adding additional storm water. If the system was to be upgraded, it would have to be done all the way down to Powell Slough. So, adding detention is preferred over upgrading the entire system. Depending on the size of the detention basin, upgrades may still be required on some of the pipes. With the current storm drain system, the manholes have blown off on a couple of occasions during large storm events. During design, it needs to be taken into consideration that there are two separate independent systems in Business Park Drive. One is for storm water and one is for ground water. Upsizing the storm drain line may affect the ground water line elevations as well.

There is potential for new outfall to be installed between Business Park and Taylor Drain. Adding a new outfall in this area would take a portion of the storm water from both Business Park and Taylor Drain, helping to alleviate the already over taxed systems The most logical place for a new outfall would be at the natural low elevation point..

- Spring Water Park (1100 S. to 300 S.) (outfall 7)
  There is a 33" abandoned sewer line running west down 1000 South (outfall 6) that is now used for storm water. This pipe has plenty of capacity to add water to it. This line is 33" going west down 1000 South only. The pipe on Geneva Road is as small as 15" (most being 18" and 24") but still likely has capacity. It also only extends as far north as 400 South and the pipe in the 400 South intersection is only 8" PVC and would likely need to be upsized.

- Lake Bottom Canal (300 S. to 400 N.) (outfall 8)
  Orem City recommends installing a detention basin west of Geneva Rd at approximately 300 South (at point of triangle). This location is in the 400 South Railroad Grade Separated project area, so all storm drain improvements will have to be coordinated between the two projects.

- Lindon Hollow Canal (400 N. to Orem/Lindon Border) (outfall 9)
  Need to add an additional 48" storm drain line between 800 North and 1600 North to handle the increased flows from the wider road. A trunk line may need to be installed between 400 North and 800 North, because there are currently no storm drain facilities parallel to Geneva Road in this section. An upgrade is needed at the outlet at Lindon Hollow. Currently there is only a small pipe (approximately 15") that Orem's current pipes (two CMP 48" equivalent squash pipe) connect to. This is where the pipe goes under the railroad tracks.

Vineyard

There are no storm drains crossing Geneva Road in Vineyard. There are however a couple of irrigation canals in the area that will need to be watched out for.

Lindon:

Lindon City has two main outfalls to their storm drain system within the Geneva Road EIS study area (outfalls 10 & 11)

- Outfall crossing Geneva Road near 150 North, flowing southwest (outfall 10)
  24" pipe crossing Geneva Road then goes to an 18" pipe until it joins with the Lower Ditch.
- Lower Ditch outfall crossing Geneva Road near 325 North, flowing west (outfall 11)
  Storm water flows under Geneva Road into a 3'x1' box culvert then goes to a pipe that joins the previously mentioned outfall.

The two outfalls join together and flow into an existing detention basin located in the fields north of Center Street at approximately 1200 West. A UDOT storm drain flowing west on Center Street flows into this detention basin as well. The detention basin lacks an overflow structure so there are problems with flooding and overflowing. If the widening of Geneva Road adds more than a minimal amount of water to Lindon's storm drains, one of the following would be required:

-Add overflow structure to the basin
-Enlarge the basin
-Take Lower Ditch flow out of the basin (re-direct the flow)

Besides the two main outfalls in Lindon, there is also the crossing of the Hollow Ditch immediately south of the underpass with I-15. There are three 36-inch culverts running parallel flowing east to west. There is a 54-inch pipe under I-15 at this location as well.

Because the widening of Geneva Road through Lindon is minimal (only widening the shoulder and widening the sidewalk to 10' up to about 100 South) few, if any, storm drain upgrades will be needed.

Pleasant Grove:
Pleasant Grove's storm drain system will not adversely be affected by the Geneva Road widening. The roadway improvements end before entering Pleasant Grove.

Further evaluation and calculations for all cities will be required during final design.

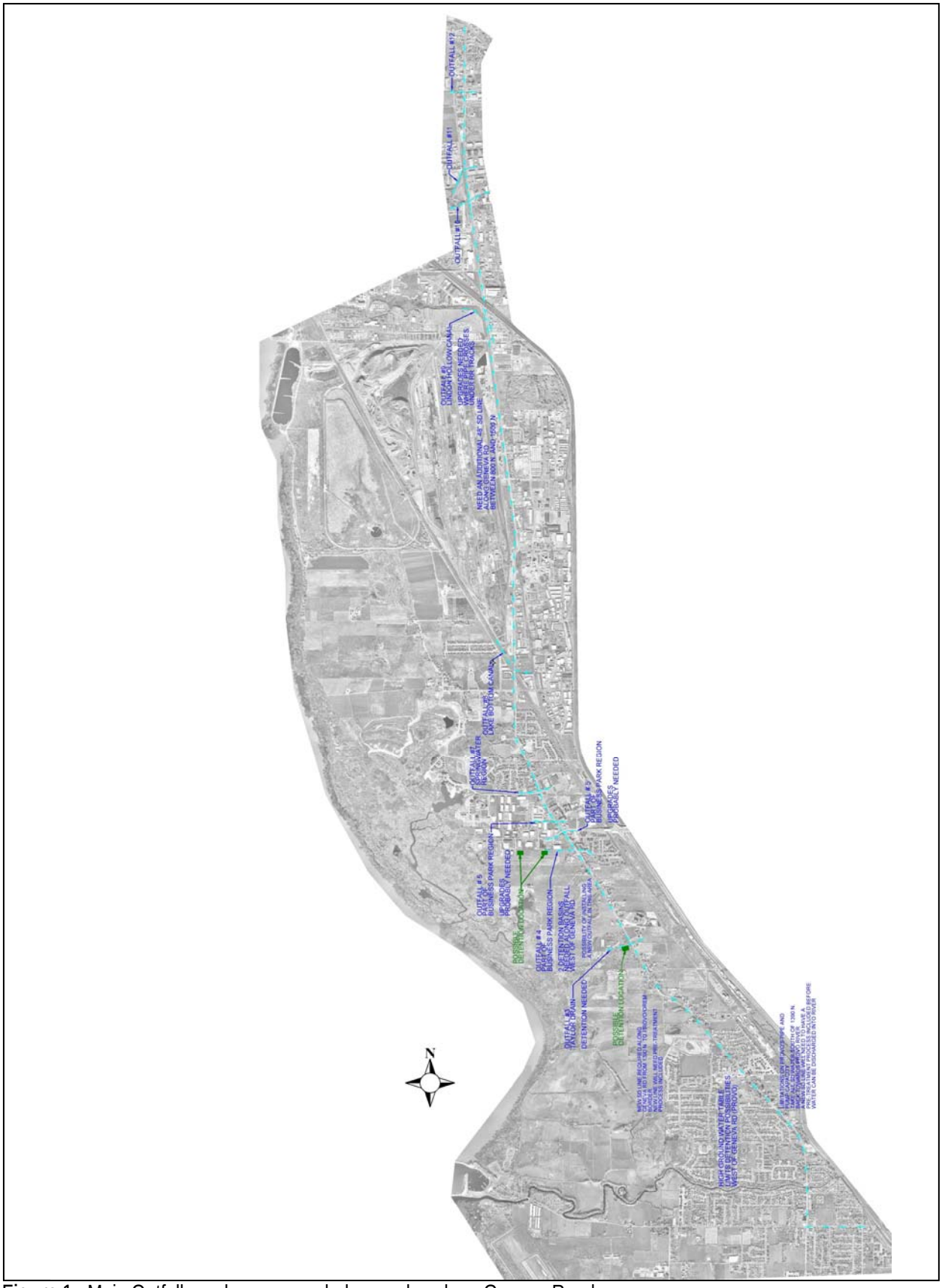

Figure 1. Main Outfalls and recommended upgrades along Geneva Road

Table 1. Point Precipitation Frequency Estimates – Provo, Utah.

Precipitation Intensity Estimates (in/hr)																		
ARI* (years)	**5 min**	**10 min**	**15 min**	**30 min**	**60 min**	**120 min**	**3 hr**	**6 hr**	**12 hr**	**24 hr**	**48 hr**	**4 day**	**7 day**	**10 day**	**20 day**	**30 day**	**45 day**	**60 day**
1	1.54	1.17	0.97	0.65	0.40	0.25	0.20	0.13	0.09	0.05	0.03	0.02	0.01	0.01	0.01	0.01	0.00	0.00
2	1.98	1.51	1.24	0.84	0.52	0.32	0.25	0.16	0.11	0.07	0.04	0.02	0.02	0.01	0.01	0.01	0.01	0.01
5	2.74	2.08	1.72	1.16	0.72	0.42	0.32	0.20	0.13	0.08	0.05	0.03	0.02	0.02	0.01	0.01	0.01	0.01
10	3.42	2.60	2.15	1.45	0.90	0.51	0.38	0.23	0.15	0.09	0.05	0.03	0.02	0.02	0.01	0.01	0.01	0.01
25	4.45	3.39	2.80	1.89	1.17	0.66	0.48	0.28	0.17	0.10	0.06	0.04	0.03	0.02	0.01	0.01	0.01	0.01
50	5.35	4.07	3.36	2.27	1.40	0.79	0.56	0.32	0.19	0.12	0.07	0.04	0.03	0.02	0.01	0.01	0.01	0.01
100	6.41	4.88	4.03	2.71	1.68	0.93	0.65	0.36	0.21	0.13	0.08	0.05	0.03	0.02	0.02	0.01	0.01	0.01
200	7.61	5.79	4.78	3.22	1.99	1.10	0.75	0.40	0.23	0.14	0.08	0.05	0.04	0.03	0.02	0.01	0.01	0.01
500	9.49	7.22	5.97	4.02	2.49	1.36	0.92	0.49	0.26	0.15	0.09	0.06	0.04	0.03	0.02	0.02	0.01	0.01
1000	11.12	8.47	7.00	4.71	2.92	1.59	1.07	0.56	0.29	0.17	0.10	0.07	0.04	0.03	0.02	0.02	0.01	0.01

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.
Please refer to the documentation for more information. NOTE: Formatting forces estimates near zero to appear as zero.