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Protecting Perth's Eastern Region

Hydrocarbon Track and Trace Project – Bellevue Light Industrial Area

September 2016

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EASTERN HILLS LANDCARE

Acknowledgments

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This project was completed by EMRC Officers, Ariadne Macleod, Jaya Vaughan and Miroslav Vujaklija. Roberta Circosta assisted with compiling the results and the report. Technical advice was received from Kim Sylva, Senior Environmental Officer from Parks and Wildlife, with expertise and assistance from both the City of Swan and South East Regional Centre for Urban Landcare (SERCUL).

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1 Background

Hydrocarbons are molecules containing only hydrogen and carbon. One class of hydrocarbons called Polycyclic Aromatic Hydrocarbons (PAHs) are produced during incomplete combustion of organic matter such as wood burning or motor vehicle fuel burning. PAHs are also produced during asphalt manufacturing. Another family of hydrocarbons called petroleum hydrocarbons (TPHs) are produced through the mining, processing, use and disposal of petroleum and petroleum products.

Several hydrocarbons are known to have carcinogenic effects and some have been shown to be endocrine disruptors and to cause birth defects in test animals. Water quality sampling within the Lower Helena River has detected hydrocarbons in sediment within pools at drainage outfalls of the Bellevue industrial area (EMRC, 2014). Studies conducted by the Department of Water in 2009 also detected PAHs in both water and sediment within the Lower Helena River (Nice et al., 2009).

The Bellevue Light Industrial Area is located within the City of Swan and contains a mixture of commercial and retail activities including: manufacturing; construction; automotive services; mechanical repairs and modifications; machinery repair services; spray painting and metal coating; cement, concrete and stone products and retail based industries.

Most of the industries are located in the area between Roe Highway to the east, Great Eastern Highway to the north and Lloyd Street to the west. For the purposes of this study a number of sites were also included between Lloyd Street and Helena Street, Midland, due to the location of the drainage outfalls.

In 2015/2016 the City of Swan conducted 39 light industry assessments in the Bellevue/Midland Light Industrial Area as part of the Light Industry Program. Some of the main issues identified included inappropriate waste water discharge, lack of cover for waste material and spray painting. The program is a joint initiative by the Department of Environment Regulation and the Department of Parks and Wildlife which aims to reduce the contaminants from light industrial and commercial activities to groundwater and drainage systems in the priority Swan and Canning River catchments.

2 Purpose of the project

Hydrocarbons have a tendency to enter aquatic environments in road runoff and waste water. This study aimed to approximate levels of hydrocarbon pollution in drains within the Bellevue Light Industrial Area through the installation of MyCelx absorbent pads in drainage pits.

There are three major outfalls of these drains that lead into the Helena River, into the Coal Dam Park in Woodbridge and into the Railway Reserve open drain. The Helena River outfall has been identified as a priority for management in previous studies and reports due to the hydrocarbon levels detected.

The objectives of the study were to:

- Identify hydrocarbon pollutant hot spots in the Bellevue light industrial area based on presence, absence and relative amount of hydrocarbons in specific stormwater drain entries;
- Prioritise areas within Bellevue for Light Industrial Program audits.

3 Methodology

This project utilised the MyCelx Track and Trace system to determine areas of hydrocarbon contamination within the Bellevue Light Industrial Area (Figure 2: Bellevue Light Industrial Area showing drains sample MyCelx pads are a filter fabric that allows the adsorption of hydrocarbons to the surface of the pad without desorbing when rinsed, therefore allowing a visual assessment of the level of hydrocarbon contamination on each pad. More information about the MyCelx Track and Trace system can be found on the Oleology website (Oleology, 2013).

Sampling of a number of drains in the sub-catchment, with knowledge of drain location in relation to direction of stormwater flow, allows for an assessment to be made on the localised source of the hydrocarbons.

35 out of approximately 100 drains were selected for sampling in the Bellevue Light Industrial Area. The drains were selected based on their position in the catchment, the source and volume of receiving water and direction of flow and connection between drains (information taken from City of Swan mapping).

A site visit was conducted to map the drain occurrence and type. This information helped determine a method for how the MyCelx pads would be attached to the drains. The drain locations were recorded using a GPS device.

Clean MyCelx pads were fitted to 35 roadside stormwater drains within the sub-catchments. The pads were lowered into the drains with enough rope to ensure the pad could reach the base of each drainage pit and adsorb any hydrocarbons present at minimal water level. A rope affixed to the pads was tied at the top of either the side entry pits or road level grates. The hydrophobic properties of the pads allow them to float so they do not obstruct flows. Three sampling events were conducted. Pads were removed in each sampling event after sufficient rainfall had mobilised contaminants and sufficient time had passed to pick up any new activity. A new set of clean pads was attached to the drains after each sampling event.

The equipment required for each sampling event included:

- GPS device to map the drain locations.
- MyCelx pads.
- Buckets to collect/carry used pads.
- Individual plastic bags to contain dirty pads and annotate pads drain location
- Permanent markers to mark drain numbers onto bags and pads.
- Clip board with a map and a list of drains listed in chronological order and room for notes on each.

First round of clean MyCelx pads were installed on the 25 September 2015 into 33 drains and retrieved on 6 November 2015. Each pad was rinsed and dried individually prior to visual assessment.

Second round; Clean Mycelex pads were installed into the 33 drains to replace those that were retrieved on the 6 November 2015. The second round of pads were retrieved on 5 May 2016. Each pad was rinsed and dried individually prior to visual assessment.

Third round; Clean Mycelex pads were installed into the 33 drains to replace those that were retrieved on the 5 May 2016 and an additional 2 pads were installed. These pads were retrieved on 9 June 2016. Each pad was rinsed and dried individually prior to visual assessment.

The pads were rinsed following retrieval to wash off any other contaminants such as dirt, sand or organics matter that might hinder the visual assessment of hydrocarbon. After rinsing, the pads were dried and then assessed so the wet colouration wouldn't affect the visual assessment.

A visual discolouration visual assessment guide developed by SERCUL in 2013 was used to assess the level of hydrocarbon on each pad. The guide allocates a numeric score to each of four classifications. See Table 1: MyCelx pad visual assessment guide below.

Figure 1 shows a clean MyCelx pad compared to a highly discoloured pad. This pad scored 100% for discolouration and was allocated a value of 3.

Table 1: MyCelx pad visual assessment guide (SERCUL, 2013).

Classification	Discolouration (%)	Value
No oil residue	0	0
Low oil discolouration	1-24	1
Moderate oil discolouration	25-74	2
High oil discolouration	75-100	3

Figure 1: A clean pad (left) compared to a hydrocarbon affected pad (right)

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Figure 2: Bellevue Light Industrial Area showing drains sampled

4 Results

Visual assessments of the MyCelx pads across the three sampling events showed that all pads had adsorbed some level of hydrocarbon material across the three sampling periods.

Figure 3 is a graphical representation of the results after each assessment.

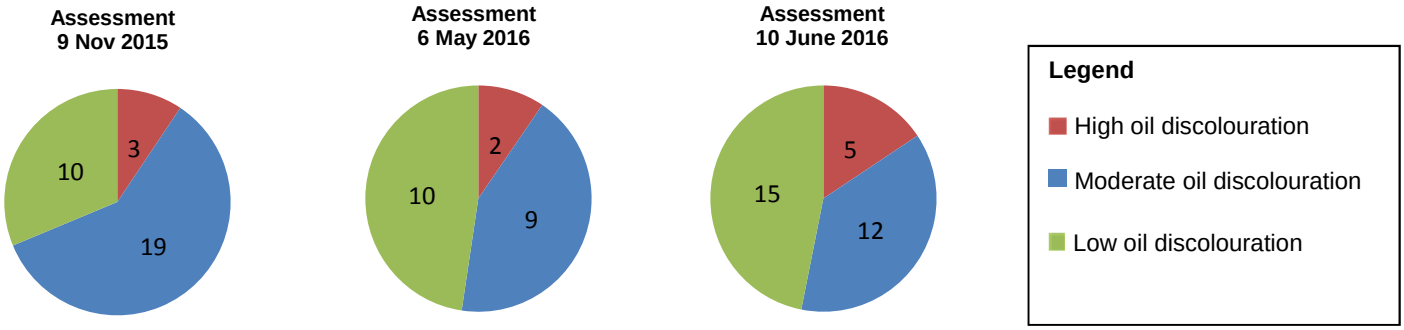

Figure 3: Oil discolouration visual assessment results after three sample events

Sampling events were scheduled after sufficient rainfall and time in order to mobilise contaminants. The first sampling event occurred over 42 days with 36.6 mm of rain recorded during this period. The highest rainfall occurred on 31 October 2015 with 10.4 mm and 2 November 2015 with 16 mm. Pads were collected on 6 November 2015 a week after the two highest rainfall events, thereby providing a good indication of the movement of hydrocarbon contaminants. 32 of the 33 pads were retrieved. The missing pad was located in an area where local business employees' cars are frequently parked so it may have been removed intentionally. A replacement pad was affixed for the second round of sampling.

The second sampling event occurred over 181 days with 119 mm of rain recorded. The highest rainfall occurred during April 2016 with 68.2 mm. December 2015, January 2016 and March 2016 averaged around 15 mm per month. The pads were left out longer than anticipated due to the inability to allocate a resource to retrieve the pads earlier.

21 of the 33 pads were collected in this sampling round, with 12 pads missing. It is assumed roadworks in the area were responsible for the absence of at least 5 of the pads. The ropes affixing 3 of the pads showed signs of being cut and were unable to be retrieved, and 4 pads were missing for unknown reasons. It is assumed that they became loose or were removed. The missing pads were replaced for the third round of sampling and two extra sites were added; one site was opposite a fishing tackle store (drain number 35) and the other was where road construction works were being undertaken (drain number 20).

The third sampling event occurred over 35 days with 142.4 mm of rain recorded. The highest rainfall occurred on 21 May 2016 with 26.4 mm, 24 May with 23.8 mm and 7 June with 19.4 mm falling two days before collection. Of the 35 pads installed, 32 were retrieved. The rope on pad number 34 showed signs of being intentionally cut and could not be retrieved. This occurred at the same site in the previous sampling round and was nearby a construction site. The pads from drains 4 and 14 were also missing for unknown reasons.

5 Analysis of Results

The results indicate variability in the amount of hydrocarbon pollution present over different sampling events and sites. This shows that pollution events are random across the catchment as opposed to continuous releases of hydrocarbon. A number of external factors may have prevented true readings of hydrocarbons in the drains as they were physically unable to adsorb hydrocarbon because of debris, cement, surfactants or high rainfall in the drainage network.

A set of criteria, Water Quality Impact (WQI), was established to assist with the identification of drains whose hydrocarbon pollutant levels would most likely compromise the water quality values held at the outfall or the receiving environment. The impact ratings are high, medium or low. The sample sites were assigned a WQI based on the following criteria:

H = high water quality impact priority (red)	Two or more instances of "high" hydrocarbon results after three sampling events.
M = medium water quality impact priority (blue)	Two or more instances of "medium" hydrocarbon results after three sampling events.
L = low water quality impact priority (green)	Two or more instances of "low" hydrocarbon results from three sampling events

A summary of sampling event results and the assigned a WQI priority is shown in Table 2. These will guide future investigations or actions. The location of the WQI priorities has been mapped (Figure 4).

Pads in drains 20, 34 and 35 were only retrieved once with a low hydrocarbon reading. It should be noted that the low WQI reading for these drains may not accurately reflect the pollutants in the vicinity as only one reading per drain was collected (Table 2). Drains 20 and 35 were introduced as new sampling sites at the second round so one reading was collected in the third sampling round. There was evidence that pad number 34 was intentionally cut during the second and third sampling rounds so there was only one reading from the first sampling round.

Drains 16, 23, 32 returned a low, medium and high result after three samplings. A medium WQI priority rating has been given (Table 2).

Pads in drains 2, 3, 4, 5, 19 and 28 were retrieved twice with two different assessment results (for example a moderate and a low percentage cover of hydrocarbon). The hydrocarbon assessment figures from the two sampling events have been averaged to determine a WQI priority (Table 2). Pads 2, 3 and 4 were missing for unknown reasons while pads 19 and 28, had signs of being intentionally cut and drain number 5 was most likely lost due to the road resurfacing on Clayton Street, Bellevue.

The raw data including WQI values and notes on each sampling event are found in the Appendices section on page 18.

Table 2: Drain hydrocarbon assessment results and water quality impact priority

	9-Nov-15	6-May-16	10-Jun-16	Water Quality Impact Priority
1	High – Strong petroleum odour and coated in thick oil	High – Strong petroleum odour and coated in thick oil	High – Strong petroleum odour and coated in thick oil	**H**
2	medium	Pad missing - unknown*	low	**L**
3	low	Pad missing - unknown*	high	**M**
4	low	medium	Pad missing - unknown*	**M**
5	medium	Pad missing - Most likely due to road resurfacing in the area	low	**M**
6	medium	low	low	**L**
7	medium	Pad missing - Most likely due to road resurfacing in the area	medium	**M**
8	medium	Pad missing - Most likely due to road resurfacing in the area	medium	**M**
9	medium	Pad missing - Most likely due to road resurfacing in the area	medium	**M**
10	Pad missing - suspected cut from employees parking on the verge adjacent to this drain	low	low	**L**
11	Low – Cement caked on the pad.	Low – Heavy build-up of cement on the pad.	Low – Cement suspended in the drain water.	**L**
12	medium	medium	medium	**M**
13	low	medium	medium	**M**
14	medium	medium	Pad missing - unknown*	**M**
15	medium	medium	medium	**M**
16	high	medium	low	**M**
17	medium	low	low	**L**
18	medium	low	medium	**M**
19	medium	Pad missing - suspected the pad was intentionally cut	low	**L**
20	Not sampled. This pad was installed at the 2nd sampling event	Not sampled. This pad was installed at this sampling event	low	**L**
21	medium	Pad missing - unknown*	medium	**M**
22	low	Pad missing - Most likely due to road resurfacing in the area	low	**L**
23	medium	low	high	**M**
24	low	medium	medium	**M**
25	low	low	low	**L**
26	medium	low	low	**L**
27	low	Pad missing - unknown*	low	**L**
28	medium	Pad missing - suspected the pad was intentionally cut	high	**H**
29	low	low	medium	**L**
30	high	medium	high	**H**
31	medium	low	medium	**M**
32	medium	high	low	**M**
33	medium	medium	medium	**M**
34	low	Pad missing - suspected the pad was intentionally cut	Pad missing - suspected the pad was intentionally cut	**L**
35	Not sampled. This pad was installed at the 2nd sampling event	Not sampled. This pad was installed at this sampling event	low	**L**

*Unknown could mean that the pad was washed away because the fixing knot became loose, the metal ring rusted allowing the rope to tear away from the pad or a high rainfall event tore the pad from the fixing knot. The pad may have also been intentionally removed.

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Figure 4: Drain site water quality impact priority and sub-catchments identified within the Bellevue light industrial area

Analysis of Results continued

From the City of Swan drainage information, 6 drainage sub-catchments were identified based on the stormwater discharge area (Figure 4). Not all sub-catchments drain into a drainage outlet into the Helena River, however, each sub-catchment was examined and analysed to determine and prioritise what action or investigation is required from the drain sites sampled.

The outfalls for sub-catchments 1, 2 and 5 discharge into a floodplain area before flowing overland into the Helena River. Sub-catchments 3 and 4 discharge into an open drain in the Railway Reserve that runs parallel to the train tracks. During high flows, this open drain overflows into the drainage line that runs south along Lloyd Street before it discharges at the end of Coppershop Road, Bellevue (the same outfall as sub-catchment 5). Sub-catchment 6 drains into the lake situated at Coal Dam Reserve. The lake is outside the boundary of Figure 4. If this lake reaches the maximum water level, an overflow pipe will direct excess water onto a floodplain area before flowing overland into the Helena River.

Action priorities were established by considering the position of the drain site within the sub-catchment. The sub-catchment is broken down into three sections depending on how far away the section is from the drainage outlet. These include; High in the sub-catchment (HC), Middle of the sub-catchment (MC) and Low in the sub-catchment (LC). The assumption is that the source of hydrocarbon higher in the sub-catchment is more defined and easier to target further investigations towards than lower in the catchment where the source of hydrocarbon is more difficult to detect. Therefore, the action priority would decrease moving lower down the catchment.

An evaluation of drain sites according to WQI priority and sub-catchment location was done using the criteria in Table 3.

Table 3: Criteria for action prioritisation based on WQI priority and location in sub-catchment

WQI Priority	Location	Action Priority
H (High)	HC	Very high
H (High)	MC	High
H (High)	LC	Medium
M (Medium)	HC	High
M (Medium)	MC	Medium
M (Medium)	LC	Low
L (low)	HC	Low
L (low)	MC	Low
L (low)	LC	Low

Analysis of Results continued

The results of the action prioritisation evaluation based on WQI priority and location in sub-catchment has identified the following action priorities. See Table 4 below.

Table 4: Drain site action prioritisation based on WQI priority and location in sub-catchment

Drain Number	WQI Priority	Sub-catchment	Sub-catchment Location	Action Priority
1	H	1	MC	High
2	L	1	HC	Low
3	M	2	HC	High
4	M	2	MC	Medium
5	M	2	MC	Medium
6	L	2	HC	Low
7	M	3	HC	High
8	M	3	MC	Medium
9	M	3	HC	High
10	L	3	MC	Low
11	L	3	HC	Low
12	M	4	HC	High
13	M	2	HC	High
14	M	2	HC	High
15	M	4	HC	High
16	M	4	MC	Medium
17	L	2	HC	Low
18	M	3	HC	High
19	L	5	MC	Low
20	L	5	MC	Low
21	M	5	LC	Low
22	L	5	HC	Low
23	M	5	HC	High
24	M	5	HC	High
25	L	5	HC	Low
26	L	5	MC	Low
27	L	5	HC	Low
28	H	5	MC	High
29	L	5	MC	Low
30	H	5	MC	High
31	M	5	HC	High
32	M	5	HC	High
33	M	6	HC	High
34	L	6	HC	Low
35	L	5	MC	Low

Analysis of Results continued

From the evaluation of the drains sites, their WQI priority and action prioritisation, the following conclusions and interpretations have been made.

Very high priority action

Drain 1 located at the end of Oliver Street, Bellevue was the only sampling site where the MyCelx pads received 100% hydrocarbon coverage for each sampling event. Figure 5 highlights the amount of thick black oil adsorbed into the pad from the 9 November 2015 and 6 May 2016 sampling rounds. Although the site is in the middle of sub-catchment 1, there are only two drains on the same street upstream of the sampling site. This suggests that there may be a localised source of hydrocarbon pollution contaminating this drain. Further investigations should be undertaken as a high priority to identify the source of the hydrocarbon contamination.

Figure 5: Hydrocarbon pad collected from drain 1 at the end of Oliver Street November 2015, May 2016 and June 2016

While undertaking the study, it also became evident that drain number 11 consistently had cement caked onto the MyCelx pads and suspended in the drain water. Cement was also observed in water flowing westward above ground on Wells Street, Bellevue where the drain was located. It is possible that businesses are washing down their equipment containing cement contributing to the flow of cement on the roads and into the drainage network. Although this isn't hydrocarbon, further efforts to determine the source of the cement should be made a priority.

High priority action

Drains 30 and 28 should be prioritised for further investigation as they have received at least one high and one medium reading for hydrocarbon. These drains are located along Elgee Road between Landor Gardens and Ferguson Street in Bellevue. There are a number of automotive businesses in this area. Drain 30 in particular received two high readings and a medium while drain 28 received one high and one medium. While undertaking the sampling in June 2016, it was observed that the fixing rope for drain 28 may have been intentionally cut. These sites are in the middle of the catchment and do receive flow from drains further upstream along Elgee Road, however the sampled drains immediately upstream have shown low readings for hydrocarbon. This would indicate that there is a localised source in the area that should be prioritised for further investigation.

Drains 12, 15 and 33 should also be prioritised as they consistently received medium readings for hydrocarbon across all three sampling events. These sites are also high in sub-catchments 4 and 6 so further efforts to investigate the sources of hydrocarbon can be targeted to a few streets in the area. Drain 12 receives flow from a small section of Rason Parade, drain 15 receives flow the middle of Helen Street while drain 33 receives flow from the eastern section of Yelverton Drive in Bellevue (Figure 4).

Other targeted action can be directed towards sites 23 and 32. Both of these drains received variable hydrocarbon readings including high, medium and low. The pollution activity leading to the hydrocarbon entering these drains appears to be less frequent in comparison to the other priority drains in the area. Despite this, further investigations should be undertaken to determine the source of hydrocarbon pollutants entering these drains high in sub-catchment 5.

Also located high in the catchment are drains 3, 7, 9, 13, 14, 18, 24, 28, and 31. These drains are high priority because they received at least one high result or two medium results. They should be investigated following the previous high priority drains because they have received at least one low reading or had a missed reading (due to a lost pad).

Medium priority action

Site 16 has been given a medium action priority because of its location within the middle of sub-catchment 4 and its medium WQI. The sampling results were variable with a high, medium and low reading for hydrocarbon. Further efforts to detect the source of hydrocarbon should be targeted towards Helen and Edward Streets in Bellevue. The outfall for this sub-catchment is located on Rason Parade and drains into the Railway Reserve that runs parallel.

The area surrounding drain 8 should also be investigated as it received 2 medium visual assessment scores for hydrocarbon. This drain receives all of the stormwater westward of Kep Court before it turns north to discharge into the Railway Reserve. The upstream drain on Kep Court also shares a medium WQI and therefore further investigative efforts should be targeted to this sub-catchment area.

Sites 4 and 5 within sub-catchment 2 may also require further attention as they received one medium reading for hydrocarbon and also had one missing pad during the sampling rounds.

6 Discussion

A number of hydrocarbon ‘hot spots’ have been identified in the Bellevue Light Industrial Area where further investigation is recommended. The area that has been assigned with a ‘Very High’ action priority falls within sub-catchment 1. All of the other five sub-catchments have sites distributed throughout that have been identified as ‘High’ action priority areas. These results highlight the need for further resources to investigate the source of hydrocarbon, identify the activities that are contributing to the release of hydrocarbons and to find ways of reducing these hydrocarbons from entering the drainage network that ultimately impacts upon the Helena River and other receiving environments.

While undertaking the study, it was noted that the results were highly variable and may reflect the frequency of hydrocarbon pollution events. The nature of the MyCelx pads is that they are designed to show snapshots of hydrocarbon pollution over a given time. This study had a high occurrence of drain sites receiving fluctuating hydrocarbon readings between low and medium across the three sampling events. The pollution event may have been reflected with the medium reading and then the ‘tapering off’ or remaining hydrocarbons from the same pollution event are later reflected with a low reading. Another reason for the variable readings could be that each reading is simply reflecting each single pollution event of differing severities.

There are a few limitations of the study that should be taken into account when assessing the priorities and recommendations of this report. The first is the limitation of the MyCelx pads to accurately adsorb the amount of hydrocarbon present due to physical barriers such as cement, sand or organic matter physically preventing the pads from attracting hydrocarbon to bond with the pad. If surfactants are present in the drainage water, they can emulsify oils and other hydrocarbons and prevent them from adsorbing onto the pad. If there is a high rainfall event allowing high flow volumes of water to flow through the drainage network, hydrocarbon is less likely to bond with the MyCelx pad due the short contact time with the pad resulting hydrocarbon presence in the drains being misrepresented.

It is of note that MyCelx pads will not desorb hydrocarbon once it has bonded. This is because the hydrocarbon is chemically bonded to the pad.

Other limitation of the study is the amount of lost pads. A high number of pads were missing in the second sampling event possibly due to the roadworks and construction that occurred during that period, the intentional removal of pads by people in the area or the duration of time between sampling events. The missing pads reduced the amount of data collected and may have impacted upon the results.

Site observations were important to detect pollutants, unusual activity or extreme cases of pollution. Observations made included the presence of cement and hydrocarbons in puddles nearby construction sites. These incidents were reported to the City of Swan.

The photos below are an indication of impediments to collecting conclusive data. The cement has the potential to interfere with the adsorption of hydrocarbons onto the pads.

Photo 1: Cement running into Drain 3 on the corner of Wells and Irwin Streets (sub-catchment 4)

Photo 2: Hydrocarbon sheen in puddles near drain 22.

Photo 3: Site visit prior to sampling – cement and stone rubble around drain.

7 Recommendations

The hydrocarbon Track and Trace project in the Bellevue Light Industrial Area has established that hydrocarbon pollutants are entering the stormwater drainage network with the Helena River being one of the receiving bodies. A number of potential hydrocarbon pollution 'hot spots' have been identified and should be a priority for further investigation. The following recommendations are based on the project findings:

Recommendation 1
The City of Swan should continue to participate in the Department of Environment Regulation's Light Industry Program and undertake actions to raise awareness and educate business owners about stormwater drainage discharge into receiving water bodies and pollution.Efforts can be targeted to those areas prioritised in section 5 'Analysis of Results' in this report. The businesses that might be targeted could include automotive industries, cement works and businesses that may undertake their own vehicle maintenance.

- Oliver Street, Bellevue. Drain 1 at the end of Oliver St close to a concrete batching plant business and a wrought iron business.
- Wells Street, Bellevue. Priority should be made to investigate cement businesses, particularly at the southern end of Wells Street.
- Northern side of Elgee Street, between Loton Avenue and Ferguson Street, Bellevue. Businesses in this area include specialty car and motorcycle businesses, panel beaters and a dewatering business.

The following sub-catchments to be considered for investigation/ audits:

- Sub-catchment 4 between Rason Parade, Helen Street and Edward Street.
- Sub-catchment 6 particularly along Yelverton Drive.
- Sub-catchment 5 around Drain 32 on Clayton Road which seems to receive drainage from the Midland Hospital carpark and Drain 23 which receives localised drainage from vehicle servicing businesses.

Recommendation 2
The City of Swan, Parks and Wildlife, EMRC and other stakeholders should seek opportunities to undertake further investigations or actions to reduce the amount of hydrocarbon pollution entering the lower Helena River. This might include incentives for businesses to implement new practices or undertake their own upgrades on premises. The City of Swan may consider installing or encouraging shared local facilities for businesses to appropriately wash down equipment and dispose of waste appropriately. A subsidised fee could be charged for businesses to make use of this service.

Recommendation 3
The City of Swan, Parks and Wildlife, EMRC and other stakeholders to seek opportunities to continue to monitor hydrocarbon sources entering the drains and investigate accessible outfalls discharging into the Helena River and other receiving water bodies for sampling. This could include routine monitoring such as water sampling and lab analysis or regular Track and Trace projects depending on the resources available.

Ongoing monitoring will highlight any hotspots or 'spikes' for hydrocarbon and assist the City of Swan and Department of Environment Regulation Officers in prioritising businesses to audit and educate. If the recommendation for ongoing Track and Trace projects was to be implemented, the same drains outlined in this report could be monitored to give a representative view of the Bellevue Light Industrial area to assist auditing Officers.

Maintaining a baseline data set will assist to monitor change and set goals to reduce hydrocarbon for the future.

Considerations for future Track and Trace projects
Determine if there are to be any scheduled road works or other obstructive activities taking place within the catchment before undertaking the project to avoid loss of pads through interference.

If possible undertake field work and sampling activities on weekends to reduce interference and or removal of the installed pads by onlookers.

Do not leave Mycelx pads in drains for extended periods as this increases the risk of the pads being removed or interfered with or ropes and pads lost to the environment. Remove pads as soon as possible after sufficient rainfall events have occurred.

8 References

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9 Appendices

Drain No	Drain Type G = grate in road S = side of kerb	Way point	Round 1 % hydrocarbon coverage	Round 1 Assessment Value	Round 1 Notes	Round 2 % hydrocarbon coverage	Round 2 Assessment Value	Round 2 Notes	Round 3 % hydrocarbon coverage	Round 3 Assessment value	Round 3 Notes	Water Quality Impact Priority
1	G	036	100	3	1st round – thick black oil	100	3	Very dark extreme oil	100 (worst)	3	Oily, flow heading east toward river. New trench being dug at business.	**High**
2	G	069	40	2		-	-	Missing pad	5	1	Retrieved	**Low (just below moderate)**
3	G	048	20	1		-	-	Missing pad	100 worst	3	Untied – needed to be retrieved from pipe on the eastern side	**Medium**
4	G	051	20	1		30	2		-	-	Missing	**Medium (just above low)**
5		053	70	2		-	-	Missing due to resurfacing of road	20	1	Flow heading east	**Medium**
6	S	100	30	2		15	1		10	1	Retrieved. Pad recorded as waypoint 36	**Low**
7	G	095	70	2		-	-	Missing road resurface	30	2	Retrieved flow heading south	**Medium**
8	S	058 (58 new)	35	2		-	-	Missing road resurfaced	30	2	Retrieved pad lying on western side	**Medium**
9	G	060	40	2		-	-	Road resurface missing.	40	2	Retrieved pad lying on western side	**Medium**
10		084	-	-	1st round - lost	15	1	Retrieved	5	1	Retrieved flow heading towards Clayton Rd. Eastern side of Military. Flow heading nth	**Low**
11	S	041	10	1	Cement thick on pad	5	1	Retrieved - flows west – heavy build up on the pad. Could be cement works	5	1	Retrieved. Flow heading towards Military St –west. Cement suspended in water	**Low**
12	G	108	50	2		60	2	Dirty	30	2	Retrieved flow heading north	**Medium**
13	G	109	20	1		25	2	Retrieved	30	2	Retrieved, earthworm present	**Medium**
14	G	110	70	2		35	2	Retrieved	-	-	Missing. Not sure if it was supposed to be on the sthn/nthn appears on GPS that drains are opp each other on same rd. GPS showing 110/111 very close	**Medium**
15	G	114	60	2		55	2		40	2	Retrieved flow heading north - west	**Medium**

Drain No	Drain Type G = grate in road S = side of kerb	Way point	Round 1 % hydrocarbon coverage	Round 1 Assessment Value	Round 1 Notes	Round 2 % hydrocarbon coverage	Round 2 Assessment Value	Round 2 Notes	Round 3 % hydrocarbon coverage	Round 3 Assessment value	Round 3 Notes	Water Quality Impact Priority
16	G	104	80	3		45	2		10	1	Retrieved flow heading north	**Medium**
17	S	208	45	2		15	1	moderate	20	1	Retrieved- rope considerably knotted. Rope hanging outside of drain pit on the rd. Suspected pull up from demolition site (old Dome)	**Low**
18	G	133	50	2		20	1	Retrieved	25	2	Retrieved, flow heading sth towards Clayton	**Medium**
19	S	121	25	2		-	-	Pad detached from rope	15	1	Retrieved	**Low**
20		138 new edition round 2		-				New – added a new pad here	20	1	Retrieved flow heading east	**Low**
21	G	139	25	2		-	-	Missing	30	2	Retrieved, flow heading sth towards Helena River	**Medium**
22	S	177	20	1	1st round pad may have been removed prematurely	-	-	Missing- road resurfaced	10	1	Retrieved	**low**
23		220	30	2		20	1	Retrieved - rope was twisted to pad wasn't sitting on the base of drain – could be inaccurate reading	100	3	Twisted, not lying flat	**Medium**
24	S	147	15	1		40	2	Retrieved	30	2	Eastern side of the rd. Retrieved	**Medium**
25	S	156	10	1		10	1	Retrieved	5	1	Retrieved	**Low**
26	G	157	70	2		5	1	Retrieved	20	1	Retrieved flow heading west	**Low**
27	G	166	10	1		-	-	Missing	20	1	Retrieved flow heading west	**Low**

Drain No	Drain Type G = grate in road S = side of kerb	Way point	Round 1 % hydrocarbon coverage	Round 1 Assessment Value	Round 1 Notes	Round 2 % hydrocarbon coverage	Round 2 Assessment Value	Round 2 Notes	Round 3 % hydrocarbon coverage	Round 3 Assessment value	Round 3 Notes	Water Quality Impact Priority
28	S	191	70	2		-	-	Missing pad/ potentially cut	90	3	Retrieved flow heading west	**High**
29	S	187	10	1		20	1	Retrieved	40	2	Retrieved flow heading west	**Low**
30	G	186	85	3		40	2	Retrieved	80	3	Retrieved flow heading west	**High**
31	S	173	30	2		5	1	Retrieved	60	2	Retrieved	**Medium**
32	G	216	50	2		90	3	Retrieved	10	1	Retrieved twisted rope	**Medium**
33	S	211	40	2		30	2	Retrieved	25	2	Retrieved	**Medium**
34	G	222	15	1		-	-	Pad missing- rope cut	-	-	Missing. Suspected workers cut rope. Next to construction site	**Low**
35		198 New pad added in round 2	-	-	-	-	-	New - Added new pad here	20	1	Retrieved	**Low**
TOTAL PADS GRADED			**Max 33 32**			**Max 33 21**			**Max 35 32**			
Total not retrieved			**1**			**12**			**3**			