BUZZI UNICEM, USA
HERCULES QUARRY
STOCKERTOWN, PA

HYDROGEOLOGIC TRACER STUDY
WORK PLAN

February 27, 2020

Prepared For:

Buzzi Unicem, USA
Northampton County, Pennsylvania
100 Brodhead Road
Bethlehem, PA 18017
(610) 882-5000

Prepared By:

Gilmore & Associates, Inc.
Engineers ♦ Land Surveyors ♦ Planners ♦ GIS Consultants
5100 Tilghman Street, Suite 150
Allentown, PA 18104
(610) 366-8064

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geoResource Risk Reduction
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CERTIFICATION

This work plan and any interpretation of geologic/hydrogeologic conditions included herein have been prepared solely by the undersigned Professional Geologist licensed to practice in the Commonwealth of Pennsylvania. Pursuant to applicable provisions of Pennsylvania Act 367, the Engineer, Land Surveyor and Geologist Registration Law, as amended by Act 25 of 2010, and to regulations promulgated at Pennsylvania Title 49, Chapter 37, the licensed Professional Geologist in responsible charge of the work presented herein has affixed and executed an appropriate seal on this, the 27th Day of February, 2020, in certification that all work reported herein has been conducted pursuant to the applicable provisions of the Act and implementing regulations.

Thomas D. Gillespie, P.G.
PA License PG 640

February 27, 2019
INTRODUCTION

Pursuant to provisions of the non-coal mining regulations at §77.401-410, §77.457 and §77.521, Buzzi Unicem USA, after participating in discussions with the Pennsylvania Department of Environmental Protection District Mining Office in Pottsville, has agreed to conduct hydrogeologic tracer studies at and in the vicinity of its Hercules Quarry and Cement operations in Stockertown, Pennsylvania (Figure 1). The tracer study will be conducted to support a pending request to PADEP to deepen the quarry to the permitted elevation of 0-ft mean sea level (msl) pursuant to Special Condition No. 21 of mining permit SMP 7473SM2.

Tracer Studies are just one of the tools employed to assess hydrogeologic conditions (see, e.g., Goldsheider, 2015) in areas where the erosion of soluble limestone bedrock results in a distinctive topography known as karst and in unique geologic/hydrogeologic conditions. Tracer studies are generally used to evaluate potential hydrologic connections between areas of interest, as defined herein. Buzzi has conducted extensive hydrogeologic evaluations over the course of the past 25 years and has amassed a significant data base including the findings of multiple valid tracer studies of various types (Goldsheider, 2015). Buzzi now plans to implement two additional tracer studies using analytically detectable optical dyes to evaluate potential hydraulic connections between the quarry and hydrogeologic conditions in areas adjacent to the quarry. The two tracer studies are designed to specifically determine whether there are direct hydraulic connections between quarry inflows and surface water in both:

Bushkill Creek—a second-order, allogenic, perched stream which, adjacent to the quarry, flows over the paleo-karst terrain characteristic of the Jacksonburg Formation. Adjacent to the cement plant and immediately downstream of the quarry the Bushkill flows over the highly karstified terrain overlying the Epler Formation, where the stream is hydrologically influent via both point drain shaft flow through in-stream swallow holes and by diffuse flow (seepage) through the stream bed;

Schoeneck Creek—a first-order, allogenic, perched, intermittent stream which flows past the western and southern areas of the quarry. Stream loss is mostly via diffuse stream bed seepage.

BACKGROUND

There are two separate and distinct groundwater inflows into the quarry which derive from two separate and distinct groundwater regimes:

- Unconfined (atmospheric pressure) groundwater, which enters the quarry through the highwalls as gravity seepage and through the quarry floor as slow upwelling via the pressure head component of the total hydraulic potential (Figure 2). Unconfined inflow accounts for ~10% (5 million gallons per day, or MGD) of the total inflow;

- Confined (> atmospheric pressure) upwelling under a positive pressure gradient at a specific location known as the West Quarry Inflow Zone (WQIZ; Figure 2), which accounts for ~90% (50 MGD) of total inflow.

There are currently two principal conceptualizations of hydrogeologic conditions at and in the area around the quarry. Each interpretation is focused on defining the source of the 50 million gallon per day confined groundwater inflow into the WQIZ. The two hydrogeologic conceptualizations are:
Unbalanced Recirculation Conceptualization—referred to hereinafter as the U-R Hypothesis, is based on an assumption that 60% of the inflowing confined groundwater (~30 MGD) derives from the capture of surface water from Bushkill Creek through several in-stream point drains in a reach of the stream referred to as “The Bushkill Corridor” (ELM, 2011). In this conceptualization stream water lost into swallow holes in the Bushkill Corridor flows ~1.2 miles in the regional upgradient direction through a hypothetical subterranean conduit system, entering the quarry as high pressure upwelling water at two (sometimes three) discrete inflow points in the WQIZ. The hypothesis does not account for the source of the remaining 40% of inflowing confined groundwater (~20 MGD). It has also been conjectured by some investigators/regulators that water from Schoeneck Creek also accounts for, or contributes to, WQIZ inflow.

Confined-Aquifer-as-Sole-Source Conceptualization—Referred to hereinafter as the CASS Hypothesis, described and defined in a report by The ELM Group in 2011. In this conceptualization, the entire volume of confined groundwater which inflows into the WQIZ derives from a deep regional confined aquifer and Bushkill surface water is not captured or transported to the WQIZ via a subterranean conduit flow system. Rather, surface water which sinks into the in-stream swallow holes in the Bushkill Corridor enters the epikarst flow system below the stream and is conveyed in the regional downgradient direction and re-surfaces either: at Tatamy Spring (~1 mile downstream); further downhill in the Bushkill watershed; or is conveyed as unconfined groundwater to the regional groundwater discharge in the Delaware River ~3 miles down the regional hydraulic gradient.

PADEP has been receptive to considering both conceptualizations and has required the tracer studies as a means “to better understand the quarry’s effects on surface and groundwater around the quarry” (PADEP, December 5, 2018). The different conceptualizations have been presented in numerous geologic/hydrogeologic reports presented to the PADEP over the course of the past decade and are not enumerated herein.

PURPOSE AND OBJECTIVES

The principal purpose of the planned tracer studies is to attempt to resolve which of the two current hydrogeologic conceptualizations will be the framework for the interpretation of cumulative hydrogeologic data.

At §77.521(a) the mining regulations require that the cumulative effects of operations must “minimize disturbances to the prevailing hydrologic balance in the permit and adjacent areas,” where the Hydrologic Balance is defined as:

“the relationship between the quality and quantity of water inflow to, water outflow from and water storage in a hydrologic unit, such as a drainage basin, aquifer, soil zone, lake or reservoir...include[ing] the dynamic relationship among precipitation, runoff, evaporation and changes in groundwater and surface water storage” (§77.1);

and where:

1 See, e.g., PAF&BC, 2018; USGS, 2005

5100 Tilghman Street | Suite 150 | Allentown, PA 18104 | Phone: 610-366-8064 | Fax: 610-366-0433
"permit and adjacent areas" are defined as "land located outside the permit area within 1,000 feet.

As discussed with PADEP during the meeting on December 12, 2019, an evaluation of potential disturbances to the prevailing hydrogeologic balance would be vastly different depending on which of the two hydrogeologic conceptualizations forms the interpretive framework. Buzzi has agreed to conduct these additional tracer studies to provide PADEP with the data and regulatory context the Department requires to approve mine deepening to the permitted elevation, pursuant to the permit and to all applicable requirements at §77.401-410, §77.457 and §77.521.

Objectives

The objectives for each of the two planned tracer studies are:

**Bushkill Creek Tracer Study** – to determine whether surface water lost from Bushkill Creek into point drains in the form of in-stream swallow holes (Ford & Williams, 2007; Fleury, 2009; AGI, 2005) is or is not connected directly via the hypothesized subterranean conduit system to the WQIZ;

**Schoeneck Creek Tracer Study** – to determine whether there is a direct hydrologic connection between water in the Schoeneck Creek sub-basin and the confined groundwater which upwells directly into the several WQIZ upwelling points.

**HYDROGEOLOGIC TRACER STUDY WORK PLAN**

Each of the two tracer studies outlined herein consists of both Pre-Study and Tracer Study phases.

**Pre-Study**

A single phase of pre-study, sufficient for both tracer studies, consists of:

**Background Monitoring** – Buzzi will monitor to determine whether any of the three tracers are present in surface water, shallow unconfined groundwater or confined zone groundwater at and in the area surrounding the quarry. Buzzi will install laboratory-provided activated charcoal collectors (Figure 3) which will be in place for approximately five days prior to each of the two tracer studies. Collectors will be handled, managed and shipped pursuant to directions from the laboratory.

**Notification** – because the tracer studies will involve analytically detectable optical tracers, residents in the area surrounding the quarry and relevant public officials/entities will be notified prior to commencing the studies. Those receiving notifications will include, at a minimum:

- Pennsylvania Fish & Boat Commission;
- owners of all private and public water supply wells within a one-mile radius of the tracer introduction points (see below);
- public officials of Stockertown, Tatamy, Northampton County and of Palmer, Bushkill, Plainfield Upper Nazareth and Lower Nazareth Townships. Local officials will include municipal and county boards of health, school districts in all surrounding municipalities, boards of supervisors, town councils, municipal utilities authorities, first responders and police departments;
• the local chapter of Trout Unlimited;
• relevant watershed associations for Bushkill Creek, the Little Bushkill Creek or both, as applicable.

The notification will be in the form of a registered letter and will provide information about the study, the chemical and physical properties of the tracers to be introduced, the anticipated start date and duration of the study, data pertaining to the safety of the tracers and information on how property owners can contact Buzzi for additional information or if they observe evidence of a tracers. Buzzi will allow a two-week interval from the time of mailing the certified letter notifications to receive responses before the tracer study will commence.

Tracer Studies

The tracer studies will be implemented in series with continuous post-introduction monitoring for each study lasting one week. The tracer studies will begin with the Bushkill Creek Study because flow in the stream is reliably continuous over time. Different tracers will be used in the two studies to eliminate the possibility of cross-contamination or false positive observations. The Schoeneck Creek tracer study will not be implemented until a minimum 72-hour post-monitoring waiting period has elapsed following the initial phase of monitoring in the Bushkill study (see below). However, the Schoeneck study is dependent on stream flow so the exact timing between the two studies cannot be constrained at this time.

Bushkill Creek Tracer Study

As stated above, the principal objective of the tracer study in the Bushkill is to evaluate whether there is a direct hydraulic connection between the stream water lost from the Bushkill Creek and the WQIZ via a subterranean conduit system. However, the study will include the placement of tracer detectors at multiple locations within and outside of the quarry in an effort to determine other possible destinations of the submerged stream water.

Tracer Introduction Locations

The tracer study will involve two distinct tracers introduced into two separate point drains (swallow holes) in the Bushkill Corridor (Figures 2 and 4a). Two distinct tracer tests will be conducted to resolve a conjecture that Bushkill stream water, upon entering the underlying epikarst unconfined groundwater zone via several in-stream swallow holes distributed along the ~1,000-ft length of the Bushkill Corridor, could flow in two opposing directions with:

• an undefined portion of the total 30 MGD of submerged water flowing in a downstream direction toward Tatamy Spring (away from the quarry);
• the remaining undefined portion flowing in the opposite direction to the WQIZ.

The distinct tracers will be introduced into swallow holes at two separate locations in the Bushkill Corridor (Figure 4a):
• below the State Rte. 33 overpass spans, downstream of the USGS stream gauging station, referred to as Bushkill Corridor Tracer Introduction Point No. 1 (BCTIP-1);
• immediately upstream of the former S.R. 2017 bridge referred to as Bushkill Corridor Tracer Introduction Point No. 2 (BCTIP-2).

Tracers

For the Bushkill Creek Study, Buzzi will introduce 24 pounds of Rhodamine W.T at location BCTIP-1 and 6 pounds of Fluorosene dye at location BCTIP-2. The two tracers will be prepared at an isolated location on the Buzzi cement plant and will be brought to the introduction points in liquid form at the commencement of the study. Tracer preparation will be conducted within a contained area to eliminate the potential for fugitive tracer transport into the quarry or surface water runoff. All equipment will be dedicated and will remain in the containment area, as will PPE used by personnel. The quantity of tracers was determined in consultation with the laboratory. The tracers are completely soluble and non-toxic to humans and aquatic life. Material Safety Data Sheets for the tracers are provided in Appendix A.

Tracer Detection Method

Tracers are chemically-detectable optical dyes so monitoring will include both visual observations and laboratory analyses of activated charcoal collectors placed in the flowing water at each of the monitoring points (see, e.g., Field, 2003 a and b). A water sample will be collected at each change-out of granular activated charcoal collectors. In addition, for the Bushkill tracer study in which two different tracers will be used, any visual detection of a dye at any point will be supplemented by analysis of a water sample collected at the time of visual confirmation in addition to detection with activated charcoal collectors. Select water samples will be analyzed regardless of the results of other detection methods as a quality assurance check. Other than those QA analyses, water samples will be held pending the results of analyses of the granular activated charcoal collectors. Because the detection limit on the collectors is so low, the presence or absence of tracer will be determined preferentially with that method. If tracer is thus detected, a water sample from the same time period/location will be analyzed to confirm which tracer is detected.

Visual monitoring will only be conducted at surface water monitoring points; monitoring in groundwater will be by activated charcoal collectors. All collectors and water samples will be managed and shipped under standard chain of custody to the analytical laboratory pursuant to specifications provided by the laboratory.

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2 At the time of an inspection conducted on 01/10/2020 by the Professional Geologist in direct charge of this project, there were no swallow holes in the stream bed below or immediately downstream of the PENNDOT SR 33 bridges. At the time of the study, the swallow hole nearest the SR 33 footprint will be the target tracer introduction point.

3 Buzzi evaluated various tracers including non-optical tracers but selected the optical dyes based on multiple factors including The volume of water lost into in-stream swallow holes in Bushkill Corridor, the total stream flow of both Bushkill and Schooneck Creeks, he distance to the WQIZ from both Bushkill and Schooneck Creek tracer introduction points, he distance to Tatamy Spring from the Bushkill Corridor tracer introduction points, the inflow rate into the WQIZ, the water temperature and general water chemistry and potential flow pathways and discharge points other than the WQIZ.
Tracer Introduction Method

To the extent possible, Buzzi plans to introduce tracers directly into in-stream swallow holes. However, Bushkill Creek in the Bushkill Corridor is too dangerous to enter the stream during normal flow conditions to construct diversions around the swallow holes. Therefore, Buzzi will implement one of the following methods (presented in the order of preference):

**Introduction Method No. 1 - Remote Introduction:** If at the time of the studies there are swallow holes close enough to either bank of the stream, the tracer will be introduced directly into the bottom of the hole via a 4-inch diameter PVC pipe inserted into the hole or by a weighted 2-inch diameter hose;

**Introduction Method No. 2: Stream Diversion:** If there are no swallow holes close enough to either bank for the remote introduction method, Buzzi will consider temporarily reducing stream flows by discharging quarry water to the Bushkill using only one pump so that:

1. swallow holes are more readily observable through the shallowed water and the best location for tracer introduction can be field-selected;
2. the field crew safety will be maximized by ensuring that personnel who enter the stream can observe the stream bed directly and clearly and will not be working in high flow rate conditions.

If stream water continues to flow into the target swallow holes, sandbag diversions would be emplaced directly upstream to divert flow around the holes. It is currently predicted that the tracer introduction via this method can be accomplished in two hours or less, during which time Buzzi would deploy two field crews so the two tracer introduction points can be prepared simultaneously.

Immediately upon isolation of the target swallow holes from stream flow the two tracers will be introduced in the form of the pre-mixed liquids and the sandbag diversions will be removed from the stream bed. As soon as the field crew is safely out of the stream channel, quarry discharge will be restored to the normal rate and the tracers introduced into the swallow holes will be ‘chased’ into the epikarst zone by the restored stream flow.

**Introduction Method No. 3 – Direct Introduction:** If it is determined that the then-current swallow holes are at locations which would be too difficult to isolate within the allotted time period, all pumping from the quarry will be terminated for a time period of approximately 15 – 20 minutes. During that brief window, two field crews will enter the dry stream channel and pour the liquid tracers down the hole after which flow would be re-established immediately.

All three methods are protective of fish in the stream channel, but to be certain that stress is reduced to the extent possible, if it becomes necessary to implement Introduction Method No. 3, Buzzi will reduce flow in the stream by pumping from only one quarry pump for twelve hours before the tracer introductions so fish can move to deeper pockets/channels in the stream bed. The short duration of the flow cessation would ensure that stresses to aquatic life are minimized.
Tracer Detection Monitoring Locations

Tracer detection locations will be in and adjacent to the quarry and at locations within the Bushkill Corridor. Monitoring locations within and adjacent to the quarry (Figure 4a; Table 1) will include:

1. The three West Quarry Inflow Zone upwelling points, which are the points which have been hypothesized to be the discharge of oestensibly-captured surface water from either Bushkill or Schoeneck Creeks. Monitoring will include visual observations, water samples and activated charcoal collectors. The WQIZ is at an elevation of ~ 145-ft msl;
2. Two highwall unconfined groundwater inflow points (visual observations and water samples only) to determine whether surface water in either stream lost into the unconfined groundwater system in the epikarst zone is transported to the unconfined inflow into the quarry. The elevations of those two points are approximately 300 ft msl;
3. Monitoring wells WS-3-13; B-4-18; B-6-15; all of which are installed into the confined groundwater zone. WS-3-13 is a flowing well, so monitoring will involve analysis of water samples collected pursuant to the schedule below. Water from wells B-4-18 and B-6-15 will be sampled by placing activated charcoal collectors into the water column within the wells. Samples will be sent to the laboratory based on observations, with a minimum of one sample per day sent for analysis. Boring/Well Logs, along with ground surface elevations, for those monitoring points have been presented to PADEP previously, but are reproduced herein as Appendix B;
4. One location in the west quarry impoundments at a point removed from the WQIZ upwellings at an elevation of ~145 ft msl. This location will be monitored visually and with water samples. This location is included because the west quarry impoundments receive transfer water from all other locations in the quarry. It is possible that tracers are detected in this standing water but not in the WQIZ upwelling water.

Tracer monitoring locations and observation points in the Bushkill Corridor (Figure 4b; Table 1) will include:

1. Tatamy Spring
2. Upstream and downstream of Tatamy Spring
3. At the confluence of Bushkill Creek with Schoeneck Creek

At all locations, monitoring will involve placement of activated charcoal detectors, visual observation and water samples.

Tracer Monitoring Schedule

Tracer study monitoring equipment and collectors will be emplaced when the pre-study background data have been received. Upon introduction of the tracers, visual observations of surface monitoring points will continue hourly until nightfall and will recommence on the same schedule the following day. Activated charcoal collectors installed in both surface and groundwater will be changed out according to the schedule in Table 1. At the time of each change-out of activated charcoal collectors a water sample will be collected for laboratory analysis.
### Table 1

<table>
<thead>
<tr>
<th>Day 1 Location</th>
<th>Visual</th>
<th>Collector Change-Out/Water Sample Collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>WQIZ Upwells</td>
<td>Hourly/8hr</td>
<td>Every 2hrs / 8hrs; 1 / 16 hrs</td>
</tr>
<tr>
<td>Highwall Seeps</td>
<td>Hourly/8hr</td>
<td>NA</td>
</tr>
<tr>
<td>WQ Impoundment</td>
<td>Hourly/8hr</td>
<td>NA</td>
</tr>
<tr>
<td>BCGW-WS313</td>
<td>Hourly/8hr</td>
<td>NA</td>
</tr>
<tr>
<td>B-4-18 &amp; B-6-15</td>
<td>NA</td>
<td>Every 4hrs/8hrs; 1 / 16 hrs</td>
</tr>
<tr>
<td>Bushkill SW</td>
<td>Hourly/8hr</td>
<td>Every 2hrs / 8hrs; 1 / 16 hrs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Days 2 &amp; 3 Location</th>
<th>Visual</th>
<th>Collector Change-Out/Water Sample Collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>WQIZ Upwells</td>
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<td>Bushkill SW</td>
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</tr>
</tbody>
</table>

As outlined in Table 1, during daylight hours tracer monitoring will involve visual observations, collection of water samples for laboratory analysis, and use of granular activated charcoal collectors, which will be analyzed in the laboratory. During nighttime hours, granular activated charcoal collectors will be in place to ensure that monitoring is conducted continuously.

### Study Outcome

For the Bushkill Tracer Study, there are multiple potential outcomes as outlined below.

**Possible Outcome No. 1:** Tracer is detected in the deep confined groundwater wells (see above) and in the inflowing confined water in the upwelling points in the WQIZ (Figures 2 and 4a) but nowhere else either within or outside the quarry.

**Necessary Conclusion No. 1:** A direct hydraulic connection between the tracer introduction location(s) and the WQIZ would be established; the U-R Hypothesis would be confirmed; the CASS Hypothesis of WQIZ Inflow would be shown to be incorrect.

**Possible Outcome No. 2:** Tracer is detected in confined wells and in WQIZ inflow water and at other monitoring locations within the quarry;

**Necessary Conclusion No. 2:** A direct hydraulic connection between the tracer input location(s), the WQIZ and other in-quarry inlets would be confirmed; the U-R Hypothesis would be confirmed but expanded to include hydraulic connection to the unconfined aquifer below the quarry; the CASS Hypothesis would be shown to be incorrect.
Possible Outcome No. 3: Tracer is detected in the WQIZ impoundments but not in the inflowing (upwelling) water nor in confined groundwater wells, and is also detected at other location(s) within the quarry. This scenario is possible because water from other locations of the quarry is pumped to the WQIZ impoundments.

Necessary Conclusion No. 3: Tracer will not have entered the quarry as confined water via the upwelling points within the WQIZ; tracer will have entered the quarry via the unconfined groundwater system; the CASS Hypothesis would be confirmed; the U-R Hypothesis would have been shown to be incorrect because tracer introduced into unconfined groundwater within the in-stream swallow holes would reappear as unconfined groundwater with no direct connection to the confined groundwater which upwells in the WQIZ;

Possible Outcome No. 4: Tracer is not detected at any location in the quarry but is detected at some other location within or in the vicinity of the Bushkill Corridor;

Necessary Conclusion No. 4: Bushkill Creek water lost to swallow holes in the Bushkill Corridor does not flow to any location in the quarry; the CASS Hypothesis would be confirmed; a direct hydraulic connection between the WQIZ inflow and surface water loss in the Bushkill Corridor would have been shown to not exist;

Possible Outcome No. 5: Tracer is detected in the upwelling water of the WQIZ and at a downstream location in Bushkill Creek.

Necessary Conclusion No. 5: The conjecture that the capture zone of the WQIZ extends to some point within the reach of the Bushkill Corridor but does not encompass the entirety of the stream loss zone will be confirmed; the U-R Hypothesis will have been confirmed; the CASS Hypothesis will be shown to be partially incorrect and must be modified to accommodate the inflow of some Bushkill Creek water into the WQIZ;

Possible Outcome No. 6: Tracer is wholly undetected at any location either within or outside of the quarry;

Necessary Conclusion No. 6: Water lost to swallow holes in the Bushkill Corridor travels via the epikarst zone in the prevailing downgradient direction to an ultimate discharge beyond the monitoring network of this study and to the regional discharge in either far downstream reaches of Bushkill Creek or to the nearby Delaware River; the U-R Hypothesis would have been shown to be incorrect and the CASS Hypothesis would have been shown to be correct.

Other potential outcomes might be possible but in terms of compliance with applicable requirements and regulations such are not relevant to the objectives of the study. The outcomes and conclusions defined above are based, in part, on extensive hydrogeologic data collected over a period of decades at the quarry, including:

- Aquifer Test data and groundwater hydraulics analysis (2011-2017)
- Quarry pump cycling tests (2010 – 2015)
- Monthly groundwater elevation data
- Hydrogeologic data associated with pressure grouting (2008-2011)
- Stream Flow/Loss Testing (2013 - 2014)
- Water quality data (2008-2018)
- Structural Geologic Data (2009-2013)

The results will be presented in a revised quarry deepening request pursuant to Special Condition No. 21 of mine permit SMP 7473SM2.

**Schoeneck Creek Study**

As stated above, the objective of the Schoeneck Creek Tracer Study is to evaluate whether there is a direct hydrologic connection between water in Schoeneck Creek and the upwelling pressurized water in the WQIZ.

**Tracer Introduction Location**

The objective of the study will be achieved with a single tracer introduction (Figure 5). Unlike the Bushkill Creek, there are no active swallow holes in Schoeneck Creek’s bed, so there is no obvious point swallow where it is certain that the tracer will be introduced directly into underlying, detached unconfined groundwater. Rather, tracer will be introduced as described below.

**Tracers**

For the Schoeneck Creek Study, Buzzi will introduce 4 pounds of eosine dye which will be prepared at the Buzzi quarry and will be brought to the introduction point in liquid form at the commencement of the study. The quantity of tracer was determined in consultation with the laboratory. Information about the tracer and its safety are identical to that provided in the Bushkill Tracer Study (above).

**Tracer Introduction Method**

There are two possibilities. At the time of the planned study:

1. the stream changes from flowing to non-flowing at some point along its thalweg south of the quarry. If it is not flowing at the time of the study, the tracer will be introduced at the point where flow sinks;

2. the stream is flowing along the entire reach south of the quarry to the point where it becomes perennial (ELM, 2011). Tracer will be introduced at the downstream end of a channel lining installed by Gilmore in 2016.
Tracer Detection Monitoring Locations

Tracer detection locations will be both in the quarry and in the adjacent area (Figure 5; Table 1) and will include:

- the three WQIZ inflow points;
- seeps on the south quarry highwall (Figure 5);
- impoundment water within the WQIZ and the west drop cut sump.

Monitoring will be conducted for 48 hours after tracer introduction, followed by an additional five-day period during which activated charcoal collectors will remain in place.

Tracer Detection Method

Rosine is a chemically-detectable optical dye so monitoring will include both visual observations and laboratory analyses of activated charcoal collectors placed in the flowing water at each of the monitoring points (see, e.g., Field, 2003 a and b). A water sample will be collected at the time of visual confirmation of tracer at any location, and/or at each change-out of granular activated charcoal collectors. Visual monitoring will only be conducted at surface water monitoring points; monitoring in groundwater will be by activated charcoal collectors. All collectors and water samples will be managed and shipped under standard chain of custody to the analytical laboratory pursuant to specifications provided by the laboratory.

Tracer Monitoring Schedule

Visual monitoring will be conducted over the course of two days with hourly observations of all surface water monitoring locations throughout daylight hours. Laboratory provided collector/detectors will be left in place for one week after tracer introduction.

<table>
<thead>
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<td>Highwalls Seeps</td>
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</tr>
<tr>
<td>WQ Impoundment</td>
<td>Hourly/8hr</td>
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</table>
Study Outcome

For the Schoeneck Creek tracer study, there are only a few potential outcomes which are of relevance to the objective of the study:

- **Possible Outcome No. 1:** Tracer is detected in WQIZ upwelling water at the upwelling point(s);

  **Necessary Conclusion No. 1:** a direct hydraulic connection between surface water/shallow unconfined groundwater and the upwelling WQIZ water will have been established and a revised hydrogeologic conceptualization must be presented as part of the pending request to extend quarry deepening to the 0 ft msl elevation as permitted;

- **Possible Outcome No. 2:** Tracer is detected in south quarry highwall seep(s) but nowhere else;

  **Necessary Conclusion No. 2:** Water lost from the influent Schoeneck Creek enters shallow groundwater at the detached water table which intersects the highwall. The hydraulic connection between shallow unconfined groundwater and quarry dewatering, would, as concluded by ELM (2011) be confirmed; the result would confirm that confined WQIZ upwelling water does not derive from the Schoeneck watershed in the area adjacent to the quarry (§77.1);

- **Possible Outcome No. 3:** Tracer is detected in surface water of the WQIZ impoundment and/or the west sump in the quarry floor, but is not present in WQIZ upwelling flow;

  **Necessary Conclusion No. 3:** Water lost from the Schoeneck enters the detached unconfined groundwater below the stream bed and discharges into the quarry floor. The hydraulic connection between shallow unconfined groundwater and quarry dewatering, would, as concluded in ELM (2011) be confirmed. Water from the Schoeneck watershed in the area adjacent to the quarry (§77.1) is not the source of upwelling water in the WQIZ;

Other outcomes are possible but those would have no relevance to the study objectives. Decisions or actions which follow from those necessary conclusions are beyond the scope of the specific studies defined herein. The results will be presented in a revised quarry deepening request pursuant to Special Condition No. 21 of mine permit SMP 7473SM2.

**CONCLUSION**

Buzzi will commence the pre-study tasks upon concurrence by PADEP that the tracer studies, as defined, satisfy the Department’s requirement, as articulated in correspondence to Buzzi on December 5, 2018. The results of the two studies will be provided to PADEP in the planned quarry deepening request pursuant to Special Condition No. 21 of mining permit SMP 7473SM2.
References:


ELM, 2011 *Geologic and Hydrogeologic Conditions at and in the Region Surrounding the Hercules Limestone Quarry, Stockertown, Pennsylvania; Assessment of the Potential Impacts of Quarry Dewatering on Local Groundwater and Surface Water Resources*, The ELM Group, Report submitted to PADEP on behalf of Buzzi.


Field, M. S., 2002a, *Efficient hydrologic tracer test design for tracer mass estimation and sample-collection frequency, 1: Method development*, Environmental Geology. Spring-Verlag,

Field, M. S., 2002b, *Efficient hydrologic tracer test design for tracer mass estimation and sample-collection frequency, 2: Experimental Results*, Environmental Geology. Spring-Verlag,


Fleury, 2009; *Land Use Policy and Practice on Karst Terrains*, Springer, 187 pps


GeoServices, 2013, as reported in ERG, 2015 and 2018


Pennsylvania Department of Environmental Protection, December 5, 2018, Acknowledgement of Application Withdrawal, *Stockertown Quarry*, letter to Hercules Cement Company


Pennsylvania Fish & Boat Commission, 2018, (b) Ryan, D., September 11, *Permit No 7473SM2A1C27 Hercules Cement Company*, Memorandum to Jeff Kost, PADEP

Petrasic, K., Oct 2, 2017, Chief Geotechnical Engineer, Pennsylvania Department of Transportation, District 5-0; SR 33, *Buzzi/Hercules Quarry Permit Application – Summary of Analysis*
Petrasic, K., Oct 2, 2017, Chief Geotechnical Engineer, Pennsylvania Department of Transportation, District 5-0; SR 33, Buzzi/Hercules Quarry Permit Application – Summary of Analysis

Petrasic, K., 2006 (a), PA State Route 33 over Bushkill Creek: Structural Failure and Replacement in an Active Sinkhole Environment, Publication venue unreported (Publication Date estimated based on references embedded in report).

Petrasic, K., 2006 (b), Extreme Karst: Investigation at PA State Route 33, Publication venue unreported. Petrasic

FIGURES
Figure 5: Schoeneck Creek Monitoring Locations

STOCKERTOWN TOWNSHIP, NORTHAMPTON COUNTY, PA
Appendix A
Tracer Material Safety Data Sheets
HUE CORPORATION
Color your everything, may your Hue come true

SECTION I. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

PRODUCT IDENTIFIER:

PRODUCT NAME ..................... HUE EOSINE EX CONC
PRODUCT NUMBER .................. 1-C6-087-XPC
COLOR INDEX NAME ............... ACID RED 087
COLOR INDEX NO ................... 45380
C. A. S. # ......................... 17372-87-1
CHEMICAL FAMILY ................. XANTHENE DYE

INTENDED USE OF THE PRODUCT:
FELT TIP, MARKER INKS, WATER BASED COATINGS AND SPECIALTY INKS, PRINTING ON NYLON, SILK AND WOOL.

NAME, ADDRESS AND TELEPHONE OF RESPONSIBLE PARTY:
HUE CORPORATION TELEPHONE 714-389-3130
P.O. BOX 509 FAX 714-389-9731
TUSTIN, CA 92781 EMAIL SUPPORT@HUECORPORATION.COM

EMERGENCY TELEPHONE NUMBER:
CHEMTREC (USA) 1-800-424-9300
CHEMTREC (OUTSIDE USA) 1-703-527-3887

SECTION 2. HAZARD(S) IDENTIFICATION

CLASSIFICATION OF THE SUBSTANCE OR MIXTURE:

GHS-US
ACUTE TOX. - INHALATION (CATEGORY 5)
EYE DAM./IRRITATION (CATEGORY 2B)
SKIN CORR./IRRITATION (CATEGORY 3)

GHS LABELING:
HAZARD PICTOGRAMS (GHS-US): NO SYMBOL

SIGNAL WORD WARNING

HAZARD STATEMENT(S) H333 - MAY BE HARMFUL IF INHALED
H320 - CAUSES EYE IRRITATION
H316 - CAUSES MILD SKIN IRRITATION

PRECAUTIONARY STATEMENTS P305 + 351 + P338 - IF IN EYES: RINSE CAUTIOUSLY WITH WATER FOR
SEVERAL MINUTES. REMOVE CONTACT LENSES IF PRESENT AND EASY TO DO. CONTINUE RINSING.
P337 + P313 - IF EYE IRRITATION OCCURS/PERSISTS: GET MEDICAL ADVICE AND ATTENTION.
P261 - AVOID BREATHING DUST/FUMES/GAS/MIST/VAPORS/SPRAY.
P264 - WASH FACE THOROUGHLY AFTER HANDLING.
P322 + P313 - IF SKIN IRRITATION OCCURS: GET MEDICAL ADVICE/ATTENTION.
P304 + 312 - IF INHALED: CALL A POISON CENTER/DOCTOR/PHYSICIAN IF YOU FEEL UNWELL.
P501 - DISPOSE OF CONTENTS/CONTAINER IN ACCORDANCE WITH LOCAL/REGIONAL/NATIONAL INTERNATIONAL REGULATIONS.

OTHER HAZARDS
UNKNOWN ACUTE TOXICITY
NO DATA AVAILABLE
NO DATA AVAILABLE

SECTION 3. COMPOSITION / INFORMATION ON INGREDIENTS

DESCRIPTION OF MIXTURE: PROPRIETARY MIXTURE OF DYES.

SUBSTANCE:

<table>
<thead>
<tr>
<th>NAME</th>
<th>CAS.#</th>
<th>WEIGHT 100%</th>
<th>GHS-US CLASSIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACID RED 087</td>
<td>17372-87-1</td>
<td>100%</td>
<td>ACUTE TOX. - INHALATION (CATEGORY 5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>EYE DAM./IRRITATION (CATEGORY 2B)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SKIN CORR./IRRITATION (CATEGORY 3)</td>
</tr>
</tbody>
</table>

SECTION 4. FIRST AID MEASURES

FIRST AID MEASURES GENERAL:

INHALATION: REMOVE TO FRESH AIR. IF BREATHING IS DIFFICULT, GIVE OXYGEN AND GET IMMEDIATE MEDICAL ATTENTION.

SKIN: WASH WITH MILD SOAP AND WATER. IF IRRITATION OCCURS GET MEDICAL ATTENTION. IF CLOTHING IS CONTAMINATED, REMOVE AND WASH BEFORE REUSE.

EYES: FLUSH EYES WITH WATER FOR AT LEAST 15 MINUTES, HOLDING EYELIDS APART FOR THOROUGH IRRIGATION. GET IMMEDIATE MEDICAL ATTENTION.

INGESTION: INDUCE VOMITING - SEEK IMMEDIATE MEDICAL ATTENTION.

MOST IMPORTANT SYMPTOMS AND EFFECTS, ACUTE AND DELAYED:

THIS PRODUCT IS NOT HAZARDOUS AS DEFINED BY HAZARDOUS COMMUNICATION STANDARD. HOWEVER, AS WITH ALL CHEMICAL; HANDLE WITH CARE, AVOID EYE AND SKIN CONTACT, AVOID INHALATION OF DUSTS OR VAPORS. WASH THOROUGHLY AFTER HANDLING. KEEP CONTAINERS CLOSED.

SECTION 5. FIRE-FIGHTING MEASURES

EXTINGUISHING MEDIA:
WATER, DRY CHEMICAL, CARBON DIOXIDE, FOAM.

SPECIAL HAZARDS ARISING FROM SUBSTANCE OR MEDIA:

FIREFIGHTERS SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS TO GUARD AGAINST POTENTIALLY TOXIC AND IRRITATING FUMES. AVOID DUSTING. DUST CAN FORM EXPLOSIVE MIXTURES WITH AIR.

PROTECTION/ADVICE FOR FIREFIGHTER(S):

BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING.

SECTION 6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS:

REMOVE PERSONS FROM DANGER AREA.

ENVIRONMENTAL PRECAUTIONS:

AVOID ANY UNCONTROLLED RELEASE OF MATERIAL. DO NOT EMPTY INTO DRAINS OR THE AQUATIC ENVIRONMENT.

EMERGENCY PROCEDURES:

NO ADDITIONAL INFORMATION

METHODS AND MATERIALS FOR CONTAMINENT AND CLEANING UP:

WHERE SPILLS ARE POSSIBLE, A COMPREHENSIVE SPILL RESPONSE PLAN SHOULD BE DEVELOPED AND IMPLEMENTED. AVOID ANY UNCONTROLLED RELEASE OF MATERIAL.

UTILIZE RECOMMENDED PROTECTIVE CLOTHING AND EQUIPMENT (SEE SECTION 8). SPILLS SHOULD BE SWEEP UP USING AN ABSORBENT DUST CONTROL PRODUCT AND PLACED IN CONTAINERS. SPILL AREA CAN BE WASHED WITH WATER. COLLECT WATER FOR APPROVED DISPOSAL. IN THE EVENT OF UNCONTROLLED RELEASE OF THIS MATERIAL, THE USER SHOULD DETERMINE IF THE RELEASE IS REPORTABLE UNDER APPLICABLE LAWS AND REGULATIONS.

SECTION 7. HANDLING AND STORAGE

PRECAUTIONS FOR SAFE HANDLING:

HANDLE WITH CARE. AVOID OVER EXPOSURE. USE NIOSH/OSHA APPROVED RESPIRATOR, WORK GLOVES, AND CLOTHING. WASH AFTER HANDLING. SENSITIVE INDIVIDUALS MAY EXPERIENCE RESPIRATORY ALLERGIES. MAY CAUSE SKIN IRRITATION. USE WITH LOCAL VENTILATION.

CONDITIONS FOR SAFE STORAGE, INCLUDING ANY INCOMPATIBILITIES:

USE PROCESS ENCLOSURES, LOCAL EXHAUST VENTILATION OR OTHER ENGINEERING CONTROLS TO KEEP AIRBORNE LEVELS BELOW RECOMMENDED EXPOSURE LIMITS.

KEEP AWAY FROM HEAT. KEEP AWAY FROM SOURCES OF IGNITION.

KEEP AWAY FROM STRONG OXIDIZING AND REDUCING AGENTS.
SPECIFIC END USES:
FELT TIP, MARKER INKS, WATER BASED COATINGS AND SPECIALTY INKS, PRINTING ON NYLON, SILK AND WOOL.

SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

CONTROL PARAMETERS:
INGREDIENTS WITH LIMIT VALUES THAT REQUIRE MONITORING AT THE WORKPLACE - NOT REQUIRED

EXPOSURE CONTROLS:
APPROPRIATE ENGINEERING CONTROLS - THE USUAL PRECAUTIONARY MEASURES ARE TO BE ADHERED TO WHEN HANDLING CHEMICALS.

PERSONAL PROTECTIVE EQUIPMENT:

- HAND PROTECTION
  WEAR IMPERMEABLE RUBBER OR PLASTIC GLOVES

- EYE PROTECTION
  TIGHTLY SEALED SAFETY GOGGLES OR FULL FACE SIDE SHIELDS.

- SKIN AND BODY
  APRON, COVERALLS AND NON-LEATHER SOLED WORK SHOES.
  WASH DYE CONTAMINATED CLOTHES AND SKIN WITH MILD SOAP AND DETERGENTS.

- RESPIRATORY
  WEAR OSHA/NIOSH APPROVED DUST MASK/RESPIRATOR

- HYGIENE MEASURES
  HANDLE IN ACCORDANCE WITH GOOD INDUSTRIAL HYGIENE AND SAFETY PRACTICES. WASH HANDS AFTER HANDLING MATERIAL.

- OTHER PROTECTION
  DELUGE SAFETY SHOWER AND EYE WASH STATION SHOULD BE LOCATED NEAR WORK AREA.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

INFORMATION ON BASIC PHYSICAL AND CHEMICAL PROPERTIES:

APPEARANCE, COLOR, ODOR
POWDER, NO ODOR

pH
7.0 - 8.5

MELTING POINT/FREEZING POINT
ND

INITIAL BOILING POINT/BOILING RANGE
0.00

FLASHPOINT
NOT APPLICABLE

EVAPORATION RATE
NO DATA

FLAMMABILITY (SOLID, GAS)
NORMALLY STABLE, NOT COMBUSTIBLE NOR FLAMMABLE

UPPER EXPLOSIVE LIMITS
NA

LOWER EXPLOSIVE LIMITS
NA

VAPOR PRESSURE
NA

VAPOR DENSITY
NA

RELATIVE DENSITY
NA
SOLUBLE
NO DATA
NO DATA
NO DATA
N/A
NA
NA

SECTION 10. STABILITY AND REACTIVITY

CHEMICAL STABILITY
STABLE UNDER NORMAL STORAGE AND HANDLING CONDITIONS.
CONDITIONS TO AVOID
OXIDIZING & REDUCING AGENTS MAY DESTROY COLOR.
INCOMPATIBLE MATERIALS
OXIDIZING & REDUCING AGENTS MAY DESTROY COLOR.
HAZARDOUS DECOMPOSITION PRODUCTS - CO, CO2, OXIDES OF NITROGEN AND OTHER POTENTIALLY TOXIC FUMES.

SECTION 11. TOXICOLOGICAL INFORMATION

TOXICOLOGICAL EFFECTS:

ORAL (ANIMAL) GREATER THAN 2000 MG/KG - RAT
DERMAL (ANIMAL) NO DATA AVAILABLE
EFFECTS TO EYES (ANIMAL) NO DATA AVAILABLE
SKIN IRRITATION (ANIMAL) NO DATA AVAILABLE

SKIN CORROSION/IRRITATION NOT CLASSIFIED
SERIOUS EYE DAMAGE/IRRITATION CAUSES SERIOUS EYE IRRITATION
RESPIRATORY OR SKIN SENSITIZATION NOT CLASSIFIED
GERM CELL MUTAGENICITY NOT CLASSIFIED
CARCINOGENICITY NOT CLASSIFIED
REPRODUCTIVE TOXICITY NOT CLASSIFIED
SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) MAY CAUSE DROWSINESS OR DIZZINESS.
ASPIRATION HAZARD NOT CLASSIFIED
INHALATION MAY CAUSE DROWSINESS OR DIZZINESS.
EYE CONTACT CAUSES SERIOUS EYE IRRITATION.
INGESTION INGESTION MAY CAUSE NAUSEA, VOMITING AND DIARRHEA

SECTION 12. ECOLOGICAL INFORMATION

TOXICITY NA
PERSISTENCE AND DEGRADABILITY NA
BIOACCUMULATIVE POTENTIAL NA
MOBILITY IN SOIL NA
OTHER ADVERSE EFFECTS NA

SECTION 13. DISPOSAL CONSIDERATION
WASTE DISPOSAL RECOMMENDATION:

EMPTY BAGS THOROUGHLY. CARRY OUT THE PROPER RECYCLING, REUSAGE OR DISPOSAL. PLEASE REFER TO THE RELEVANT EU REGULATIONS, IN PARTICULAR THE GUIDELINES/DECISIONS OF THE COUNCIL REGARDING HANDLING OF WASTES (E.G. 75/442/EEC, 91/689/EEC, 94/67/EC, 94/904/EC) AS IMPLEMENTED IN NATIONAL REGULATIONS.

REGIONAL RECOMMENDATION:

BURY OR INCINERATE ACCORDANCE WITH FEDERAL, STATE AND LOCAL REGULATIONS.

CONTAINERS SHOULD NOT BE REUSED WITHOUT PROFESSIONAL CLEANING AND RECONDITIONING. OBSERVE ALL LABELED SAFEGUARDS UNTIL CLEANED, RECONDITIONED OR DESTROYED.

PLEASE REFER TO SECTION 8 (EXPOSURE CONTROLS /PERSONAL PROTECTION) OF THIS SDS.

SECTION 14. TRANSPORTATION INFORMATION

UN NUMBER
UN PROPER SHIPPING NAME

DEPARTMENT OF TRANSPORTATION (DOT):
NOT HAZARDOUS FOR TRANSPORTATION

TRANSPORT HAZARD CLASS(ES):

HAZARD LABELS (DOT):
PACKING GROUP (DOT)
DOT SPECIAL PROVISIONS

ADDITIONAL INFORMATION:
OVERLAND TRANSPORT
TRANSPORT BY SEA
AIR TRANSPORT
DOT QUANTITY LIMITATIONS PASSENGER AIRCRAFT
DOT QUANTITY LIMITATIONS CARGO AIRCRAFT

SECTION 15. REGULATORY INFORMATION

US FEDERAL REGULATIONS:
THIS SUBSTANCE IS LISTED ON UNITED STATES TSCA (TOXIC SUBSTANCE CONTROL ACT) INVENTORY.

US STATE REGULATIONS:
NONE

CHEMICAL IDENTITY:
17372-87-1 TSCA DSL NDSL EINECS ELINCS ENCS CHINA KECL PICCS AICS

X
TSCA STATUS      IN COMPLIANCE
E C CLASSIFICATION   (67/548/EEC - 88/379/EEC) N/A
EINECS NUMBER
REACH CLASSIFICATION
R PHRASES
ADDITIONAL REGULATORY INFORMATION CONTAINS:
<11PPM BENZENE, (CAS#71-43-2)
<11PPM TOLUENE, (CAS#108-88-3)
<11PPM XYLENES, (CAS#1330-20-7)

SECTION 16. OTHER INFORMATION

INDICATION OF CHANGES:
NA

OTHER INFORMATION:
NA

GHS FULL TEXT PHRASES:
MAY BE HARMFUL IF INHALED      H333
CAUSES EYE IRRIGATION           H320
CAUSES MILD SKIN IRRITATION      H316

H. M. I. S. CLASSIFICATION: 1  0  0  D
HMIS CODE: 4 - SEVERE HAZARD, 3 - SERIOUS HAZARD, 2 - MODERATE HAZARD, 1 - SLIGHT HAZARD, 0 - MINIMAL HAZARD

SAFETY DATA SHEET (SDS)
REVISION DATE: 03/03/2016

ALL INFORMATION AND DATA APPEARING ON THIS SDS ARE BELIEVED TO BE RELIABLE AND ACCURATE. HOWEVER, IT IS THE USER'S RESPONSIBILITY TO DETERMINE THE SAFETY, TOXICITY, AND SUITABILITY FOR USE OF THE PRODUCT DESCRIBED. SINCE THE ACTUAL USE BY OTHERS IS BEYOND OUR CONTROL, NO GUARANTEE, EXPRESSED OR IMPLIED, IS MADE BY HUE CORPORATION. USER ASSUMES ALL RISK AND RESPONSIBILITY.
HUE CORPORATION
Color your everything, may your hue come true

SECTION 1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

PRODUCT IDENTIFIER:

PRODUCT NAME .................... HUE URANINE CONC (Also known as Fluorescein)
PRODUCT NUMBER ............... 1-C8-073PC
COLOR INDEX NAME .............. ACID YELLOW 073
COLOR INDEX NO ................ 45350
C. A. S. # ......................... 518-47-8
CHEMICAL FAMILY .............. XANTHENE

INTENDED USE OF THE PRODUCT:
FELT TIP, MARKER INKS, WATER BASED COATINGS AND LEAK DETECTION

NAME, ADDRESS AND TELEPHONE OF RESPONSIBLE PARTY:
HUE CORPORATION	TELEPHONE 714-389-3130
P.O. BOX 509	FAX 714-389-9731
TUSTIN, CA 92781	EMAIL SUPPORT@HUECORPORATION.COM

EMERGENCY TELEPHONE NUMBER:
CHEMTREC (USA) 1-800-424-9300
CHEMTREC (OUTSIDE USA) 1-703-527-3887

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TO DO. CONTINUE RINSING.
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P304 + 312 - IF INHALED: CALL A POISON CENTER/DOCTOR/PHYSICIAN
IF YOU FEEL UNWELL

OTHER HAZARDS
UNKNOWN ACUTE TOXICITY
NO DATA AVAILABLE
NO DATA AVAILABLE

SECTION 3. COMPOSITION / INFORMATION ON INGREDIENTS
DESCRIPTION OF MIXTURE: PROPRIETARY MIXTURE OF DYES.

SUBSTANCE:

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<tbody>
<tr>
<td>ACID YELLOW 073</td>
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<td>100%</td>
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SECTION 4. FIRST AID MEASURES

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MOST IMPORTANT SYMPTOMS AND EFFECTS, ACUTE AND DELAYED:

THIS PRODUCT IS NOT HAZARDOUS AS DEFINED BY HAZARDOUS COMMUNICATION STANDARD. HOWEVER, AS WITH ALL CHEMICAL, HANDLE WITH CARE, AVOID EYE AND SKIN CONTACT, AVOID INHALATION OF DUSTS OR VAPORS. WASH THOROUGHLY AFTER HANDLING. KEEP CONTAINERS CLOSED.

SECTION 5. FIRE-FIGHTING MEASURES

EXTINGUISHING MEDIA:

WATER, DRY CHEMICAL, CARBON DIOXIDE, FOAM.
SPECIAL HAZARDS ARISING FROM SUBSTANCE OR MEDIA:

FIREFIGHTERS SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS TO GUARD AGAINST POTENTIALLY TOXIC AND IRRITATING FUMES. AVOID DUSTING. DUST CAN FORM EXPLOSIVE MIXTURES WITH AIR.

PROTECTION/ADVICE FOR FIREFIGHTER(S):

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SECTION 6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS:

REMOVE PERSONS FROM DANGER AREA.

ENVIRONMENTAL PRECAUTIONS:

AVOID ANY UNCONTROLLED RELEASE OF MATERIAL. DO NOT EMPTY INTO DRAINS OR THE AQUATIC ENVIRONMENT.

EMERGENCY PROCEDURES:

NO ADDITIONAL INFORMATION

METHODS AND MATERIALS FOR CONTAMINENT AND CLEANING UP:

WHERE SPILLS ARE POSSIBLE, A COMPREHENSIVE SPILL RESPONSE PLAN SHOULD BE DEVELOPED AND IMPLEMENTED. AVOID ANY UNCONTROLLED RELEASE OF MATERIAL.

UTILIZE RECOMMENDED PROTECTIVE CLOTHING AND EQUIPMENT (SEE SECTION 8). SPILLS SHOULD BE SWEPT UP USING AN ABSORBENT DUST CONTROL PRODUCT AND PLACED IN CONTAINERS. SPILL AREA CAN BE WASHED WITH WATER. COLLECT WATER FOR APPROVED DISPOSAL. IN THE EVENT OF UNCONTROLLED RELEASE OF THIS MATERIAL, THE USER SHOULD DETERMINE IF THE RELEASE IS REPORTABLE UNDER APPLICABLE LAWS AND REGULATIONS.

SECTION 7. HANDLING AND STORAGE

PRECAUTIONS FOR SAFE HANDLING:

HANDLE WITH CARE. AVOID OVER EXPOSURE. USE NIOSH/OSHA APPROVED RESPIRATOR, WORK GLOVES, AND CLOTHING. WASH AFTER HANDLING. SENSITIVE INDIVIDUALS MAY EXPERIENCE RESPIRATORY ALLERGIES. MAY CAUSE SKIN IRRITATION. USE WITH LOCAL VENTILATION.

CONDITIONS FOR SAFE STORAGE, INCLUDING ANY INCOMPATIBILITIES:

USE PROCESS ENCLOSURES, LOCAL EXHAUST VENTILATION OR OTHER ENGINEERING CONTROLS TO KEEP AIRBORNE LEVELS BELOW RECOMMENDED EXPOSURE LIMITS.

KEEP AWAY FROM HEAT. KEEP AWAY FROM SOURCES OF IGNITION.

KEEP AWAY FROM STRONG OXIDIZING AND REDUCING AGENTS.
SPECIFIC END USES:
FELT TIP, MARKER INKS, WATER BASED COATINGS AND LEAK DETECTION

SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

CONTROL PARAMETERS:
INGREDIENTS WITH LIMIT VALUES THAT REQUIRE MONITORING AT THE WORKPLACE - NOT REQUIRED

EXPOSURE CONTROLS:
APPROPRIATE ENGINEERING CONTROLS - THE USUAL PRECAUTIONARY MEASURES ARE TO BE ADHERED TO WHEN HANDLING CHEMICALS.

PERSONAL PROTECTIVE EQUIPMENT:

HAND PROTECTION	WEAR IMPERMEABLE RUBBER OR PLASTIC GLOVES
EYE PROTECTION	TIGHTLY SEALED SAFETY GOGGLES OR FULL FACE SIDE SHIELDS.
SKIN AND BODY	APRON, COVERALLS AND NON-LEATHER SOLED WORK SHOES.
	WASH DYE CONTAMINATED CLOTHES AND SKIN WITH MILD SOAP AND DETERGENTS.
RESPIRATORY	WEAR OSHA/NIOSH APPROVED DUST MASK/RESPIRATOR
HYGIENE MEASURES	HANDLE IN ACCORDANCE WITH GOOD INDUSTRIAL HYGIENE AND SAFETY PRACTICES. WASH HANDS AFTER HANDLING MATERIAL.
OTHER PROTECTION	DELUGE SAFETY SHOWER AND EYE WASH STATION SHOULD BE LOCATED NEAR WORK AREA.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

INFORMATION ON BASIC PHYSICAL AND CHEMICAL PROPERTIES:

<table>
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<th>PROPERTY</th>
<th>VALUE</th>
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<tbody>
<tr>
<td>APPEARANCE, COLOR, ODOR</td>
<td>YELLOW POWDER, NO ODOR</td>
</tr>
<tr>
<td>pH</td>
<td>8.0 - 9.0</td>
</tr>
<tr>
<td>MELTING POINT/FREEZING POINT</td>
<td>ND</td>
</tr>
<tr>
<td>INITIAL BOILING POINT/BOILING RANGE</td>
<td>0.00</td>
</tr>
<tr>
<td>FLASHPOINT</td>
<td>normally stable, not combustible nor flammable</td>
</tr>
<tr>
<td>EVAPORATION RATE</td>
<td>NO DATA</td>
</tr>
<tr>
<td>FLAMMABILITY (SOLID,GAS)</td>
<td>normally stable, not combustible nor flammable</td>
</tr>
<tr>
<td>UPPER EXPLOSIVE LIMITS</td>
<td>NA</td>
</tr>
<tr>
<td>LOWER EXPLOSIVE LIMITS</td>
<td>NA</td>
</tr>
<tr>
<td>VAPOR PRESSURE</td>
<td>NA</td>
</tr>
<tr>
<td>VAPOR DENSITY</td>
<td>NA</td>
</tr>
<tr>
<td>RELATIVE DENSITY</td>
<td>NA</td>
</tr>
<tr>
<td>SOLUBILITY IN WATER</td>
<td>soluble</td>
</tr>
<tr>
<td>PARTITION COEFFICIENT N-OCTANOL/WATER</td>
<td>NO DATA</td>
</tr>
</tbody>
</table>
SECTION 10. STABILITY AND REACTIVITY

CHEMICAL STABILITY
STABLE UNDER NORMAL STORAGE AND HANDLING CONDITIONS.

CONDITIONS TO AVOID
OXIDIZING & REDUCING AGENTS MAY DESTROY COLOR.

INCOMPATIBLE MATERIALS
OXIDIZING & REDUCING AGENTS MAY DESTROY COLOR.

HAZARDOUS DECOMPOSITION
PRODUCTS - CO, CO2, OXIDES OF NITROGEN AND OTHER POTENTIALLY TOXIC FUMES.

SECTION 11. TOXICOLOGICAL INFORMATION

TOXICOLOGICAL EFFECTS:

ORAL (ANIMAL) GREATER THAN 7,000 MG/KG - RAT
DERMAL (ANIMAL) NA
EFFECTS TO EYES (ANIMAL) EYES - RABBIT, NOT IRRITATING
SKIN IRRITATION (ANIMAL) SKIN - RABBIT, SLIGHT IRRITANT

SKIN CORROSION/IRRITATION NOT CLASSIFIED
SERIOUS EYE DAMAGE/IRRITATION CAUSES EYE IRRITATION
RESPIRATORY OR SKIN SENSITIZATION NOT CLASSIFIED
GERM CELL MUTAGENICITY NOT CLASSIFIED
CARCINOGENICITY NOT CLASSIFIED
REPRODUCTIVE TOXICITY NOT CLASSIFIED
SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) MAY CAUSE DROWSINESS OR DIZZINESS.
ASPIRATION HAZARD NOT CLASSIFIED
INHALATION MAY CAUSE DROWSINESS OR DIZZINESS.
EYE CONTACT CAUSES SERIOUS EYE IRRITATION.
INGESTION INGESTION MAY CAUSE NAUSEA, VOMITING AND DIARRHEA

SECTION 12. ECOLOGICAL INFORMATION

TOXICITY NA
PERSISTENCE AND DEGRADABILITY NA
BIOACCUMULATIVE POTENTIAL NA
MOBILITY IN SOIL LC-50 (LETHAL CONCENTRATION) UG = MICROGRAMS/LITER CHANNEL CATFISH - 2,267,000 UG/LITER RAINBOW TROUT - 1,372,000 UG/LITER BLUEGILL - 3,433,000 UG/LITER

SECTION 13. DISPOSAL CONSIDERATION
WASTE DISPOSAL RECOMMENDATION:

EMPTY BAGS THOROUGHLY. CARRY OUT THE PROPER RECYCLING, REUSAGE OR DISPOSAL.
PLEASE REFER TO THE RELEVANT EU REGULATIONS, IN PARTICULAR THE GUIDELINES/DECISIONS OF
AS IMPLEMENTED IN NATIONAL REGULATIONS.

REGIONAL RECOMMENDATION:

BURY OR INCINERATE ACCORDANCE WITH FEDERAL, STATE AND LOCAL REGULATIONS.

CONTAINERS SHOULD NOT BE REUSED WITHOUT PROFESSIONAL CLEANING AND RECONDITIONING.
OBSERVE ALL LABELED SAFEGUARDS UNTIL CLEANED, RECONDITIONED OR DESTROYED.

PLEASE REFER TO SECTION 8 (EXPOSURE CONTROLS /PERSONAL PROTECTION) OF THIS SDS.

SECTION 14. TRANSPORTATION INFORMATION

UN NUMBER NONE
UN PROPER SHIPPING NAME NONE

DEPARTMENT OF TRANSPORTATION (DOT): NOT HAZARDOUS FOR TRANSPORTATION

TRANSPORT HAZARD CLASS(ES)

HAZARD LABLES (DOT):

PACKING GROUP (DOT) NA
DOT SPECIAL PROVISIONS NA

ADDITIONAL INFORMATION:

OVERLAND TRANSPORT NONE
TRANSPORT BY SEA NONE
AIR TRANSPORT NONE
DOT QUANTITY LIMITATIONS PASSENGER AIRCRAFT NA
DOT QUANTITY LIMITATIONS CARGO AIRCRAFT NA

SECTION 15. REGULATORY INFORMATION

US FEDERAL REGULATIONS:

THE SUBSTANCES IS LISTED ON UNITED STATES TSCA (TOXIC SUBSTANCE CONTROL ACT) INVENTORY.

US STATE REGULATIONS:

NONE

CHEMICAL IDENTITY:

518-47-8 TSCA DSL NDSL EINECS ELINCS ENCS CHINA KECL PICCS AICS
X  -  -  -  -  -  -  -  -  -
TSCA STATUS: IN COMPLIANCE
E C CLASSIFICATION: (67/548/EEC - 88/379/EEC) N/A
EINECS NUMBER: N/A
REACH CLASSIFICATION: N/A
R PHRASES: N/A
ADDITIONAL REGULATORY INFORMATION: N/A

SECTION 16. OTHER INFORMATION

INDICATION OF CHANGES:
NA

OTHER INFORMATION:
NA

GHS FULL TEXT PHRASES:
MAY BE HARMFUL IF INHALED: H333
CAUSES EYE IRRITATION: H320
CAUSES MILD SKIN IRRITATION: H316

H, M, I, S. CLASSIFICATION:
HEALTH: 1
FLAMMABILITY: 0
REACTIVITY: 0
PERSONAL PROTECTIVE EQUIPMENT: D

HMIS CODE: 4 - SEVERE HAZARD, 3 - SERIOUS HAZARD, 2 - MODERATE HAZARD, 1 - SLIGHT HAZARD, 0 - MINIMAL HAZARD

SAFETY DATA SHEET (SDS)
REVISION DATE: 03/03/2016

ALL INFORMATION AND DATA APPEARING ON THIS SDS ARE BELIEVED TO BE RELIABLE AND ACCURATE. HOWEVER, IT IS THE USER’S RESPONSIBILITY TO DETERMINE THE SAFETY, TOXICITY, AND SUITABILITY FOR USE OF THE PRODUCT DESCRIBED. SINCE THE ACTUAL USE BY OTHERS IS BEYOND OUR CONTROL, NO GUARANTEE, EXPRESSED OR IMPLIED, IS MADE BY HUE CORPORATION. USER ASSUMES ALL RISK AND RESPONSIBILITY.
1. IDENTIFICATION
Product identifier
Mixture identification:
  Trade name: INTRACID RHODAMINE WT LIQUID
Other means of identification:
  Trade code: A45171566
Recommended use of the chemical and restrictions on use
Recommended use: Industrial color additive
Restrictions on use: Not Determined
Name, address, and telephone number of the chemical manufacturer, importer, or other responsible party
Sensient Colors LLC
2515 N. Jefferson
63106 St. Louis, MO (USA)
Phone: 1 800-325-8110
Emergency Number (CHEMTREC): 1-800-424-9300

2. HAZARD(S) IDENTIFICATION
The identity of the individual components of this product is proprietary information and is considered a trade secret pursuant to 29 CFR 1910.1200
Hazardous components as defined in the OSHA Hazard Communication Standard: components with a HEALTH hazard (carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, etc..) and/or a PHYSICAL hazard (a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water-reactive, etc.)

Classification of the chemical

Skin Irrit. 2 Causes skin irritation.
Eye Irrit. 2B Causes eye irritation

Label elements
Symbols:

Code Description
H315 Causes skin irritation.
H320 Causes eye irritation

Code Description
P264 Wash ... Thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352 IF ON SKIN: Wash with plenty of water/...
P305+P351+P33 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P321 Specific treatment (see ... On this label).
P332+P313 If skin irritation occurs: Get medical advice/attention.
P337+P313 If eye irritation persists: Get medical advice/attention.
Take off contaminated clothing and wash it before reuse.

**Ingredient(s) with unknown acute toxicity:**
None

**Hazards not otherwise classified identified during the classification process:**
None

### 3. COMPOSITION/INFORMATION ON INGREDIENTS

**Substances**
Not Determined

**Mixtures**
Hazardous components within the meaning of 29 CFR 1910.1200 and related classification:

**List of components**

<table>
<thead>
<tr>
<th>Qty</th>
<th>Name</th>
<th>Ident. Numbr.</th>
<th>Classification</th>
<th>Registration Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-12.5%</td>
<td>RHODAMINE LIQUID</td>
<td>CAS:65392-81-6</td>
<td>Skin Irrit. 2, H315; Eye</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>EC:255-730-6</td>
<td>Irrit. 2B, H320</td>
<td></td>
</tr>
<tr>
<td>10-12.5%</td>
<td>RHODAMINE LIQUID</td>
<td>CAS:75701-30-3</td>
<td>Skin Irrit. 2, H315; Eye</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>EC:278-292-6</td>
<td>Irrit. 2B, H320</td>
<td></td>
</tr>
<tr>
<td>1-3%</td>
<td>TRIMELLITIC ACID</td>
<td>CAS:528-44-9</td>
<td>Skin Irrit. 2, H315; Eye</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>EC:208-432-3</td>
<td>Irrit. 2A, H319; STOT SE 3, H335</td>
<td></td>
</tr>
</tbody>
</table>

### 4. FIRST AID MEASURES

**Description of first aid measures**

In case of skin contact:
- Immediately take off all contaminated clothing and shoes.
- Immediately remove any contaminated clothing, shoes or stockings.
- After contact with skin, wash immediately with soap and plenty of water.

In case of eye contact:
- Wash immediately and thoroughly with running water, keeping eyelids regularly raised, for at least 15 minutes. Cold water may be used. Check for and remove any contact lenses at once. OBTAIN A MEDICAL EXAMINATION.
- Protect the eyes with a sterile gauze or a clean, dry handkerchief.

In case of ingestion:
- Do not induce vomiting, get medical attention showing the MSDS and label hazardous.

In case of inhalation:
- Remove casualty to fresh air and keep warm and at rest.

**Most important symptoms/effects, acute and delayed**

Eye irritation
Eye damages
Skin Irritation
Erythema

**Indication of any immediate medical attention and special treatment needed**

In case of accident or unwellness, seek medical advice immediately (show directions for use or safety data sheet if possible).

### 5. FIRE-FIGHTING MEASURES

**Extinguishing media**

Suitable extinguishing media:
- Water, CO2, foam, chemical powders, according to the materials involved in the fire.
- In case of fire, use foam, dry chemical, CO2.

**Unsuitable extinguishing media:**
None in particular.

**Specific hazards arising from the chemical**

- Do not inhale explosion and combustion gases.
- Burning produces heavy smoke.
- Hazardous combustion products: Not Determined
- Explosive properties: Not Determined
- Oxidising properties: Not Determined

**Special protective equipment and precautions for fire-fighters**

- Use suitable breathing apparatus.
- Collect contaminated fire extinguishing water separately. This must not be discharged into drains.
- Move undamaged containers from immediate hazard area if it can be done safely.

### 6. ACCIDENTAL RELEASE MEASURES
Personal precautions, protective equipment and emergency procedures
- Wear personal protection equipment.
- Remove persons to safety.
- See protective measures under point 7 and 8.

Methods and material for containment and cleaning up
- Suitable material for taking up: dry and inert absorbing material (e.g. vermiculite, sand, earth).
- Wash with plenty of water.

7. HANDLING AND STORAGE

Precautions for safe handling
- Avoid contact with skin and eyes, inhalation of vapours and mists.
- Don't use empty container before they have been cleaned.
- Before making transfer operations, assure that there aren't any incompatible material residuals in the containers.
- Contaminated clothing should be changed before entering eating areas.
- Do not eat or drink while working.
- See also section 8 for recommended protective equipment.

Conditions for safe storage, including any incompatibilities
- Storage temperature: Not Determined
- Incompatible materials: None in particular.
- Instructions as regards storage premises: Adequately ventilated premises.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters
- No Data Available

Appropriate engineering controls: Not Determined

Individual protection measures
- Eye/face protection:
  - Use close fitting safety goggles, don't use eye lens.
- Skin protection:
  - Use clothing that provides comprehensive protection to the skin, e.g. cotton, rubber, PVC or viton.
- Hand protection:
  - Use protective gloves that provide comprehensive protection, e.g. P.V.C., neoprene or rubber.
- Respiratory protection:
  - Not Determined

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties
- Physical State Liquid
- Appearance: Liquid,
- Odour: Not Determined
- Odour threshold: Not Determined
- pH: 10.50
- Melting point/ range: Not Determined
- Boiling point/ range: Not Determined
- Flash point: > 100°C / 212°F
- Evaporation rate: Not Determined
- Upper/lower flammability or explosive limits: Not Determined
- Vapour density: Not Determined
- Vapour pressure: Not Determined
- Density: Not Determined
- Water solubility: Not Determined
- Lipid solubility: Not Determined
- Partition coefficient (n-octanol/water): Not Determined
- Auto-ignition temperature: Not Determined
- Decomposition temperature: Not Determined
- Viscosity: Not Determined
- Explosive properties: Not Determined
- Oxidising properties: Not Determined
- Flammability (Solid, Gas): Not Determined
10. STABILITY AND REACTIVITY

Reactivity
Stable under normal conditions.

Chemical stability
Data not Available.

Possibility of hazardous reactions
Burning produces carbon monoxide and/or carbon dioxide.

Conditions to avoid
Stable under normal conditions of temperature and pressure.

Incompatible materials
Avoid strong oxidizing agents, peroxides, acids, alkali metals.

Hazardous decomposition products
Burning produces carbon monoxide and/or carbon dioxide.

11. TOXICOLOGICAL INFORMATION

Information on toxicological effects
Toxicological information of the product: No Data Available

Substance(s) listed on the IARC Monographs:
None

Substance(s) listed as OSHA Carcinogen(s):
None

Substance(s) listed as NIOSH Carcinogen(s):
None

Substance(s) listed on the NTP report on Carcinogens:
None

12. ECOLOGICAL INFORMATION

Toxicity
Adopt good working practices, so that the product is not released into the environment.

Eco-toxicity:

List of Eco-Toxicological properties of the product
No Data Available

Persistence and degradability
Not Determined

Bioaccumulative potential
Not Determined

Mobility in soil
Not Determined

Other adverse effects
Not Determined

13. DISPOSAL CONSIDERATIONS

Waste treatment methods
Recover if possible. In so doing, comply with the local and national regulations currently in force.

14. TRANSPORT INFORMATION

UN number
ADR-UN number: N/A
DOT-UN Number: N/A
IATA-Un number: N/A
IMDG-Un number: N/A
5. REGULATORY INFORMATION

SA - Federal regulations

TSCA - Toxic Substances Control Act

TSCA inventory:

All the components are listed on the TSCA inventory

TSCA listed substances:

- RHODAMINE LIQUID
- RHODAMINE LIQUID
- TRIMELLITIC ACID
SARA - Superfund Amendments and Reauthorization Act

Section 302 - Extremely Hazardous Substances:
no substances listed

Section 304 - Hazardous substances:
no substances listed

Section 313 - Toxic chemical list:
no substances listed

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act

Substance(s) listed under CERCLA:
no substances listed

CAA - Clean Air Act

CAA listed substances:
no substances listed

CWA - Clean Water Act

CWA listed substances:
no substances listed

USA - State specific regulations

California Proposition 65

Substance(s) listed under California Proposition 65:
no substances listed

Massachusetts Right to know

Substance(s) listed under Massachusetts Right to know:
no substances listed

Pennsylvania Right to know

Substance(s) listed under Pennsylvania Right to know:
no substances listed

New Jersey Right to know

Substance(s) listed under New Jersey Right to know:
no substances listed

16. OTHER INFORMATION

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>H315</td>
<td>Causes skin irritation.</td>
</tr>
<tr>
<td>H319</td>
<td>Causes serious eye irritation.</td>
</tr>
<tr>
<td>H320</td>
<td>Causes eye irritation</td>
</tr>
<tr>
<td>H335</td>
<td>May cause respiratory irritation.</td>
</tr>
</tbody>
</table>

Safety Data Sheet dated: 5/13/2015 - version 1

The information contained herein is based on our state of knowledge at the above-specified date. It refers solely to the product indicated and constitutes no guarantee of particular quality. The information relates only to the specific material and may not be valid for such material used in combination with any other material or in any process.

This document was prepared by a competent person who has received appropriate training.

It is the duty of the user to ensure that this information is appropriate and complete with respect to the specific use intended.

This MSDS cancels and replaces any preceding release.

Legend to abbreviations and acronyms used in the safety data sheet:

ADR: European Agreement concerning the International Carriage of Dangerous Goods by Road.
RID: Regulation Concerning the International Transport of Dangerous Goods by Rail
IMDG: International Maritime Code for Dangerous Goods
IATA: International Air Transport Association
IATA-DGR: Dangerous Goods Regulation by the "International Air Transport Association" (IATA)
ICAO: International Civil Aviation Organization
ICAO-TI: Technical Instructions by the "International Civil Aviation Organization" (ICAO)
GHS: Globally Harmonized System of Classification and Labeling of Chemicals
CLP: Classification, Labeling, Packaging
EINECS: European Inventory of Existing Commercial Chemical Substances
INCI: International Nomenclature of Cosmetic Ingredients
CAS: Chemical Abstracts Service (division of the American Chemical Society)
GefStoffV: Ordnance on Hazardous Substances, Germany
LC50: Lethal concentration, for 50 percent of test population
LD50: Lethal dose, for 50 percent of test population
DNEL: Derived No Effect Level
PNEC: Predicted No Effect Concentration
TLV: Threshold Limiting Value
TWATLV: Threshold Limiting Value for the Time Weighted Average 8 hour day (ACGIH Standard)
STEL: Short Term Exposure limit
STOT: Specific Target Organ Toxicity
WGK: German Water Hazard Class
Kst: Explosion coefficient for the damage.
Appendix B
Monitoring Network
Well Boring Logs
**Monitoring Well: WS-3-13**

**G&A Rep:** Peter Lyng  
**Project No:** 12-03081 A7  
**Project:** Buzzi West Sump Investigation  
**Client:** Buzzi Unicem  
**Site Location:** Stockertown PA

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Well Construction</th>
<th>Symbol</th>
<th>Description</th>
<th>Number</th>
<th>Type</th>
<th>Blows/g</th>
<th>N-Value</th>
<th>VOC</th>
<th>Recovery</th>
<th>Remarks</th>
<th>Water Bearing Zones</th>
</tr>
</thead>
<tbody>
<tr>
<td>-5</td>
<td>Gate Valve Installed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Grouting Materials</td>
<td>15 bags of cement grout with 5% bentonite</td>
</tr>
<tr>
<td>5</td>
<td>6&quot; Steel Casing from +2 - 100 ft bgs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Cement Grout from 0 - 100 ft bgs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>25</td>
<td></td>
<td></td>
<td>Ground Surface</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>2 bags of hole plug</td>
</tr>
<tr>
<td>35</td>
<td>Limestone</td>
<td></td>
<td>Dark grey gravel and cobbles</td>
<td>90.00</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
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<tr>
<td>45</td>
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<td>50</td>
<td>Clay Seam</td>
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</tr>
<tr>
<td>55</td>
<td>Limestone</td>
<td></td>
<td>Dark grey limestone</td>
<td>70.00</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Depth to Water:** 57 ft  
- **Surface Elevation:** 103.35 ft  
- **Drill Date:** 9/3/13, 9/4/13, 9/5/13  
- **Hole Size:** 6 inches

- **Depth of Well:** 150 ft  
- **Top of Casing:** 104.86 ft  
- **Drill Method:** Air Rotary  
- **Sheet:** 1 of 4

- **Depth of Drill Hole:** 150 ft  
- **Total Yield:** N/A  
- **Drilled By:** C. S. Garber  
- **Reviewed By:** Toby Kessler
## Monitoring Well: WS-3-13

**G&A Rep:** Peter Lyng  
**Project No:** 12-03081A7  
**Project:** Buzzi West Sump Investigation  
**Client:** Buzzi Unicum  
**Site Location:** Stockertown PA

### Subsurface Profile

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Well Construction</th>
<th>Symbol</th>
<th>Description</th>
<th>Depth/Elev. (ft)</th>
<th>Number</th>
<th>Type</th>
<th>Blow/ft</th>
<th>N-Value</th>
<th>VOC</th>
<th>Recovery</th>
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<td></td>
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<tr>
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<tr>
<td>65</td>
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<td>55</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td></td>
<td></td>
<td>50 - 60 GPM at 57 ft bgs</td>
<td>40.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>50 to 60 gpm observed at 57 ft bgs (Cased off)</td>
</tr>
<tr>
<td>0.00</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
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</tbody>
</table>

- **Depth to Water:** 57 ft  
- **Surface Elevation:** 103.35 ft  
- **Drill Date:** 9/3/13, 9/4/13, 9/5/13  
- **Drill Method:** Air Rotary  
- **Hole Size:** 6 inches  
- **Sheet:** 2 of 4  
- **Top of Casing:** 104.88 ft  
- **Drilled By:** C.S. Garber  
- **Reviewed By:** Toby Kessler  
- **Total Yield:** N/A
### Monitoring Well: WS-3-13

**G&A Rep:** Peter Lyng

**Project No:** 12-03081 A7

**Project:** Buzzi West Sump Investigation

**Client:** Buzzi Unicem

**Site Location:** Stockertown PA

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Well Construction</th>
<th>Symbol</th>
<th>Description</th>
<th>Depth/Level (ft)</th>
<th>Number</th>
<th>Type</th>
<th>Blows/ft</th>
<th>M-Value</th>
<th>VOC</th>
<th>Recovery</th>
<th>Remarks Water Bearing Zones</th>
</tr>
</thead>
<tbody>
<tr>
<td>105</td>
<td>Open Borehole from 100 to 150 ft bgs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>125</td>
<td></td>
<td></td>
<td>Limestone</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>Confined aquifer encountered between 122 to 124 ft bgs &gt;1000 gpm observed</td>
</tr>
<tr>
<td>135</td>
<td></td>
<td></td>
<td>Limestone</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
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<td>145</td>
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</tr>
</tbody>
</table>

- Depth to Water: 57
- Surface Elevation: 103.35
- Drill Date: 9/3/13, 9/4/13, 9/5/13
- Hole Size: 6 inches
- Depth of Well: 150
- Top of Casing: 104.88
- Drill Method: Air Rotary
- Sheet: 3 of 4
- Depth of Drill Hole: 150
- Total Yield: N/A
- Drilled By: C.S Garber
- Reviewed By: Toby Kessler
## Monitoring Well: WS-3-13

**G&A Rep:** Peter Lyng  
**Project No:** 12-03081A7  
**Project:** Buzzi West Sump Investigation  
**Client:** Buzzi Unicem  
**Site Location:** Stockertown PA

### Subsurface Profile

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Well Construction</th>
<th>Symbol</th>
<th>Description</th>
<th>Depth/Elev. (ft)</th>
<th>Number</th>
<th>Type</th>
<th>Blows/6'</th>
<th>N-Value</th>
<th>VOC</th>
<th>Recovery</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>155</td>
<td>End of Boring</td>
<td></td>
<td>Limestone, dark grey, Limestone with brown clay, weathered cobble size pieces of limestone, iron oxide stained surfaces; calcite surface; some appear to be conglomerate</td>
<td>-60.00</td>
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<td>-90.00</td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>195</td>
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<td></td>
<td>-100.00</td>
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<td></td>
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</table>

### Additional Information
- **Depth to Water:** 57
- **Surface Elevation:** 103.35
- **Drill Date:** 9/3/13, 9/4/13, 9/5/13
- **Hole Size:** 6 inches
- **Depth of Well:** 150
- **Top of Casing:** 104.88
- **Drill Method:** Air Rotary
- **Sheet:** 4 of 4
- **Depth of Drill Hole:** 150
- **Total Yield:** N/A
- **Drilled By:** C.S Garber
- **Reviewed By:** Toby Kessler
### EarthRes
**Client:** BUZZI UNICEM USA  
**County:** NORTHAMPTON COUNTY, PENNSYLVANIA  
**Township or Municipality:** STOCKERTOWN  
**Logged By:** JMK & JAY  
**Drilling Method:** AIR ROTARY  
**Drilled By:** C.S.GARBER & SON, INC.  
**Latitude/Longitude:** N 40.748860°; W -75.278847°  
**Elevation:** Ground = 457.86' MSL; TOC = 439.29' MSL  
**Depth to Static Water Level (SWL):** 233.41' BTOC on 01/29/18

### Project: 121005.045 EAST PARTIAL DEEPENING HYDRO

**Boring Number:** B-4-18  
**Total Depth:** 504' bgs  
**Date Drilled:** 01/25/18 - 01/26/18 & 01/28/18 (mm/dd/yy)

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Lithologic Description</th>
<th>Plot</th>
<th>Additional Description</th>
<th>Comments</th>
<th>Borehole Construction</th>
<th>Elevation (ft MSL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>180' - 220' Gray dolostone with minor tan/orange weathered dolostone, quartz and calcite</td>
<td></td>
<td></td>
<td>Drilling Conditions: Water used during drilling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>160</td>
<td>180' - 180' Drilling Rate = 2.2'/min Strength/Weathering = R2/W1</td>
<td></td>
<td></td>
<td></td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>180</td>
<td>180' - 220' Drilling Rate = 1.8'/min Strength/Weathering = R2/W1</td>
<td></td>
<td></td>
<td></td>
<td>270</td>
<td></td>
</tr>
<tr>
<td>190</td>
<td>200' - 220' Drilling Rate = 1.7'/min Strength/Weathering = R2/W1</td>
<td></td>
<td></td>
<td></td>
<td>280</td>
<td></td>
</tr>
<tr>
<td>200</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>210</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>270</td>
<td></td>
</tr>
<tr>
<td>220</td>
<td>220' - 240' Gray dolostone with trace quartz</td>
<td></td>
<td></td>
<td>6' # open hole from 120' to 370' bgs</td>
<td></td>
<td>280</td>
</tr>
<tr>
<td>230</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>210</td>
<td></td>
</tr>
<tr>
<td>240</td>
<td>240' - 260' Gray dolostone with oxidized surfaces</td>
<td></td>
<td></td>
<td></td>
<td>250</td>
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<tr>
<td>250</td>
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<td></td>
<td></td>
<td>270</td>
<td></td>
</tr>
<tr>
<td>260</td>
<td>260' - 250' Gray dolostone with calcite</td>
<td></td>
<td></td>
<td>260' - 280' Drilling Rate = 1.5'/min Strength/Weathering = R3/W1</td>
<td></td>
<td>210</td>
</tr>
<tr>
<td>270</td>
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<td></td>
<td></td>
<td>190</td>
<td></td>
</tr>
<tr>
<td>280</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>170</td>
<td></td>
</tr>
<tr>
<td>290</td>
<td>290' - 340' Gray dolostone with minor tan/orange weathered dolostone, quartz and calcite</td>
<td></td>
<td></td>
<td></td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>300</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>130</td>
<td></td>
</tr>
<tr>
<td>310</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>120</td>
<td></td>
</tr>
</tbody>
</table>

- **Encountered Groundwater**  
- **Composite Static Water Level**  
- R2 = Weak rock  
- R3 = Medium strong rock  
- W1 = Fresh, unweathered rock  
- W2 = Slightly weathered rock
### Project: 121005.045 EAST PARTIAL DEEPENING HYDRO

**Boring Number:** B-4-18  
**Total Depth:** 594' bgs  
**Date Drilled:** 01/25/18 - 01/28/18 & 01/29/18 (mm/dd/yy)

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Lithologic Description</th>
<th>Plot</th>
<th>Additional Description</th>
<th>Comments</th>
<th>Borehole Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 - 330</td>
<td>Gray dolostone with minor tan/orange weathered dolostone, quartz and calcite</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 330 - 340 |                        |      | 300' - 320' Drilling Rate = 1.3' / min  
Strength/Weathering = R2/W2 | Drilling Conditions: Water used during drilling |                       |
| 340 - 360 | Gray dolostone with minor tan/orange weathered dolostone |      |                        |          |                       |
| 360 - 370 |                        |      | 360' - 365' Drilling Rate = 0.8' / min  
Strength/Weathering = R2/W2 |          |                       |
| 370 - 400 | Gray dolostone with minor tan/orange weathered dolostone, quartz and calcite |      |                        |          |                       |
| 400 - 420 |                        |      | 400' - 420' Drilling Rate = 1.3' / min  
Strength/Weathering = R2/W1 |          |                       |
| 420 - 460 |                        |      | 420' - 460' Drilling Rate = 1.3' / min  
Strength/Weathering = R2/W2 |          |                       |
| 460 - 480 | Gray dolostone with minor quartz and calcite |      |                        |          |                       |
| 480 - 500 |                        |      | 480' - 485' Drilling Rate = 1.3' / min  
Strength/Weathering = R2/W2 |          |                       |

**Notations:**  
- **Encountered Groundwater**  
- **Composite Static Water Level**

**Client:** BUZZI UNICEM USA  
**County:** NORTHAMPTON COUNTY, PENNSYLVANIA  
**Township or Municipality:** STOCKERTOWN  
**Logged By:** MK & JAY  
**Drilling Method:** AIR ROTARY  
**Drilled By:** C.S.GARBER & SON, INC.  
**Latitude/Longitude:** N 40.748880°, W -75.278847°

**Elevation:**
- Ground = 437.85' MSL  
- Top of Composited Water = 439.29' MSL

**Depth to Static Water Level (SWL):** 233.41' BTGC on 01/29/18
Client: BUZZ UNICEM USA  
County: NORTHAMPTON COUNTY, PENNSYLVANIA  
Township or Municipality: STOCKERTOWN  
Logged By: JM & JAY  
Drilling Method: AIR ROTARY  
Drilled By: C.S.GARBER & SON, INC.  
Latitude/Longitude: N 40.748860°, W -75.278647°  
Elevation: Ground = 437.85' MSL, TOC = 430.29' MSL  
Depth to Static Water Level (SWL): 233.41' BTC on 01/29/18

<table>
<thead>
<tr>
<th>Depth (Ft)</th>
<th>Lithologic Description</th>
<th>Plot</th>
<th>Additional Description</th>
<th>Comments</th>
<th>Borehole Construction</th>
<th>Elevation (Ft MSL)</th>
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</thead>
<tbody>
<tr>
<td>440 - 460</td>
<td>Gray dolostone with trace quartz and calcite</td>
<td></td>
<td></td>
<td>Drilling Conditions: Water used during drilling</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 460 - 480  | 460' - 480' Drilling Rate = 1.3'/min  
Strength/Weathering = R2/W1 | | | | | |
| 460 - 504  | Gray dolostone | | | 5.5' Ø open hole completed to 504' bgs | | |
| 480 - 504  | 480' - 504' Drilling Rate = 1.3'/min  
Strength/Weathering = R2/W1 | | | | | |

Depth: 504' bgs  
Total Yield: 60 gpm
<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Lithologic Description</th>
<th>Plot</th>
<th>Additional Description</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>160</td>
<td>168'-172' Tan/Brown Banded Coarse Grained Heavily Weathered Limestone</td>
<td></td>
<td>168'-172' Fracture Yellow Mud (Est. Water 30 GPM) 170' Water Yield ~42 GPM</td>
<td></td>
</tr>
<tr>
<td>170</td>
<td>172'-190' Light Gray Fine Grained Limestone w/ Dark Gray Coarse Grained Limestone</td>
<td></td>
<td>194' Fracture (Est. Water ~45 GPM) 195' Water Yield ~36 GPM</td>
<td></td>
</tr>
<tr>
<td>190</td>
<td>190'-260' Light Gray Fine Grained Dolomite w/ Dark Gray Coarse Grained Limestone w/ Calcite Veins</td>
<td></td>
<td>220' Water Yield ~42 GPM</td>
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<tr>
<td>230</td>
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<td></td>
<td>235' Calcite Vein 236' Water Loss</td>
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<tr>
<td>240</td>
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<td></td>
<td>245' Water Yield ~43 GPM</td>
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<td>250</td>
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</tr>
<tr>
<td>260</td>
<td>260'-310' Dark Gray Fine Grained Dolomite</td>
<td></td>
<td>260'-262' Calcite Veins 264'-285' Calcite Veins</td>
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<tr>
<td>270</td>
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<td>270' Water ~41 GPM</td>
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<td>280</td>
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<td></td>
<td>278' Chatter (Calcite Vein) 279' Chatter (Calcite Vein) 285' Calcite Vein 280' Calcite Vein</td>
<td></td>
</tr>
<tr>
<td>290</td>
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</tr>
<tr>
<td>300</td>
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</tbody>
</table>

** Encountered Groundwater  □ Composite Static Water Level  ** Recovered/Attempted
Borehole Number: B-6-15
Elevation (Surface): 376.88' MSL (TOC)
Borehole Diameter: 8.5" Inches, From 0" To 19"
6.125" Inches, From 19" To 170"
Total Depth: 425'

Depth to Static Water Level (SWL): 96.98' (ft)
Date SWL Measured: 6/15/2015 (mm/dd/yy)

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Lithologic Description</th>
<th>Plot</th>
<th>Additional Description</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>260-310</td>
<td>Dark Gray Fine Grained</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>310-390</td>
<td>Dark Gray Fine Grained</td>
<td>315' Calcite Vein</td>
<td>315 Water Yield ~44 GPM</td>
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<tr>
<td>330-340</td>
<td>Dolomite; Gray Coarse Grained Limestone w/ Calcite Veins</td>
<td>335' Water Yield ~56 GPM</td>
<td></td>
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</tr>
<tr>
<td>340-360</td>
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<tr>
<td>360-379</td>
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</tr>
<tr>
<td>379-390</td>
<td>Dark Gray Fine Grained</td>
<td>375' Water Yield ~70 GPM</td>
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</tr>
<tr>
<td>390-400</td>
<td>Limestone</td>
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</tr>
<tr>
<td>400-425</td>
<td>Dark Gray Fine Grained Limestone; Gray Coarse Grained Limestone w/ Calcite Veins</td>
<td>395' Water Yield ~50 GPM</td>
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<tr>
<td>425-430</td>
<td>Total Water Yield: ~50 GPM</td>
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</tr>
</tbody>
</table>

Encountered Groundwater □ □ Composite Static Water Level □ □ Recovered/Attempted