**Canyon County**
**Pickles Butte Landfill**

# Landfill Status Report Update






TETRA TECH

**4576RPT.DOC**
December 8, 2015

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December 8, 2015

**PRESENTED TO**

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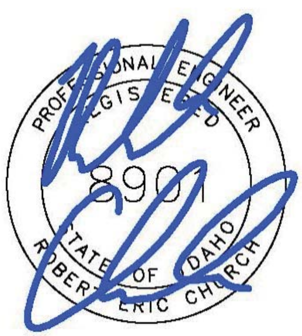


Robert Church 12/8/2015
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# TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF FIGURES

## APPENDICES

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# EXECUTIVE SUMMARY

Canyon County (the “County”) contracted with the Tetra Tech/Great West Engineering team in June 2015 to prepare a Landfill Status Report for the Pickles Butte Sanitary Landfill (PBSL, or “the Landfill”). The landfill began accepting waste in 1983 under the original facility design, which was revised in 1994 as part of licensing the facility with the Idaho DEQ under the Federal Subtitle D rules. The 1994 fill configuration is the currently approved design for the facility. The previous Landfill Status Report was written in 1997 by Holliday Engineering Company. The report covered the design history, fill rates, the facility master plan, methane and groundwater monitoring, applicability of the clean air act, and a financial assurance calculation. This report updates the previous report by reviewing operations and activities at the site since the previous report was written, and includes an evaluation, where applicable, of revised regulations that could potentially affect the landfill. The report is divided into eight sections, which are briefly described below.

**Section 1.0** of the report reviews the operation of the Landfill by evaluating performance, equipment use, litter and dust control, special wastes, and infrastructure. Overall, the site is well operated and maintained. To assist with future operations, the site needs to update the operation and management plan, and develop a fill plan. In addition, this section of the report discusses alternative daily cover (ADC) options, waste diversion, infrastructure improvements, and the establishment of a capital improvement plan (CIP) for financial planning.

**Section 2.0** examines activities related to the groundwater at the site, and includes a review of the geology, stratigraphy, groundwater flow characteristics, groundwater composition, and groundwater sampling program around and beneath the Landfill. Consistent with previous work at the site, the results indicate that the regional groundwater has background metals and methane present. An analysis was done to evaluate how the concentrations detected compared to regulatory limits. This report makes recommendations for standard practices used for groundwater sampling to improve data quality.

**Section 3.0** evaluates the request by the Landfill to accept Class B biosolids from the Cities of Nampa and Caldwell. The Landfill can benefit by using biosolids to augment final cover or intermediate cover soil. Key benefits for cover soil are moisture holding capacity and the growth of surface vegetation, which will inhibit erosion and reduce slope maintenance. The addition of this waste stream will also provide another source of revenue for the landfill. Biosolids can be handled at the landfill in a variety of ways, each with their own regulatory implications. Four general procedures include, land application, incorporation into the active face, incorporation into soil used for landfill operations, and use as feedstock for a compost program.

There would be some health and safety concerns associated with the acceptance of biosolids. Class B biosolids contain relatively high concentrations of pathogens (fecal coliform, helminth ova, etc.). Direct contact with exposed skin should be avoided, as well as contact with the eyes and mouth. The best protection is to avoid direct contact with the biosolids. Personal protective equipment would include gloves, goggles/face shield, a Tyvek suit, and Tyvek booties.

**Section 4.0** estimates the amount of landfill gas produced by the landfill from the start of operations to the year 2048. Based on the non-methane organic carbon (NMOC) concentration from the most recent Tier 2 analysis and the landfill gas generation estimates from our study, the annual NMOC emission rate was determined. This annual NMOC emission rate is a key regulatory parameter contained in 40 CFR 60, Subpart WWW. The NMOC emission rate determines if the landfill is required to install a landfill gas collection and control system (GCCS). The PBSL does not currently have a GCCS. The current NMOC threshold that applies to the PBSL is 50 Mg/year NMOC. It is estimated that the Landfill is generating 33.3 Megagrams per year (Mg/year) (estimate from 2014). However, new regulations being promulgated by the EPA will reduce the NMOC emission threshold to 34 Mg/year. If the final version of the new regulations contain this threshold, the PBSL may be required to install a GCCS.

Tetra Tech recommends that the PBSL explore the Tier IV option for measuring NMOC emissions if this option is included in the final version of 40 CFR 60, Subpart XXX. The Tier IV option may result in a lower NMOC emission rate that would postpone the installation of a GCCS. The PBSL may also want to review the need to install perimeter LFG probes, as required by 40 CFR §258.23.

**Section 5.0** of the report discusses a preliminary stability analyses and seismic evaluation of the proposed cell geometries. The analysis was conducted to verify satisfactory stability or indicate if flatter slopes are required to achieve stability. The material strength properties incorporated in the preliminary analyses were based on lower bound shear strength values, and are considered conservative estimates. Results of the preliminary seismic evaluation indicate that the Conceptual Fill Plan design for future Phases 1 through 4 should meet the requirements of the Administrative rules for the Idaho Solid Waste Facilities Act for the Idaho DEQ's administration of Municipal Solid Waste Landfills (MSWLF).

**Section 6.0** presents a conceptual fill plan for the landfill area that was developed based on the stability analysis and the landfill management's preference on fill sequence and slope criteria. The conceptual fill plan includes four phases. Phase 1, currently under way, includes completion of the fill to match a historic ridgeline. Phase 2 includes filling a triangular portion of the property east of Perch Road. Phase 3 includes filling the current soil borrow area called the West Borrow Area. Phase 4 includes capping the top deck of the landfill with a 5% grade to the east. This fill plan allows the County to maximize the amount of time a motorcycle recreation area to the west can remain open for public use. This fill plan provides approximately 27 years of capacity under the current operational methods used at the facility. The soil available within the West Borrow Area will last approximately 9 years using the current cover operations. At that time, the County needs to have a plan prepared for the next excavation/soil borrow area. We recommend that the County proceed immediately with developing a cut and fill plan design in accordance with the conceptual fill plan.

**Section 7.0** is an engineering analysis of the stormwater at the site and serves as an update to the previous stormwater analyses contained in the *1997 Landfill Status Report* dated February 1998 and the *Pickles Butte Sanitary Landfill Operation and Maintenance Manual* dated December 2012. This analysis includes identification and evaluation of existing run-on and run-off controls along with recommendations for additional and/or improved controls where necessary. A the 25-year, 24-hour storm event (a criterion meeting that contained in the *EPA's Solid Waste Disposal Facility Criteria Technical Manual, revised April 1998,* and the *Code of Federal Regulations, Title 40, Section 258.26* (40 CFR 258.26) was used to calculate design flows for the on-site and off-site drainage features. Utilizing AutoCAD software, the existing 2014, 2-foot PBL topography was divided into drainage tributaries. This was only possible by including the following recommended features into a preliminary design:

1) Inwardly pitched haul road/drainage benches that divide portions of the west fill face. This allows control of the stormwater rather than allowing it to continue downslope for very long distances. Such long distances of travel would cause excessive erosion of the west fill face cover;
2) Additional drainage channels, culverts and berms to manage and direct on-site stormwater away from or around future excavation and filling areas, and direct it to on-site retention basins; and,

Additional drainage channels and berms to divert off-site flow around the current site and future excavation/filling areas.

A detailed engineering analysis was conducted and is described in detail in this section to help reduce erosion and road crossing maintenance. The analysis assumes that all stormwater control features are in-place, so it is important that all Plan features be implemented by the County as soon as permissible. Finally, although improved stormwater controls will result in reduced future erosion rates and road crossing maintenance requirements, storm event run-off will still include significant sediment transport. Modified and/or additional controls may become necessary in the future. It is critical for the viability of stormwater controls that maintenance take place after each storm event. Required maintenance would typically consist of sediment removal from stormwater conveyance structures and retention basins as well as repairing rills formed in slopes and erosion of berms. Disregard of such maintenance will inevitably, no matter how good the design, cause loss of conveyance capacity and a failure of the stormwater control system. The extents and costs of necessary repairs caused by disregard of routine maintenance would far exceed those incurred had routine maintenance been performed.

**Section 8.0** examines the basis for the proper level of funding to close and provide post-closure maintenance for the Landfill in an environmentally sound manner. Cost estimates were prepared reflecting the proposed closure design and post-closure maintenance procedures presented in the 2012 Operations and Maintenance Manual. At the request of DEQ, closure cost estimates for both the current landfill footprint (74.2 acres) and for the final build-out of the landfill (116 acres) were prepared. The closure cost estimates consider two types of final cover for each acreage scenario. Currently, the final cover design is a capillary break; however, it may be more cost effective and provide equivalent performance to use a 4-foot thick monolithic soil final cover. The total annual maintenance and monitoring cost estimate for post-closure is discussed in detail in this section. The total 30-year post-closure cost estimate was calculated by multiplying the annual cost estimate by 30 years. In accordance with 40 CFR, Subpart G, and Title 39, Chapter 74 of the Idaho Code, an operator must demonstrate financial assurance for the proper closure and post-closure maintenance. According to the Operations and Maintenance Manual, the financial assurance mechanisms for the Pickles Butte Sanitary Landfill are in the form of a Local Government Financial Test and restricted cash account. Each year, the amount of financial assurance and the choice of funding instrument is reviewed and approved by the DEQ.

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# 1.0 OPERATIONS ASSESSMENT

This section reviews the landfill operations based on a review of previous landfill documentation, interviews with key staff, and a comprehensive two-day field inspection

## 1.1 Site History

The Idaho Department of Environmental Quality (DEQ) approved the original design and operating plan in June 1973, and reconfirmed approval in May 1975 (Holladay, 1994). The Southwest District Health Department approved the landfill in December 1979 (ibid). The landfill initially began accepting waste in April 1983. With the implementation of Subtitle D, the County obtained site certification for the landfill from the DEQ in August 1993. The DEQ subsequently approved a Hydrogeologic Characterization, Ground Water Monitoring Plan and Facility Design Report prepared by Holladay Engineering Company (ibid). The approval included exemptions from the requirements for a liner/leachate collection system and groundwater monitoring. This technical decision was based on the depth to groundwater, native soils characteristics, and the arid climate of the facility.

The 1994 Hydrogeologic Characterization, Ground Water Monitoring Plan, and Facility Design Report is still the current regulatory basis for the design of the facility. It included a design boundary footprint for waste disposal. The design boundary for the waste footprint on the east side followed the topography of the top of the ridgeline of several coulees as shown in Figure 6 of that report. The County did not submit the 1997 Landfill Status Report to the DEQ or the Southwest Idaho District Health Department.

The County subsequently submitted an updated Site Certification in June 2010 (Daniel B. Stephens and Associates, 2010), which expanded the site certification boundary to 492 acres. Figure 1 from that report documents the current site certification boundary and is included with this report as Appendix 1-A. The DEQ approved this site certification in August 2010. That document serves as the current certification boundary for the facility.

Finally, the most current Operations and Maintenance manual for the facility is dated December 2012 (Canyon County Solid Waste (CCSW), 2012). Idaho code requires that the O&M manual be updated every three years so an updated O&M Manual will need to be completed and submitted to the DEQ by December 2015.

The 1994 Design Report, 2010 Site Certification Document, and the 2012 O&M Manual are the primary regulatory documents governing site design and operations at the facility. According to County records, the landfill has 4,074,170 tons of waste in-place as of September 30, 2014 (Appendix 1-B).

Holladay Engineering Company (Holladay) installed seven monitoring wells beginning in 1992 as part of the investigation described in their 1994 report. These were designated PB-2 through PB-8. The designation PB-1 was applied to an existing domestic well located adjacent to the shop building at the Landfill. Holladay installed monitoring wells PB-9 and PB-10 in 1995. Daniel B. Stephens & Associates (DBS&A) installed wells PB-10 through PB-15 in 2011 as part of their investigation. The County has conducted voluntary groundwater sampling on all available site monitoring wells on a biannual basis since 1995. The County also commissioned significant hydrogeologic investigations between 2010 and 2014 for the future expansion of the landfill. DBS&A conducted this work. The County has not submitted this report to the DEQ because it wishes to prepare an expansion design first.

## 1.2 Service Area/Tonnage

The PBSL currently services the residents of Canyon and Owyhee Counties. The 2014 population of the service area as estimated by the US Census Bureau (Appendix 1-C) is summarized in **Table 1-1**.

**Table 1-1. Service Area Population 2014 Census Estimates**

| Area | Population |
|---|---|
| Canyon County | 203,143 |
| Owyhee County | 11,353 |
| Total | 214,496 |

According to the US Census Bureau, Canyon County's population increased 7.5% between 2010 and 2014. Owyhee County had a 1.5% decline over this same period. The County has kept detailed annual waste acceptance records at the landfill since scales were put into operation in February 1995 (Appendix 1-B). During the last complete fiscal year of October 2013 - September 2014, the Landfill accepted 216,376 tons. **Table 1-2** shows the per capita waste generation for this period. Annual tonnage will continue to increase with population growth.

**Table 1-2. Fiscal Year 2014 Waste Generation Statistics PBSL Service Area**

| Item | Amount |
|---|---|
| Total Tonnage | 216,376 tons |
| Service Area Population | 214,496 |
| Peak Day Tonnage | 1,200 tons/day |
| Per Capita Waste Generation | 1.0 tons/person/year<br>5.5 lbs./person/day |
| National Waste Generation | 4.4 lbs./person/day (EPA – 2013 Materials Fact Sheet) |
| Waste Tonnage Diverted | 4,413 tons |
| Waste Diversion Percentage | 2.0% |

Although Canyon County does generate more than the national average of waste per person, 5.5 lbs./person/day is consistent with similar rural areas within the Western US. We have seen generation rates as high as 7 lbs./person/day in some communities in the Western US. Because the County only diverts approximately 2.0% of the wastes that arrive on-site, we recommend the County consider a waste characterization and waste diversion study so that the diversion of additional wastes can be investigated and evaluated.

## 1.3 Site Access and Security

The landfill is open between 8:00 am and 5:30 pm six days per week. Site access is via Missouri Avenue, which is a well maintained, two lane County Road. Because the majority of the waste originates in the cities of Nampa and Caldwell, State Highway 45 is also a major transportation route for most of the waste being delivered to the site. The entire area that the County regularly operates within is fenced with 12-15 foot high, woven wire litter fence. The primary access gate is located on the southern boundary of the facility and is locked during hours the landfill is closed. All other supplementary access gates around the facility remain locked and only opened when used by PBSL staff. Site security is maintained off hours by a caretaker that resides at a house located immediately south of the landfill. About 1350 acres of the western portion of the property owned by the County, but outside the perimeter fenced area, has been developed as a recreation area called Jubilee Park. The emphasis of use of Jubilee Park near the Landfill is for off-highway vehicle (OHV) use.

Site Entrance

Site access and security are in good condition and we have no recommendations for improvements.

## 1.4 Staffing/Organization

The PBSL is operated under the Canyon County Solid Waste Department. The Board of County Commissioners has the ultimate responsibility and decision-making authority for the Landfill. The Solid Waste Director reports to the Board and has the overall responsibility for the day-to-day operations of the landfill. The County has 24 employees for the landfill including the Director. The Director supervises three managers, including the Administrative Supervisor, Landfill Supervisor, and Code Enforcement Supervisor. The overall organization chart is included in Appendix 1-D.

The Administrative Supervisor oversees five employees including three full time Fee Collectors, a maintenance custodian, and the caretaker. The Administrative Supervisor also supervises two part time Fee Collectors. The Administrative section is generally responsible for record keeping, operating the scalehouses, collecting fees, invoicing, accounts receivable, payroll, human resources, and other accounting functions for the PBSL. Fee Collectors staff the scales and provide the first line of waste screening as well as directing traffic and collecting fees. With the four day per week, 10 hour per day (4 x 10) schedule the landfill needs three full time Fee Collectors and two part time Fee Collectors (2 for each day except 3 on Saturday so the upper scalehouse can be manned). Therefore, the Fee Collector staff is adequate and there are no recommendations for staffing changes.

The Landfill Supervisor oversees eleven employees including three hazardous waste screeners, seven heavy equipment operators, and one mechanic. Nearly all activities in the active landfill area are under the supervision of this section including waste screening, traffic control, waste compaction, soil excavation and cover, water truck operation, grading, and road maintenance. This group is also responsible for on-site equipment maintenance.

Hazardous waste screeners direct traffic at the active face and transfer station, and screen the loads for hazardous waste. They play a major role in safe operations, especially at the active face where interaction between heavy equipment and customers can occur. Two screeners are needed each day. With the 4 x 10 work schedule, three hazardous waste screeners are needed. Therefore, we recommend no changes to staffing for the hazardous waste screeners.

Equipment operators run the heavy excavation and compaction equipment including the landfill compactors, scrapers, front-end loader, water trucks, dozer, and roll-off truck. The landfill has 3 to 5 equipment operators on site each day in addition to the Landfill Supervisor. Three pieces of equipment are operated full time including the scraper, loader, and compactor. The other 1 or 2 operators run the other equipment including water trucks, grader, roll-off truck, fuel tender, dozer, etc. One equipment operator is also responsible for maintaining the tires of the equipment maintenance. The Landfill staff repairs and replaces all of the tires at the facility. This has saved the County a great deal of money compared to contracting with private tire repair services. At this time, the PBSL is properly staffed with equipment operators considering the extra duties they have, such as tire maintenance. If the County elects to implement Alternative Daily Cover (ADC) as discussed in Sections 1.9.5 and 1.10.4 this may result in the need for another equipment operator. We recommend the County track and review the activities of the equipment operators so that the staffing level can be regularly evaluated.

The County has one mechanic that is responsible for all regular maintenance and fueling at the facility. The County has included budget for the addition of another mechanic in the next fiscal year.

The Code Enforcement Supervisor oversees two employees. Code Enforcement employees enforce County's litter and covered load ordinances. They also supervise the inmate crew that does the majority of the litter picking.

Most employees work four 10-hour shifts per week. The June 2015 schedule is included in Appendix 1-D as an example of a typical schedule. The landfill has an adequate staff to run the landfill properly.

## 1.5 Waste Acceptance / Screening / Scale Operations / Traffic Control

Upper Scalehouse

The facility has two scalehouses through which all of the incoming waste is routed. The upper scalehouse has two 50-foot pit scales. The upper scale facility is used for commercial charge accounts. Customers key in their account number on the inbound scale. Once the account number is entered onto the keypad, the traffic control gate rises. All commercial account users know to travel to the upper deck of the active fill area. The customer returns to the outbound scale after dumping and keys in their account number to leave the facility, which actuates the traffic control gate. This scalehouse is completely automated when used in this fashion. The County does staff this scale occasionally on Saturdays to assist with handling public users and increase the throughput out of the facility. The County regularly has 600-700 customers on some Saturdays that are primarily paying customers instead of commercial haulers.

Lower Scalehouse

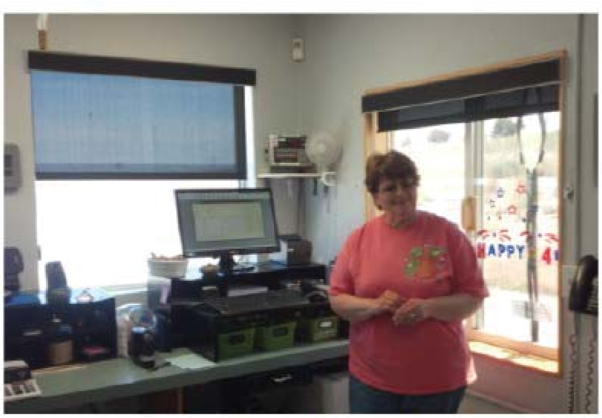
The lower scalehouse is used for all customers that do not have a charge account. This scalehouse is equipped with two, 70-foot pit scales and is staffed with two scale attendants that the County calls Fee Collectors. The Fee Collectors ask the customers where they live and the type of wastes they have. If someone is suspected to be out-of-County, the Fee Collector will ask for identification. Out of County wastes are charged double the current tonnage fee.

Customers with special wastes that the County diverts are directed to the appropriate area. Customers with municipal solid waste are directed to one of two areas. Customers with trailers or otherwise large loads are sent to the working face. Pick-up truckloads and other small loads are sent to the six bay roll-off transfer station.

The Fee Collector enters the gross weight of the vehicle into the scale software (WasteWorks) and the customer is given a laminated number placard corresponding to that transaction. When the customer leaves the site, they hand the account number placard back to the outbound Fee Collector. The Fee Collector enters the outbound weight into the scale software and the customer is billed on a per ton basis. The general fee for County residents is $14.50 a ton with a minimum transaction fee of $5.00 for 0-600 pounds. Owyhee County residents pay slightly higher fees than Canyon County residents do. A full breakdown of the landfill fee schedule is included in Appendix E. Other fees for Canyon County residents are as follows:

- $12.00/ton for clean wood wastes,
- $15.00 per unit for removal of Freon/oil from refrigeration units and other compressors, and
- $2.00 per passenger or light truck tire.

The current tipping fee of $14.50/ton is the lowest tipping fee for any facility that we have worked for in the region. Typical tipping fees for rural western landfills of similar size range from $25-$40/ton. The next lowest tipping fee in the region that we are aware of is the City of Billings, MT, which charges $18.50/ton. The PBSL is an enterprise account and all revenues are generated from tipping fees, interest and commodity sales. The County does not have a tax assessment for solid waste. The County does not have a Capital Improvements Plan (CIP) for equipment purchases and capital improvements projects at the landfill. We recommend the County develop a 5-10 year CIP for the landfill and establish reserve accounts for equipment and capital projects. This will help the County determine whether the current tipping fee is adequate to fund the operation in the long term.



Lower Scalehouse Outbound Interior

Two hazardous waste screeners are on site each day. One waste screener is assigned to the transfer site. The screener examines wastes as they are dumped for unacceptable wastes. The screener also helps the customer identify wastes that may be diverted and helps direct traffic around the transfer site. The other screener works at the bottom of the active face examining loads and directing traffic, which improves the safety in this area.


Special Waste Diversion Area

The County conducts random screening of waste loads at the active face. Hazardous waste handling and screening protocol and forms are documented within the O&M Manual (CCSW, 2012). Records of these inspections are kept on site.

## 1.6 Transfer Station

The transfer station consists of a six-bay, Z-wall that accommodates 20 cubic yard roll-off containers. Customers with smaller loads are directed to this area to dump which helps reduce the traffic at the active face. A retaining wall constructed of pre-cast concrete blocks provides the grade separation for dumping. The drop off is protected partially by a board system which prevents the customer from backing up too far and provides a surface for standing on while unloading into the container. The County uses one of the containers for diverting metal and another for diverting wood wastes. Once a container is full, the County uses its roll-off truck to haul the wastes to the active face. There is also a waste diversion area next to the transfer site which provides a drop off location for batteries, tires, e-waste, white goods and waste oil.

Roll-off Container Wall

The container bay arrangement for the transfer station does not meet the International Building Code (IBC) requirement 1013, which requires a 42-inch high guard barrier to protect the public from a drop off higher than 30 inches. Therefore, we recommend the County install a code-compliant 42-inch barrier along the top of the container wall. Barrier systems do sustain damage so it is advisable to add parking bumpers to prevent customers from backing into the barriers. Two alternatives for addressing the barrier requirement are: (1) to build up the surface that the containers sit on up to an elevation where the container itself provides the 42-inch barrier or (2) build up the container level, such that the drop off is less than 30 inches.

## 1.7 Fill and Cover Operations

The County typically runs a 15-20 foot high waste lift with a working slope of approximately 5:1. Public customers are directed to the lower level of the working face to dump. Commercial customers are directed to the top level of the lift to dump. The County uses a front-end loader to push waste from the tipping floor onto the active face. In the process, the loader helps keep the lower tipping floor deck clean of waste for the public. It also keeps the lower deck smoother because it does not tear it up like tracked equipment would. The top tipping deck is kept clean by periodically hauling soil into this area and grading the daily cover with the front-end loader. The County uses a 2013 John Deere 624K Loader. The County is in the process of purchasing a larger loader so that they will have a backup as they have for each other major piece of landfill equipment. The County uses its water trucks to periodically moisten both the bottom and top tipping decks, which allows the soil to be more cohesive and helps control dust.

Lower Deck Operations

The County has two waste compactors, a 2014 Aljon 525A and a 2010 Aljon 525J4. These machines are similar in weight and horsepower to a CAT 836 Compactor. The County typically runs only one compactor a day. Having a second compactor provides redundancy for breakdowns and scheduled maintenance. Both compactors are used on high tonnage days or when a large volume of waste comes into the facility in a short period of time. The compactor places and compacts waste perpendicular to the slope. According to staff, the compactor operates continuously during the workday.

Daily cover operations are performed by two scrapers; a 2014 CAT 623K and a 2010 CAT 623G. Daily and intermediate cover is obtained from the area southwest of the waste footprint shown on **Figure 1-1** (West Borrow Area). The County also borrows material from a gravel source immediately east of the waste footprint (East Borrow Area). Gravel is used to stabilize roads and operations areas on site.

Compactor from Lower Deck

Two hours before the end of the operational day, the staff starts placing daily cover on half of the exposed active waste face. The waste face is covered by running the scraper load down the compacted slope and dropping the load while moving down the active face. The goal is to place six inches of daily cover. However, the staff believe that they typically place more than six inches because of the loose, dry nature of the cover soil. In fact, the silts and sands that dominate the material are extremely dry and turn into a flour-like consistency when driven over repeatedly with heavy equipment. By starting to cover the active face earlier in the afternoon, the staff can complete the daily cover operations more quickly at the end of the day. The last load is taken at 5:30 pm and the operations crew generally completes their work at 6:00 pm.

After the first round of daily cover placement, the County has any construction and demolition (C&D) debris dumped in the area where the next day's waste will be placed. Idaho does not require that C&D waste be covered daily. This helps reduce the volume of waste that needs to be compacted and covered at the end of the day.

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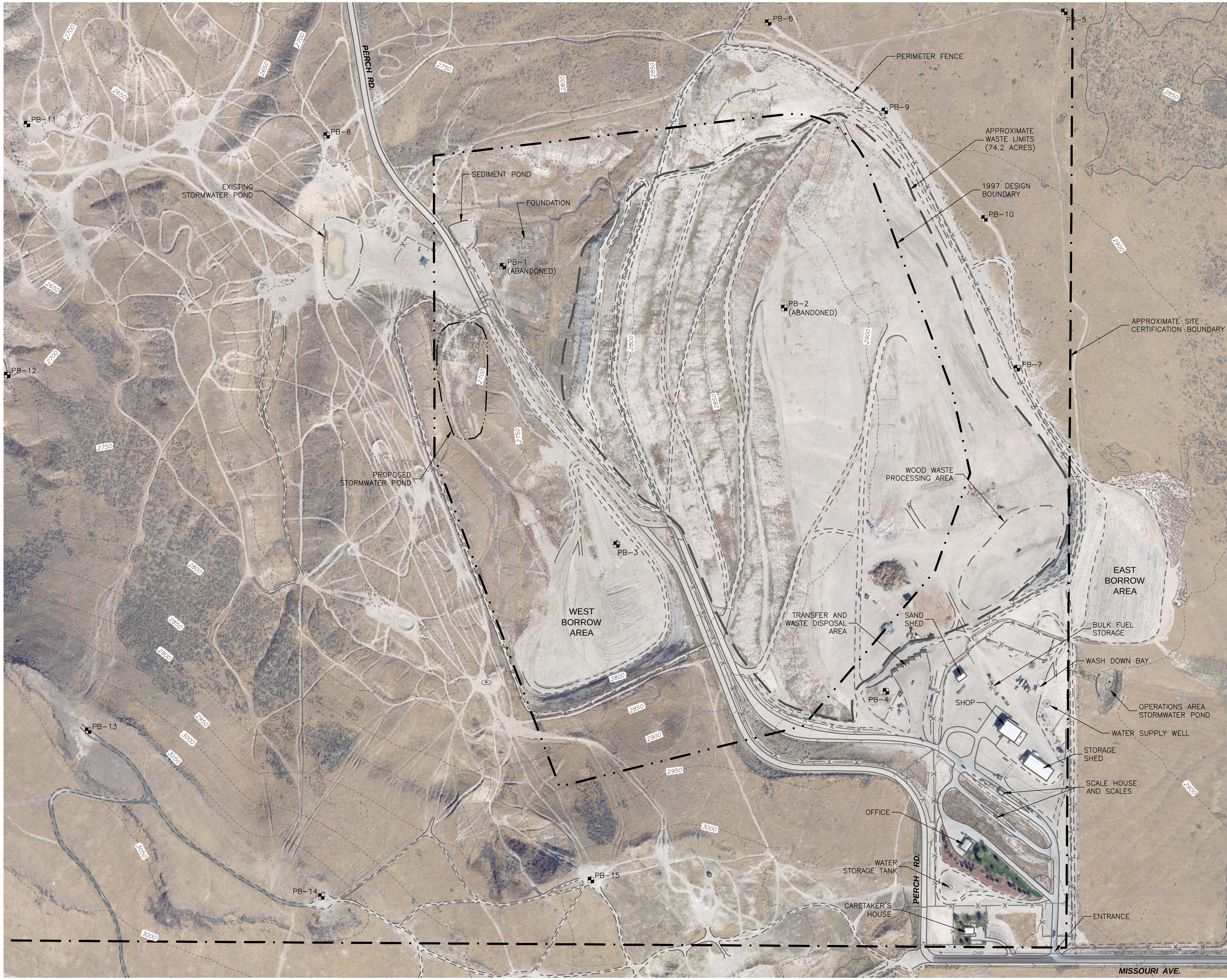


TOPOGRAPHIC INFORMATION PROVIDED BY MILLER CREEK AERIAL MAPPING DATED OCTOBER 4, 2014.

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SCALE IN FEET

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PROJECT: 1-15170
DESIGNED:
DRAWN: BAA
CHECKED: REC
APPROVED: REC
DATE: JULY 10, 2015

REGISTERED PROFESSIONAL ENGINEER 8901 STATE OF IDAHO ROBERT ERIC CHURCH

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# PICKLES BUTTE LANDFILL
# OPERATIONS ASSESSMENT
## EXISTING SITE PLAN

FIGURE NO.
**1-1**

## 1.8 Landfill Performance Evaluation

The County has conducted aerial photography and mapping of the facility on an annual basis for over a decade. We obtained surfaces from the 2013 and 2014 mapping efforts from Miller Creek Aerial Mapping so that a volume and performance evaluation could be completed. Miller Creek recommended that the 2013 surface be adjusted 0.5 feet downward because of an error during the translation of the data. Volumes were calculated with boundaries limited to the waste areas that received fill and borrow areas that had active excavation. This eliminated data scatter and resulted in accurate cut and fill volumes. The performance criteria volumes are based on the adjusted 2013 surface and the 2014 surface. **Table 1-3** summarizes the results of the evaluation.

**Table 1-3. Performance Evaluation Summary**

| Item | Amount |
|---|---|
| Tonnage Landfilled | 211,955 tons |
| Total Fill Volume | 363,225 CY |
| Western Borrow Area | 82,972 CY |
| Eastern Borrow Area | 29,975 CY |
| Total Borrow Soil | 112,947 CY |
| Waste Volume | 250,278 CY |
| Waste-to-Soil Ratio | 2.22:1 |
| Compacted Waste Density | 1,690 lb./CY |
| Volume Per Ton Ratio | 1.7 CY/Ton |

### 1.8.1 *Compacted Waste Density*

The compacted waste density for this time period was outstanding. The Aljon waste compactors are similar in weight (107,000 lbs.) and horsepower (540 hp) to a CAT 836 Compactor. The CAT Performance Manual (Appendix 1-F) lists the range of compacted waste densities for an 836 machine to be between 1,200 and 1,800 lb./cy with an average of 1,500 lb./cy. The PBSL compacted waste density exceeds the average by over 12%, which results in better utilization of the air space at the landfill.

### 1.8.2 *Waste-to-Soil Ratio*

The other factor that impacts landfill disposal performance is the waste-to-soil ratio. This is simply the volume of air space used for waste divided by the total volume of daily and intermediate soil cover used. The 2.22:1 waste to soil ratio indicates a very high usage of soil cover. In fact, 31% of the air space used over this time period was for soil cover. Landfills of similar size that use soil on a daily basis typically operate at a waste-to-soil ratio of 3:1 or higher. This indicates that the County should be able to operate with the use of significantly less cover soil at the facility, which would expand the life of the landfill.

The borrow material at the PBSL is very dry, non-cohesive, and does not effectively bridge over the waste. This is one reason that the operators are forced to use additional soil to obtain the six-inch minimum soil cover depth. The County has tried deploying daily cover by stockpiling soil at the top of the slope with the scraper and pushing it onto the slope with the dozer. This is a more typical approach in the industry. However, the County believes they actually use more soil with this technique because the tracked dozer works waste up through cover soil because it does not effectively bridge the waste. We agree that the County should continue to place daily cover with the scraper because of the soil properties at the site.

### 1.8.3 *Overall Performance/Volume Per Ton*

The overall landfill performance is evaluated based on the air space used per ton of waste disposed. This criteria is termed the volume per ton ratio and is the best performance measure because it factors in both compacted waste density and soil usage. The PBSL operated at 1.7 cy/ton over the evaluation time period. Industry standards typically recognize a volume per ton ratio of less than 2.0 cy/ton as good overall performance. However, if the PBSL reduced its soil usage the overall air space utilization could be improved. For example, if the PBSL maintained a 1,690 lbs./cy compacted waste density and achieved a waste to soil ratio of 5:1 the volume per ton ratio would improve to 1.4 cy/ton. This represents nearly a 20% improvement in air space efficiency.

### 1.8.4 *Value of Air Space*

The value of air space at facilities varies widely. Certainly, landfills with costly liners, leachate collection systems, and final covers place a high value on air space because of the capital investment required to construct the air space. With the PBSL's exemption from the lining system requirements and relatively low cost alternative final cover, we understand that the air space value is less at the PBSL than other facilities on a purely capital cost perspective.

The other factor that drives air space value is the remaining life of the facility. Landfills that have minimal remaining capacity will often value the air space based on the cost of licensing and constructing a new facility. Currently, PBSL has a large approved site certification area, and likely has many decades of landfill capacity available.

### 1.8.5 *Alternative Daily Cover*

Alternative daily cover (ADC) is commonly used nationwide as a replacement for meeting the six-inch daily soil cover requirements for landfills. The six-inch daily soil cover is required to control vectors and litter at the active face of the landfill. The two most common types of ADC utilized are tarps and spray-on products

The two primary drivers for the implementation of ADC include the more efficient use of air space and the reduction in heavy equipment time. Because of the large reserve capacity at PBSL and the exemption from liner installation, air space value is not a compelling argument for evaluating the use of ADC. However, we believe that the evaluation of ADC at the PBSL is warranted based on the reduction in heavy equipment hours and the associated cost savings. ADC alternatives are evaluated within the next section of the report.

## 1.9 Primary Heavy Equipment Analysis and Recommendations

An evaluation of the heavy equipment used at the landfill typically starts with an evaluation of the number of hours each type of equipment is used per day. **Table 1-4** summarizes hour usage on the primary pieces of equipment used in compaction and cover activities at the landfill. **Table 1-4** also includes Federal Emergency Management Agency (FEMA) equipment rates for the key pieces of heavy equipment (Appendix 1-G). The FEMA rate covers ownership and operation costs including depreciation, overhead, maintenance, and repairs. The FEMA rate does not include the cost of the operator. FEMA rates are commonly used by local governments and are significantly less than other rate books used by private contractors, such as Blue Book.

**Table 1-4. Heavy Equipment Hours and Operating Costs**

| Equipment Description | Time Period | Hours | Hours /Day | FEMA Equipment Hourly Rate | Equipment Cost/Day |
|---|---|---|---|---|---|
| 2014 Aljon 525 A Compactor | 03/2014-06/2015 | 2,841 | 7.5 | $225.00 | $1,687.50 |
| 2010 Aljon 525J4 Compactor | 03/2014-06/2015 | 1,266 | 3.3 | $225.00 | $742.50 |
| Total Compactor Time | 03/2014-06/2015 | 4,107 | 10.8 | $225.00 | $2,430.00 |
| 2014 Cat 623K Scraper | 10/2014-06/2015 | 1,349 | 6.6 | $130.00 | $858.00 |
| 2010 Cat 623G Scraper | 10/2014-06/2015 | 378 | 1.9 | $130.00 | $247.00 |
| Total Scraper Time | 10/2014-06/2015 | 1,727 | 8.5 | $130.00 | $1,105.00 |
| 2013 John Deere Loader | 05/2013-06/2015 | 6,194 | 9.7 | $52.00 | $504.40 |
| 2006 John Deere 1050C Dozer | 06/2006-06/2015 | 2,671 | 1 | $135.00 | $135.00 |

### 1.9.1 *Compactors*

As shown in **Table 1-4**, the PBSL runs a compactor full time on the site each day (10.8 hours/day). The CAT Performance Manual shows that an 836-equivalent compactor is capable of handling up to 1,000 tons/day (Appendix F). The PBSL averages nearly 700 tons/day and has days exceeding 1,000 tons/day. According to PBSL staff, the landfill peak days are 1,200 tons/day.

While the CAT Performance Manual rates the compactor production at 1,000 tons/day for an eight-hour day (125 tons/hour), this assumes that the operation has a tracked loader or dozer assisting the compactor by pushing loads into thin lifts prior to compaction. Theoretically, during an average day of 700 tons/day the compactor would only need to run 5.5 to 6 hours a day if it had assistance pushing loads. The County needs to run the compactors nearly 11 hours a day because the compactors are pushing the waste into place and compacting it. The only assistance is provided by the loader at the very top and bottom of the waste fill that pushes wastes from the tipping area onto the active face. If the County utilized a tracked dozer to push waste, the compactor hours could be reduced.

As shown in **Table 1-3**, PBSL has an excellent compacted waste density based on current procedures at PBSL. This is likely due to the additional compaction obtained by pushing the waste with a compactor versus pushing it with a tracked machine.

The industry standard for municipal landfills is to use tracked equipment for pushing waste (Appendix 1-F). Utilization of tracked machinery to push waste would reduce compactor hours and could reduce overall operations costs at the facility. The County would need to experiment with the number of hours required per day for the dozer to work in this role to determine whether this would result in efficiency improvements, particularly for the compacted waste density.

Even if the County elects to continue to push waste with the compactor there may be opportunities to reduce compactor hours during low tonnage months. For instance, the tonnage during the December-February time frame historically drops off to 500 tons/day or less than half of the production capacity of the Aljon compactors. We recommend that the County consider delaying initiation of compactor start-up operations in December-February until mid-morning and possibly consider closing the site an hour early during these three months. If the County reduced compactor hours by 3 hours per day over this 3-month period (225 hour/year) that alone could save the County over $50,000 per year.

### 1.9.2 *Loader*

As shown in **Table 1-4**, the PBSL runs the Loader full time on site each day (9.7 hours/day). The County is in the process of purchasing a second loader to serve as a backup. Use of a loader is not a typical approach for pushing waste at the active face of the landfill. The CAT Performance Manual (Appendix 1-F) recommends utilizing tracked equipment for pushing waste. In fact, most landfills nationwide use a tracked dozer to push waste and augment the compactor operation. We understand that the County uses a loader because it helps keeps the tipping decks clean. In addition, since it has rubber tires it does not tear up the tipping decks like a track mounted machine would. This approach works for the County, and there are some clear advantages even though it is not an industry standard.

One reason tracked machinery is used to push waste is that they are often needed so the compactor can keep up with the waste compaction. As discussed in the previous section, the landfill compactors are comfortably within their operating tonnage production rate, which allows time for the compactor to push waste. The effectiveness of the PBSL approach is proven by the outstanding compacted waste density the County is achieving. Therefore, a dozer is not needed to maintain the landfilling production rate at this site. The other reason for pushing with tracked equipment is that it can reduce the amount of time on the compactor. This would in turn increase time on the dozer. Therefore, if the County is interested in exploring pushing with tracked equipment, we recommend that a trial can be conducted to compare the effectiveness and costs of this method to the County's current method.

If the County stays with the current methods and the tonnage continues to increase, the County will eventually need to operate the second compactor more frequently to handle the waste volume.

The County is achieving good compaction results with the Loader/Compactor combination so we accept this as a suitable approach for landfill operation. However, the County may want to experiment with utilizing the dozer in an effort to reduce compactor hours. If the County elected to move to pushing with the dozer, the purchase of the second loader could be delayed.

### 1.9.3 *Tracked Dozer*

PBSL has a 2006 John Deere 1050C Crawler Dozer. The dozer is used sporadically for ripping in the borrow areas, pulling out stuck equipment, and miscellaneous site improvements projects. With the minimal hours placed on this piece of equipment it should continue to serve the County for many years to come. If the County elected to push waste with the dozer, this would dramatically increase the number of hours used per year on this equipment.

### 1.9.4 *Scrapers/Alternative Daily Cover (ADC)*

As shown in **Table 1-4**, the PBSL runs the scrapers nearly full time on site each day (8.5 hours/day). The paddle wheel scrapers work well for bulk excavation of the soil materials in the borrow areas. Occasionally the County does need to rip the borrow areas with the dozer when more consolidated material is encountered. Utilizing the scrapers to place daily cover material is an effective approach, but it does result in high soil usage. As discussed previously, the characteristics of the cover soil material drive this approach.

The biggest question is whether or not it would be more cost effective for the County to use ADC rather than daily soil cover. The PBSL currently runs at a 2.22:1 waste-to-soil ratio. Facilities of similar size that use ADC are typically able to achieve a waste-to-soil ratio of 5:1 to 6:1. **Table 1-5** compares annual scraper usage and operating costs under the current operation with an operation that utilizes ADC and obtains a 5:1 waste-to-soil ratio.

**Table 1-5. Equipment Comparison between Daily Soil Cover and Alternative Daily Cover**

| Cover Type | Waste to Soil Ratio | Annual Soil Volume (CY) | Annual Scraper Hours | FEMA Scraper Hourly Rate | Annual Scraper Costs |
|---|---|---|---|---|---|
| Current Daily Soil Cover Operations | 2.22:1 | 113,000 | 2,600 | $130 | $338,000 |
| Alternative Daily Cover | 5:1 | 50,000 | 1,150 | $130 | $149,500 |
| Annual Scraper Use Savings with Alternative Daily Cover | | | | | $188,500 |

**Table 1-5** indicates that the County could realize significant costs on the scraper by implementing ADC. Both spray-on ADCs and tarp systems are commonly used for landfills this size. The FEMA hourly rates in **Table 1-5** do not include operator labor.

With a spray-on ADC system, the County would purchase a trailer-mounted hydro-seeder and the spray-on products (TopCoat and Posi-Shell are the most common). The spray-on products take approximately one hour to mix, spray on, and clean the equipment. For labor costs, we used an estimated loaded labor rate of $35/hour. **Table 1-6** shows that the County could save approximately $150,000 per year by implementing a spray-on ADC system.

**Table 1-6. Estimated Annual Cost Savings Using a Spray-On ADC System**

| Item | Cost (Savings) |
|---|---|
| Spray-On Product | $75,000 |
| Sprayer Purchase ($50,000 spread over 10 years) | $5,000 |
| Spray-on Labor (1hr/day) | $10,700 |
| Labor Savings Scraper (1,450 hours) | -$50,800 |
| Equipment Savings Scraper | -$188,500 |
| Estimated Annual Savings | -$148,600 |

Another ADC option is a tarp system. A 100 foot x 100 foot tarp would be adequate to cover the current active face operated by the County. Deployment of the tarp includes utilizing a dozer to pull the tarp into place after the surface has been well compacted to reduce items which could protrude and damage the tarp. The tarp would need to be anchored with tires and/or soil on the leading edge facing the wind direction. The tarp would then need to be removed each day as well. As shown in **Table 1-7**, the tarp purchase is a small fraction of the overall costs for this alternative. **Table 1-7** shows that the County could save approximately $140,000 per year with a tarp system.

**Table 1-7. Estimated Annual Cost Savings Using a Tarp System**

| Item | Cost (Savings) |
|---|---|
| Tarps (1 per year) | $4,000 |
| Dozer Deployment and Removal of Tarp (1.5 hr./day – 459 hrs. x $135/hour) | $62,000 |
| Tarp Labor (3hr/day – Includes Dozer Operator plus helper 1.5 hour/day) | $32,000 |
| Tarp Repair Labor (40 hours/year – Sewing and Miscellaneous Repair) | $1,400 |
| Labor Savings Scraper (1,450 hours) | -$50,800 |
| Equipment Savings Scraper | -$188,500 |
| Estimated Annual Savings | -$140,000 |

Another alternative for ADC is to use tarp deployment equipment like a Tarpomatic, which is a framed mechanical tarp roller that is easily mounted to the front end of the compactor or dozer at the end of the day. The advantages of this system is that the tarps are rolled out and rolled in rather than dragged across the surface of the active face, which increases the life of the tarp to two years. In addition, the tarps are weighted to improve their performance in the wind. The tarp deployment and removal is also quicker with the Tarpomatic. The tarp dimensions are limited to 40 feet wide so the County would need 3 – 40 foot x 100 foot tarps. **Table 1-8** shows the County could save approximately $170,000 per year with a Tarpomatic system.

**Table 1-8. Estimated Annual Cost Savings Using a Tarpomatic System**

| Item | Cost (Savings) |
|---|---|
| Tarps (3 which need replacement every 2 years – 1.5 tarps per year) | $9,000 |
| Dozer Deployment and Removal of Tarps (1 hr./day – 306 hrs. x $135/hour) | $41,300 |
| Tarp Labor (1hr/day – Dozer Operator 1 hour/day) | $10,700 |
| Tarpomatic ($65,000 purchase with 15 year life - $4,300/year) | $4,300 |
| Tarpomatic and Tarp Repairs (80 hours/year) | $2,800 |
| Labor Savings Scraper (1,450 hours) | -$50,800 |
| Equipment Savings Scraper | -$188,500 |
| Estimated Annual Savings | -$171,200 |

There are advantages and disadvantages of each of these ADC systems that should be considered during the choice of an ADC system. As shown in the analysis, the annual cost savings of all three ADC systems are very similar. We recommend the County implement one of these ADC systems. We also recommend the County tour facilities that use each one of these alternatives before making a decision on the preferred ADC alternative for the Pickles Butte Sanitary Landfill.

## 1.10 Supplementary Equipment

The PBSL has an excellent complement of equipment needed to operate the landfill. The entire equipment list is included in Appendix G. Equipment includes:

- Two water trucks
- Vacuum truck

- Fuel tender/trailer
- Backhoe
- Magnetic Sweeper
- Roll-off Truck
- Motor grader
- Several pick-up trucks

All of this equipment is in relatively good condition and well maintained. This equipment provides all the capability the PBSL needs at this time.

## 1.11 Litter Control/Dust Control

The County has a covered waste load ordinance. It is enforced by three deputized officers who work as Code Enforcement for the Landfill. They cite customers for uncovered loads and littering. The Code Enforcement employees also supervise County Inmate crews that pick litter at the facility on nearly a daily basis. Code Enforcement also investigates illegal dumps in the County.

Litter control infrastructure consists of a 12-15 foot high woven-wire perimeter fence, which provides the primary control of windblown litter at the landfill perimeter. The County also uses smaller intermediate fencing within the landfill as well as portable litter screens to control litter to the working areas to extent possible. Finally, the County has a vacuum truck it uses for bulk litter pick-up on-site. The County litter control system is well organized and executed.

Water Truck From Top Deck

Dust control is limited to periodic watering of the primary access roads near the tipping area and the tipping area itself. Given the dry nature of the soils and the arid climate it would be difficult to expand dust control operations to the soil borrow areas. In our opinion, the current dust control operations are adequate because there are no neighbors within close proximity of the Landfill.

## 1.12 Special Wastes

Special Wastes and their handling are discussed in detail within the Operations and Maintenance Manual (CCSW, 2012). A few wastes of interest are discussed below. As discussed earlier, the County should investigate alternatives for increasing the amount of diverted waste.

### 1.12.1 *Asbestos*

The County has chosen to comply with the asbestos rules by stating that the entire waste footprint has asbestos rather than document the exact location of each load of asbestos via a legal survey. The O&M Manual describes the paperwork and acceptance criteria for asbestos-containing material in detail. This is an acceptable approach and there are no additional recommendations at this time.

### 1.12.2 *Clean Wood Waste*

Clean wood waste is directed to a separate area where a private contractor processes it. The Contractor grinds the waste and hauls it off site for $24.50/ton. This results in a significant amount of material diversion from the landfill. The tub grinder is located such that the danger from flying debris is minimized. This is an acceptable approach for diversion of wood wastes. A second option would be to consider using this material to help stabilize the final and intermediate cover slopes to help establish vegetation. A third option would be to incorporate this material with biosolids for composting, if the County elects to accept biosolids.

Wood Processing

### 1.12.3 *Tires*

The Landfill accepts tires and stockpiles them at a designated location. Tires are removed from the wheels, and the steel and aluminum wheels are recycled. Whole tires are placed in a trailer owned by a private contractor. When the trailer is full, the tires are taken away by the contractor whom the County pays $130/ton. Customers are charged by the tire to fund this disposal arrangement. Idaho law prevents the disposal of whole tires within the landfill. This is a reasonable approach for tire disposal and we have no recommendations.

Tire Recycling Area

### 1.12.4 *White Goods*

White goods are accepted by the County and stockpiled in a separate area on the landfill property. Once enough white goods are stockpiled, a private recycling vendor is brought in to crush the material and haul it away. The County staff removes Freon from appliances and sells it to a recycler. The County keeps the required Freon removal paperwork on site as required by law. This is an acceptable approach and we have no recommendations.

### 1.12.5 *Household Hazardous Waste*

The landfill does not have a household hazardous waste (HHW) collection program. The County does collect some used paint from customers. The County is budgeting $150,000 to conduct two household hazardous waste collection events for the next fiscal year. Long term the County may want to consider constructing a household hazardous waste collection facility on-site. The success and response to the HHW collection events will help the County decide if this is worthwhile.

## 1.13 Support Infrastructure

Support infrastructure consists of buildings, roads, and utilities. The original shop building and support complex was on the northwest portion of the property. This was abandoned in the mid-1990's. We understand that most of the current facilities, including the office, scale facilities, shop building, paved entrance roads, and equipment shed were constructed between 1995 and 1998.

This infrastructure is less than 20 years old and generally in good condition. A brief description of each element of infrastructure is discussed below.

### 1.13.1 *Office Building*

This building contains the Solid Waste Director, Code Enforcement Supervisor, and Administrative Supervisor's offices. It also houses all the landfill records. It has a meeting room and is in good condition. No improvements were identified for the short term for this building.

### 1.13.2 *Scalehouses*

The scalehouses are both in good condition. The County is replacing the transaction windows in the lower scalehouse with automated windows. The Fee Collectors struggle with keeping eye contact with the customers while they are entering data. Improving the transaction window area to accommodate the Fee Collector's workstations would be a significant improvement and would improve work efficiency.

The original scales are approximately twenty years old, so the County will need to look at replacement or major rehabilitation within 5 to 10 years, and include this effort in the CIP recommended in Section 6. The next time the scales are serviced, the County should request that the service company conduct a detailed inspection of each scale's condition and estimate the remaining service life.

### 1.13.3 *Shop Building*

The shop building has two equipment bays, restrooms, break area, locker room, and storage space. The equipment bays include overhead doors so that equipment can be brought in for servicing. One equipment bay is equipped with a rail system cast into the floor so that the compactor and dozer can be brought inside without significantly damaging the concrete floor. The County does all the regular preventive maintenance on its landfill equipment as well as repair work. It does not do major rebuild projects on the equipment. The County has the equipment required so that it can service its own tires. The work area is equipped with a 10-ton overhead crane. The building was designed so that another work bay could be added relatively easily. However, at this time County staff felt that two service bays were adequate for their needs.

Shop Building

A few deficiencies and wish list items were noted for the shop building as follows:

- The entire work bay area is serviced by one fan and louver. In hot weather, it is quite hot in the shop building, particularly when working with engines and welding equipment. The County should evaluate an enhanced cooling/fan system for the main shop working area, and incorporate into the CIP.
- The radiant heat system is marginal during the winter, and the County uses a significant amount of propane to keep the building heated. The County may want to evaluate a waste oil burner as an alternate heat source and whether the waste oil collected on site would provide an adequate amount of fuel. If viable, this could reduce the fuel costs to heat the building.
- Currently the shop is outfitted with bulk hydraulic oil stations with above ground storage tanks that range in size between 137 gallons to 240 gallons. The county has indicated that they plan to transition to 55 gallon drums to more efficiently service all the equipment on

site. Based on the oil storage capacity on site, the site may need a Spill Prevention and Control and Countermeasure (SPCC) plan as defined in 40 CFR 112 to be developed, which would provide guidance on whether or not secondary containment would be required.

- An outdoor plug-in station for equipment for use during cold weather operations was mentioned as a desired upgrade.

### 1.13.4 *Shed Building*

The shed building provides cold storage and houses the inmate work crew equipment. This building is in relatively good condition and no improvements are needed at this time. If the County needed more storage space, this building could be modified to be enclosed.

### 1.13.5 *Caretaker House*

The County owns a house south of the Office Building with its own access off Missouri Avenue. The caretaker provides off-hour security for the facility in exchange for reduced rent.

Bulk Fuel Station

### 1.13.6 *Bulk Fuel Station*

The site has a 6000-gallon diesel and a 1000-gallon gasoline double lined AST. The fuel tanks appear to be in good condition. An SPCC plan should be in place because the storage capacity is greater than 1320 gallons. The site may qualify as a Tier 1 facility and be eligible for self-certification because the total capacity at the site is less than 10,000 gallons. We recommend verifying that if a plan has been developed, that it is current (regulations require plans to be updated be updated every five years), and that it reflects current conditions at the facility.

Wash Down Bay

### 1.13.7 *Wash Down Bay*

The County has an outside wash down concrete bay with pressurized water for washing equipment. Wash down water run-off flows to a stormwater pond, which accommodates run-off from the operations support area. Because fuels, waste, and hydraulic oil run-off from this wash bay, we recommend the County install an oil/water separator prior to discharge to the stormwater pond.

### 1.13.8 *Water System*

The water supply is provided by a deep well located east of the Shop Building. The well fills a buried 40,000 gallon storage tank located immediately west of the Office building. This provides water for flushing, sinks, and showers. Bottled water is provided for employees to drink. The water supply also feeds a fire hydrant located near the Shop Building that can be used for fire suppression. The fire hydrant can deliver between 500 to 650 gpm depending on the static water level within the storage tank. There is also a septic tank/cistern located next to the main storage tank, which the County uses to water the lawn at the office. More information about the water system is provided within the O&M Manual.

The County does have public restrooms for customers. The water system is regulated as a non-community transient water system by the State of Idaho. As a result, the County is required to regularly test for nitrates and bacterial contamination of the water supply.

This system is working well and no improvements are needed at this time.

### 1.13.9 *Wastewater Systems*

Each building that has a bathroom, sink, and/or shower is equipped with its own septic tank and drainfield. The County has as-constructed records of the design and location of these facilities. This system is working well and no improvements are needed at this time.

## 1.14 Fill Plan

The approved fill plan for the Landfill is not well documented. The 1994 Design Report (Holladay, 1994a) includes a drawing of the waste design boundary and several cross sections that are difficult to interpret.

The waste design boundary shown in the 1994 Design Report has been modified by the actual operation. The 1994 boundary showed the southern and eastern limits being defined by the top ridgeline of three coulees. Since that time, the County has “rounded off” the eastern and southern boundaries with a footprint that is larger than that shown on the 1994 documents. This “rounded design boundary” is shown on Figure 10 of the 1997 Status Report (Holladay, 1998a), which was never submitted to the DEQ. This “rounded boundary” is similar to the current waste limit; however, the County has expanded the waste footprint significantly to the east as shown on **Figure 1-1**. The current waste limit covers 74.2 acres. The design boundary will need to be updated when the new fill plan is submitted to the DEQ. There is also concern that the eastern boundary of the waste limits may extend slightly past the site certification boundary. We recommend the County discuss this issue with DEQ staff to determine if any action needs to be taken on this issue.

As discussed earlier the County is constructing 15 to 20 foot high lifts. In recent history, the lifts have progressed from north to south. The crew grades each lift so that positive drainage is maintained across the top deck from east to west. Storm water control benches have been constructed every 20 to 40 feet of elevation along the western fill slope. The stormwater control benches direct water southward to a main run-off control ditch along the western limit of the waste. The benches also provide vehicle access.

Top Deck Looking Southeast toward Historic East Ridge

In the absence of a fill plan design, the County has developed a conceptual plan for the completion of the facility fill within the design boundary. A description of that plan follows. First, the County currently is placing the last full lift (15’-20’) within the southern third of the existing waste footprint. Once that lift is complete one more partial lift will placed on the waste footprint. The northern third of the current landfill top deck matches elevation of the historic eastern ridgeline. The Landfill Director does not want to place any additional waste in this area because the next lift would be visible from across the eastern boundary. This is a condition he wants to avoid or at least delay. This final lift would cover approximately two-thirds of the existing waste footprint and would be constructed to match the elevation of the historic ridgeline and avoid a direct line of sight to the east. For the purposes of discussion, this has been termed Phase 1.

Phase 2 would consist of filling a triangular area northwest of the existing fill footprint. This area is within the design boundary and represents a significant volume of waste disposal because of the overlapping air space created over the existing waste footprint. One reason the County wants to fill this area next is there is a large (approximately 60 feet high) historic waste slope that was constructed at approximately 1:1. Placing fill in this area would effectively buttress this waste slope. A cursory examination of the slope did not reveal any indications of recent slope movement or instability. However, the County does need to periodically repair erosion damage on this slope because of the extreme slope.

Phase 2/Historic Waste Slope

Phase 3 West Borrow Area

The Old Shop area was located in the Phase 2 footprint. The shop had a water supply well in this area (PB-1) which appears to have been properly abandoned (Appendix 1-H). We looked in the field to see if we could find the well but were unsuccessful. We were provided with a list of wells and coordinates including PB-1. We recommended that the County surveyor, if available, identify the well location on the ground and the County make sure that no excavation occurs in this area during the development of Phase 2.

Phase 3 would consist of filling the current soil borrow area in the southwest portion of the design boundary. This fill would provide significant overlap of the western portion of the existing waste footprint. With the completion of Phase 3, the existing design boundary's air space would be exhausted unless the County decided to fill again on the top deck and expose the site visually on the east side. The other argument for this approach is that it maximizes the amount of time that County can stay on the existing design boundary, which is where the perimeter fence is constructed. The County wants to maximize the length of time that the public can use the OHV area in Jubilee Park west of the fenced boundary.

As discussed previously, the County has conducted hydrogeologic investigations for future expansion of the landfill. Once we complete our estimates of remaining capacity and life under the conceptual lift design task we will make recommendations on when the County should pursue the design and submittal of the expansion area.

## 1.15 Stormwater Run-On/Run-Off Control

Typical Stormwater Bench/Equipment Road

Main Stormwater Ditch Repair

The site has essentially no run-on control; however, it is unnecessary for the most part. The justification is as follows. First the eastern waste boundary is being filled to match the historic ridgeline so all stormwater along this side drains to the east rather than onto the waste. The western side is filled above grade so run-on cannot happen on that side. The northern boundary drains primarily west so the potential for run-on here is quite minimal. The southern boundary does technically need run-on control, however once the current lift is extended to the fill boundary, the waste slope will effectively prevent run-on. Phases 2 and 3 will require the construction of run-on control.

Run-off control works as follows. The crew grades each lift so that positive drainage is maintained across the top deck from east to west. Storm water control benches have been constructed every 20 to 40 feet of elevation along the western fill slope. The stormwater control benches direct water southward to a main run-off control ditch along the western limit of the waste. The benches also provide vehicle access. The main stormwater ditch runs north/northwest to a small sedimentation pond. From there the water goes through a culvert to a large stormwater pond, which is located outside the fence in an area that has public access.

Existing Stormwater Pond

The stormwater pond has never discharged according to County staff. According to the design report documents, this facility was designed for total retention. The County does not have an Industrial Stormwater Discharge Permit or SWPPP. However, the County has constructed a new stormwater pond southeast of the current pond. The County would like to direct water to this pond because it is inside the fenced boundary and would eliminate the concern about motorcycle/ATV riders getting stuck in the pond. We agree that moving the stormwater facility inside the fence is a good idea. The County would keep the existing pond in case the new pond overfilled. This would provide additional capacity to avoid a stormwater discharge off the site.

At the time of our inspection, the County was repairing erosion damage to the main stormwater ditch. The sediment pond had filled in from the last event and needed to be cleaned out. The fill slopes and other minor run-off control ditches did not show any erosion damage except the large 1:1 slope referenced earlier.

There is also a smaller stormwater pond on the east side which controls run-off from the operational support area including shop building, wash down bay, and other support facilities. A detailed analysis of the adequacy of the existing storm water system is presented in Section 7 of this report.

New Stormwater Pond

## 1.16 Summary of Recommendations for Landfill Operations

The following is a summary of recommendations for the County developed in this report:

1) Update and resubmit the Operations and Maintenance Plan by December 2015.
2) Upgrade the transfer site to comply with International Building Code by installing a guard barrier or reducing the drop-off to less than 30 inches.
3) Run the compactor three hours less per day from December to February. This would be accomplished by delaying compactor start-up until mid-morning and closing the site one hour early. Annual cost savings from this measure are projected to be over $50,000/year.
4) Implement an ADC system and only place soil cover once a week. Annual cost savings are estimated to be approximately $130,000 to $170,000/year.
5) Consider conduct a waste characterization and diversion study in the long term.
6) Consider using processed wood waste for final and intermediate cover stabilization and vegetation. Also, consider using processed wood wastes for co-composting with biosolids.
7) Evaluate the condition of the scales and estimate their remaining service life.
8) Implement the five improvements for the shop building as discussed within this report
9) Improve the Fee Collector workstations for more efficient operation and communication with customers.
10) Install an oil/water separator for the wash down bay.
11) Verify that facility has up-to-date SPCC plan for bulk fuel storage.
12) Discuss potential infringement of the eastern site certification boundary with the DEQ to determine if any measures need to be undertaken to address this issue.
13) Develop a fill plan design for completing the existing waste design boundary and submit to DEQ for approval.
14) Obtain DEQ approval for diversion of stormwater run-off to the new stormwater detention pond.
15) Prepare a 5 to 10 year Capital Improvements Plan (CIP) for the landfill. The CIP would itemize major equipment and capital expenditures over the planning period and would be a valuable financial planning tool for the County in the future.

16) Establish equipment and capital reserve accounts (sinking funds) for future major expenditures identified in CIP.

## 1.17 Operations Assessment Conclusions

The Pickles Butte Sanitary Landfill is a well-operated and maintained facility. We compliment the landfill management and staff on the obvious care and attention to detail they provide. The site is very clean and is a tremendous asset to the residents of Canyon County. This public-owned facility provides low-cost, environmentally sound solid waste disposal to the residents. In addition, the County has shown excellent planning and forward thinking with the purchase of surrounding property and site certification of a large boundary. This additional property insures the public-owned facility will remain a valuable asset to Canyon County for many decades to come.

## 1.18 Personnel Interviewed

1) David Loper, Landfill Director
2) Rick Boyd, Landfill Supervisor
3) Debbie Jenks, Administrative Supervisor
4) Kirk McGee, Mechanic
5) Fee Collectors (Scalehouse attendants) several

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# 2.0 GROUNDWATER EVALUATION

The purpose of the groundwater evaluation presented in this section of the report is to review the geology, stratigraphy, groundwater flow characteristics, groundwater composition, and groundwater sampling program around and beneath the Pickles Butte Sanitary Landfill (referred to as PBSL or “the Landfill”). Groundwater at the Landfill has a unique chemistry and is greater than 400 feet deep. The potential for impacts to groundwater from the Landfill are low because of the depth to groundwater and the geologic stratigraphy. Canyon County has been granted a waiver for conducting groundwater monitoring at the Landfill, but elects to conduct semi-annual monitoring on a voluntary basis. Metals at concentrations above the laboratory detection limits have been observed, the county wishes to establish background concentrations at the site. Groundwater sampling reports and previous studies have been reviewed, and where appropriate, groundwater data have been put into electronic form for analysis.

## 2.1 Previous Investigations

Two previous studies researched and investigated the geology, stratigraphy, and groundwater flow characteristics near to and beneath the Landfill. The first of these was conducted by Holladay Engineering Company (Holladay) beginning in 1992. The results are summarized in a report titled *Hydrogeologic Characterization, Ground Water Monitoring Plan, and Facility Design, Pickles Butte Sanitary Landfill* (Holladay, 1994a). This report was the initial status report for the Landfill, and was commissioned by Canyon County for the Landfill to comply with Title 39, Chapter 74 of the Idaho Solid Waste Facility Act.

The second primary investigation to study subsurface conditions was conducted by Daniel B. Stephens & Associates, (DBS&A) beginning in 2011. The results were summarized in two reports: *Hydrogeologic Characterization Report, Pickles Butte Sanitary Landfill* (DBS&A, 2014a), and *Monitor Well Installation, Pickles Butte Sanitary Landfill* (DBS&A, 2014b). The Holladay and DBS&A reports have been reviewed to assess the current groundwater monitoring program relative to known groundwater conditions, area geology, and stratigraphy. A brief summary of the work conducted and findings from the previous investigations is presented below, along with recommendations where appropriate.

### 2.1.1 *Holladay Engineering Company Investigation*

The investigations by Holladay were conducted between 1992 and 1994. Subsurface activities included excavating trenches to identity a potential fault zone, drilling one boring using core drilling to collect continuous samples (designated PB-2), drilling six rotary borings (designated PB-3 through PB-8), installing one piezometer, installing six monitoring wells, conducting geophysical logging of an existing well and at three of the drilling locations, and conducting methane monitoring. Their investigation also included collecting numerous soil/core samples for the testing of various physical parameters. Holladay installed two additional monitoring wells (PB-9 and PB-10) in 1995.

### 2.1.2 *DBS&A Investigation*

The field investigation by DBS&A was conducted between May and December 2011. Their subsurface activities included installing five additional monitoring wells (designated PB-11 through PB-15). They also submitted over 50 core samples for testing of various physical parameters and/or hydraulic properties.

## 2.2 Geology

### 2.2.1 *Area Geology*

The regional geology of the Canyon County area is briefly described here to provide a basic framework for the stratigraphy discussed in the next section. The reports described above can be referenced for more thorough descriptions of area geology.

The Pickles Butte area of Canyon County is located in the western portion of the Snake River Plain. The Snake River Plain is a broad structural depression that extends across southern Idaho. The axis of the western Snake River Plain is oriented in a northwesterly/southeasterly direction; this part of the Plain is about 35 miles wide and is bounded on the northeast and southwest by a series of northwest-trending normal faults. Through this series of faults, the center of the basin dropped relative to the margins by several thousand feet. Some downwarping may have also occurred that contributed to the structural depression (Swirydczuk, et. al., 1982). The shape of the basin can be described as arcuate, or arc shaped, when viewed in both cross section and plan views. The Landfill is located near the center of the plain.

The basin or depression created by the faulting has been filled over the past several million years by igneous rocks, lacustrine (lake deposited) and fluvial (river deposited) sediments, to depths of possibly greater than 20,000 feet (Mabey, 1982). Most notable among the more recent sedimentary materials that have filled the basin are those belonging to the Idaho Group, chiefly the Glenns Ferry Formation. The sediments that comprise the Glenns Ferry Formation mainly include sand, silt, and clay deposited in lacustrine and deltaic environments. Several ash layers have also been identified with the Glenns Ferry Formation (Swirydczuk, et. al., 1981). The Glenns Ferry Formation near the Landfill area may be over 2000 feet thick (IDWR, 1981).

Younger sedimentary and igneous materials of the Idaho Group have been deposited in the plain above the Glenns Ferry Formation. Geologic mapping by Anderson and Wood (in IDWR, 1981) identified two formations near the Landfill that are present above the Glenns Ferry Formation: the Tuana Gravels and the Bruneau Formation. The Tuana Gravels are mostly poorly sorted and coarse grained, with cobbles up to several inches in diameter. These coarser grained sediments are interbedded with finer grained layers of sand and silt. The Bruneau Formation is predominantly fine-grained sediments interbedded with basalt flows.

### 2.2.2 *Stratigraphy*

Subsurface investigation activities were not conducted for this report. The descriptions of the geologic conditions located at and beneath the Landfill that are presented below are taken from the work conducted by Holladay and DBS&A as described in their 1994 and 2014 reports.

A relatively thin layer of basalt belonging to the Bruneau Formation is present on the top of Pickles Butte and on parts of the upper rim of Deadhorse Canyon north of the Landfill. Available information does not indicate that this material is present within the boundaries of the Landfill. It appears that only boring PB-13, drilled on Pickles Butte in the area southeast of the active Landfill, encountered this material. The basalt overlies sand and gravel of the Tuana Gravel formation. According to the DBS&A report (2014a), the Tuana Gravel is present at the Landfill area only on the upper part of Pickles Butte and in the northeastern rim of Deadhorse Canyon. It was encountered during the drilling of borings PB-13, PB-14, and PB-15. These three borings were drilled in the area near the southern edge of the active Landfill, in an area where the natural topographic surface is higher than in other areas of the project. The observation of the limited spatial presence the Tuana Gravel in the project area is generally consistent with the geologic map produced by Anderson and Wood (in IDWR, 1981). That map shows that Tuana Gravels are near the southern boundary of the active Landfill, but that the contact is uncertain. The map also shows that they are also present in the eastern part of the active Landfill.

Upper (younger) Glenns Ferry Formation soils are the majority of geologic materials exposed on Pickles Butte and in the walls of Deadhorse Canyon to the north. The Glenns Ferry Formation extends beneath the Landfill beyond the total depths explored by Holladay and DBS&A. Information gathered during their drilling indicates that the textural composition and physical properties of the Glenns Ferry Formation vary with depth. In general, the material becomes finer grained and more consolidated or indurated with increasing depth. The properties also vary laterally, and the Holladay report mentioned that the lithification in correlating beds was seen to vary between borings.

The upper part of the Glenns Ferry Formation encountered in the borings is comprised primarily of sand and silt. DBS&A described the sand beds as ranging from poorly to well sorted, from very fine grained to coarse-grained, and having little or no consolidated structure to a well-lithified sandstone. The grain size of the upper Glenns Ferry Formation tends to decrease with depth, and in the lower depths explored the Glenns Ferry Formation consists primarily of siltstone or claystone.

A laterally extensive confining layer in the Glenns Ferry Formation is present beneath the Landfill at depths ranging from 150 to 500 feet. DBS&A describes the change between the confining layer and the sediments above it as “abrupt,” therefore its presence across the area is well defined. This layer is usually described as a siltstone or claystone on the lithologic logs. Contained within this layer is a boundary at which the sediments below were deposited in an anoxic or oxygen deficient state. This condition gives them a characteristic blue green or blue grey color. This distinguishing characteristic is easily seen, so the layer is often referred to as the “blue clay,” and can be identified on boring logs and traced laterally across the entire Landfill area.

The confining layer is hundreds of feet thick as evidenced by observation and core samples from the Holladay and DBS&A investigations. The confining layer slopes or dips to the northeast with a gradient of about 0.06 foot per foot.

The saturated hydraulic conductivity ($K_{sat}$)of the confining layer ranges from about $10^{-4}$ to $10^{-9}$ centimeters per second (cm/sec) based on testing conducted on core samples collected during the Holladay investigation,. Core samples were also collected during the DBS&A investigation; $K_{sat}$ values averaged about $4x10^{-8}$ cm/sec, with a range from about $10^{-4}$ to $10^{-9}$ cm/sec. Movement of groundwater through the confining layer is thus interpreted to be very slow.

### 2.2.3 *Methane*

Holladay conducted limited methane monitoring during their investigation using field screening techniques. They reported that during drilling; only location PB-5 yielded a detectable amount of methane, and this was after the boring had advanced into the clay unit at 620 feet deep. The recorded value was 21% of the lower explosive limit (LEL). They further reported that methane was detected within the casing of monitoring well PB-3 after it had been capped for months. Two readings specifically mentioned were 11% LEL and 44% LEL. Their interpretation was that the methane was naturally occurring based on the lithology and depth of the well screens in relation to the Landfill. This is supported by a study conducted by Idaho National Laboratory for the city of Marsing, Idaho on how to capture and utilize the naturally occurring methane found in the city’s groundwater wells (Orme, et. al., 2012). The city of Marsing is located approximately seven miles northwest of the landfill, and is in a geologically similar area. The concentration of methane in the wells in Marsing varied between 0.2% to 95% methane, with an average methane concentration from six wells of 49%. In the DBS&A report, it indicated that abundant organic matter was present in the fine-grained sediments at depth, which “results in a detectable amount of natural methane production.” Therefore, based on the local geology and correlation of methane with sediments at the site, the methane at the site is predominately from naturally occurring sources. Tetra Tech recommends that the groundwater monitoring caps at the site be modified or replaced to allow the methane to naturally vent for several reasons. First, this would increase the safety at the site during routine groundwater monitoring, since the wells would not be opened under positive pressure. Second, if landfill gas ever does enter the well it would be better not to have the well under positive pressure, which would increase the chance of the landfill gas influencing groundwater. Finally, this would eliminate the need to monitor methane during groundwater sampling, and help prevent confusion between the natural methane production and potential methane production from the landfill.

### 2.2.4 *Groundwater Conditions*

Groundwater conditions across the Landfill area are somewhat variable. Holladay identified three water bearing zones during a literature review and their investigation, and referred to them as UA, MA, and BA, for Upper Aquifer, Middle Aquifer, and Bottom Aquifer. It should be noted that while these names may correspond to subsurface intervals that produce water, they are not necessarily to be considered aquifers because of low production rates or quality concerns. DBS&A acknowledged the naming convention used by Holladay, and used similar reference names in their 2014 report (uppermost-unconfined aquifer or unconfined aquifer, middle confined aquifer, or confined aquifer, and bottom aquifer). As with the site stratigraphy, a field investigation to study groundwater conditions was not conducted for this report. Instead, the information presented here has been gleaned from the Holladay and DBS&A reports.

Both reports indicated that monitoring wells were screened to characterize the first groundwater encountered at each location. The uppermost aquifer or upper unconfined aquifer was characterized at Holladay monitoring wells PB-5, PB-6, PB-7, PB-9, and PB-10. This water bearing zone is not present beneath the entire Landfill area; it is limited to the area at the northeast corner of the active Landfill and certification area. The wells set in this zone encountered water between about 490 to 535 feet deep, or between elevations of about 2330 and 2400 feet above mean sea level. The saturated thickness of sediments within the unconfined aquifer is on the order of tens of feet, with groundwater present at depths ranging from about 500 to 550 feet deep. These depths increased about eight to ten feet between 1995 and 2015. Groundwater flows to the northeast with a hydraulic gradient that is similar to the slope of the top of the confining layer (DBS&A, 2014a).

The southwestern boundary of the unconfined system appears to coincide with the approximate location of a possible northwest trending fault system that runs through the northeastern part of the Landfill, as shown on the geologic map from Anderson and Wood (in IDWR, 1981). This spatial relationship may only be coincidental; however, as neither the Holladay nor DBS&A investigations were able to provide geologic evidence that the fault system provides a barrier to groundwater flow or a source of groundwater in the unconfined system (DBS&A, 2014a). The Holladay investigation included excavating three trenches six to ten feet deep, and 150 to 200 feet long to look for evidence of concealed faulting. They reported that no evidence of faulting beneath the overburden materials was seen (Holladay, 1994a).

The confined aquifer is located within the blue clay unit and appears to underlie the entire Landfill. It is characterized by Holladay wells PB-3, PB-4, PB-8 and by DBS&A wells PB-11 through PB-15. The depth to the water bearing zone ranges from over 300 feet to almost 900 feet. Observations during the investigation indicated that water within the confining layer is present in deeper fractures within that unit. DBS&A's interpretation was that the material is more indurated with depth and can support open fractures, while the shallower parts of it are more plastic and not able to support open fractures (DBS&A, 2014a). **Table 2-1** includes well completion and basic stratigraphic information.

**Table 2-1. Summary of Monitoring Well Information**

| Well Number | Groundwater Source | Screened Interval(s) | Depth to Top of Confining Layer | Total Depth Drilled | Depth First Water Encountered | Depth to Potentiometric Surface* (April 2015) |
|---|---|---|---|---|---|---|
| PB-3 | Glenns Ferry Fm - Confining Layer | 340-350, 410-420, 520-530 | 263 | 860 | 410 | 418.65 |
| PB-4 | Glenns Ferry Fm - Confining Layer | 560 - 575, 605 - 620 | 422 | 640 | 565 - 630 | 557.48 |
| PB-5 | Tuana Gravel | 512.5 - 522.5 | 630 | 660 | 517 | Dry |
| PB-6 | Tuana Gravel | 487.5 - 497.5 | 620 | 700 | 490 | 504.87 |
| PB-7 | Tuana Gravel | 535 - 555 | 540 | 610 | 535 | 547.46 |
| PB-8 | Glenns Ferry Fm - Confining Layer | 377 - 407 | 240 | 420 | 380 | 290.27 |
| PB-9 | Tuana Gravel | 508 - 543 | 510** | 544 | Unknown | 525.55 |
| PB-10 | Tuana Gravel | 504 - 534 | 515** | 560 | Unknown | 522.1 |
| PB-11 | Glenns Ferry Fm - Confining Layer | 340 - 400 | 200 | 420 | 350 - 400 | 293.69 |
| PB-12 | Glenns Ferry Fm - Confining Layer | 480 - 540 | 140 | 555 | 500 - 560 | 309.58 |
| PB-13 | Glenns Ferry Fm - Confining Layer | 840 - 900 | 545 | 923 | 850 - 900 | 733.55 |
| PB-14 | Glenns Ferry Fm - Confining Layer | 845 - 905 | 522 | 923 | 800 - 840 | 717.56 |
| PB-15 | Glenns Ferry Fm - Confining Layer | 790 - 850 | 565 | 870 | 800 - 860 | 657.85 |

Measurements are in feet and referenced to ground surface except as noted
*Referenced to top of casing, typically about 2 feet higher than ground surface
**Based on interpretation from driller's log

### 2.2.5 *Areas of Potential Recharge*

#### *2.2.5.1 Recharge Zones*

The Holladay investigation examined the upper unconfined and the lower confined aquifer to determine if there was any surface connection to the aquifers at the site. The unconfined aquifer only exists in the northeastern corner of the site. The report indicates that the yield from that area was low (less than 1 gpm) and had no beneficial use. Therefore, they questioned whether it was even a viable aquifer. For the confined aquifer that is found below most or all of the site, they found that the aquifer appears to be partially supplied by deep geothermally based water of remote origin. The water is under positive pressure head, and is protected by the lateral and vertical continuity of the confining bed across the site. This confining layer is hundreds of feet thick. They also evaluated the potential for a northwesterly fault for providing a preferential pathway from the surface to groundwater. However, based on the higher permeability soils in the overlying sediments and the deformation that would occur in the soft soils due to lithostatic load, it was concluded that the faults or fractures would close at depth. Therefore based on the information available, it is not likely that there is any connection between the site's surface and the confined aquifer. Based on the data available, it is more likely that there is not a connection.

The 2014 DBS&A study had similar conclusions about recharge to the confined aquifer, and noted that the confining layer at the site occurs on a regional basis and exerts a strong influence on groundwater movement. They also discuss the unconfined aquifer, and note that the water is chemically different from the confined aquifer. They postulated that percolation of irrigation water from irrigated agriculture to the east and north of the Landfill may have created the aquifer, but this has not been confirmed.

#### *2.2.5.2 Infiltration Studies*

Infiltration studies were done for the site by Holladay in 1994 and DBS&A in 2014 to be in compliance with Title 39, Chapter 74 of the Idaho Code, and to apply for an exemption for groundwater monitoring under 40 CFR 258.50 and a liner under 40 CFR Section 258.40(d). These sections of the Code allow for the exemption of groundwater monitoring or a liner when there is no potential for migration of hazardous constituents from the municipal solid waste landfill (MSWLF) to the uppermost aquifer during the life of the Landfill and post-closure care. In the initial study conducted by Holladay (2014a), they calculated the travel time based on hydraulic conductivity rates assuming *saturated* conditions (which is very conservative for an arid environment), and using the EPA's Hydrologic Evaluation of Landfill Performance (HELP) model. Both calculations were based on laboratory data analyzed for 11 core samples collected during the subsurface investigation. For the stratigraphy in wells PB-2 through PB-8 the saturated travel times were 495, 12376, 753, 30, 31, 184, and 505 years, respectively. These values are quite conservative for this site because based on the *unsaturated* conductivity travel times would be one to five orders of magnitude longer. The HELP model was then used to calculate the specific moisture capacity to look at the time required for water to be retained in the formation. Evaluating how long it takes to increase the moisture to allow water to flow through the system provides an estimate of the time required before the calculated travel times would start. The range of values for PB-3 to PB-8 was 936, 1134, 1648, 1312, 2149, and 1796 years, respectively. Therefore, even for the wells where the saturated travel times were less than 100 years, the time required for migration is well over 1000 years, which exceeds the operational life of the Landfill. The analysis concluded that the Landfill would not generate significant leachate during the active life or post-closure at the site.

The infiltration study by DBS&A used saturated travel time calculations, the HELP model, and the HYDRUS model to estimate unsaturated fluxes based on Richards equation. The results were similar to those presented by Holladay. The analysis was based on hydraulic properties from core samples collected during the installation of PB-11 through PB-15, which are located in an area proposed for expansion of the Landfill and are deeper than the previous wells at the site. Multiple samples were taken from each stratigraphic unit, and the harmonic mean of the values was used in the modeling to help account for heterogeneity and variability within each unit. For PB-11 to PB-15, the saturated travel time to the first groundwater was 19,456; 42,071; 3,875; 12,923; and 5,075 years, respectively.

The HELP modeling looked at both the flow of leachate to the bottom of the landfill without a cover and the infiltration to groundwater. For the first set of simulations, percolation through the bottom of the Landfill was estimated to be $1.19 \times 10^{-8}$ in/year, which is essentially zero. This reflects the dry conditions at the Landfill, the loss of moisture due to evaporation, and the storage capacity within the Landfill for precipitation not lost to evaporation. In the simulations, water retained in the Landfill caused the water content at 100 years of simulation to increase from 9.83% to 12.31%. The field capacity of the site, which indicates when saturated flow would occur, is calculated to be 29.20% by volume. At the rate of moisture accumulation estimated by the HELP model it would take approximately 700 years before field capacity is reached and percolation into the vadose zone would begin. The model then estimated it would take approximately 7,255 years to reach groundwater.

The analysis by the HYDRUS model provides the most realistic calculations of infiltration to the site because it uses unsaturated water flow. The modeling considered vapor flow in the system, but the results indicated it did not significantly impact the results, so the more conservative analysis without vapor flow was presented. The modeling of the field capacity within the Landfill indicated that it would take 200 years to reach field capacity. This is conservative because the modeling used an average precipitation value repeated each year for 100 years versus a more realistic cycle of wet and dry years. The calculation of travel time through the vadose zone with HYDRUS was approximately 52,040 years, which is significantly longer then the HELP model because of the differences in model assumptions. The HELP model uses a linear interpolation between field capacity and wilting point, which overestimates percolation rates versus the more rigorous use of the Richard's equation. The results from the HYDRUS model are more realistic for the vadose zone flow through the system, and support the previous conclusions by Holladay that the risk to groundwater from the Landfill is very low if not zero.

### 2.2.6 *Geochemical Composition*

Groundwater characterized for this project is present within the Glenns Ferry Formation. Although primarily sedimentary by nature, several ash layers have been identified within it at other locations (Swirydczuk, et. al., 1981), and the parent material for the sediments may have been older igneous rocks that partially filled the Western Snake River Plain basin. The chemical composition of the sediments therefore can include many of the elements associated with igneous rocks, including metals. Chemical composition of the ash layers within the Glenns Ferry Formation was studied by Swirydczuk and others. This included several metals though only two of the RCRA metals were included (barium and chromium). The results showed that the ash samples did have an abundance of metals. In addition, as discussed above, a source for the deeper groundwater may be a geothermal system. Geothermal waters often contain high concentrations of metals, including arsenic, because of their interaction with igneous rocks. The presence of metals in groundwater samples collected from monitoring wells at the Landfill likely represents a natural occurrence of those elements, rather than impacts from the Landfill. It is not uncommon for groundwater in southern Idaho within sedimentary aquifers to contain concentrations of metals (non-anthropogenic), at some cases above EPA drinking water standards.

## 2.3 Groundwater Sampling

Although exempt from groundwater sampling per 40 CFR 258.50, Canyon County has maintained a biannual groundwater-sampling program at PBSL. **Figure 2-1** shows the location of wells relative to the footprint of the Landfill. Wells PB-3 through PB-15 are sampled biannually by Landfill personnel, if water is present, and analyzed for constituents listed in Appendix I of 40 CFR 258. The testing includes measuring various geochemical parameters in the field, laboratory analysis for metal using EPA methods 200.7 through 200.11, and laboratory analysis for volatile organic compounds (VOCs) by EPA method 8260B.

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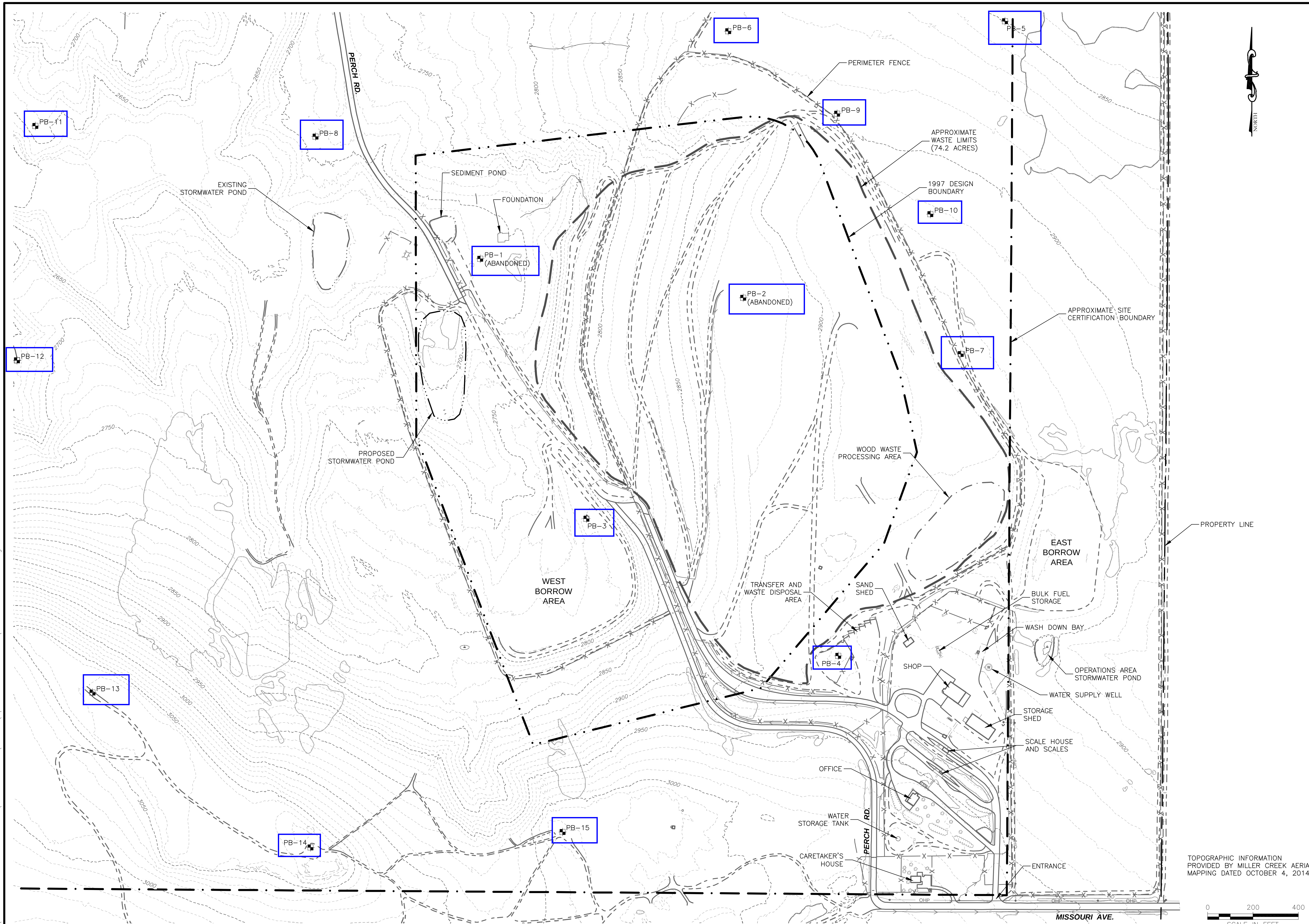


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DESIGNED:
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CHECKED: REC
APPROVED: REC
DATE: JULY 10, 2015

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PICKLES BUTTE LANDFILL
OPERATIONS ASSESSMENT
SITE PLAN / MONITORING WELL LOCATION MAP

FIGURE NO.
2-1

### 2.3.1 *Groundwater Sampling Procedure*

Holladay prepared a groundwater-sampling plan in 1994 to guide sampling activities at the Landfill (Holladay, 1994b). The plan includes the procedure for taking water level measurements, field parameters, well purging, sampling, and decontamination. As written, the procedure calls for purging a specified amount of stagnant water before sampling the well using dedicated stainless steel bailers that are raised and lowered into the well. There is no indication in the procedure how the purged water is disposed, so it is assumed it is spread on the surface and that there is no disposal cost associated with the purged water. There is no depth specified for sampling in the method. Groundwater sampling was initially done with hand-lowered bailers, which at some point was modified to lower the bailers from a truck, which is how sampling is currently conducted. Because of the use of dedicated bailers, standard decontamination was not required before and after each sampling event. Instead, decontamination was limited to rinsing the bailers with deionized water only if required because of obvious contamination. At some point, the sampling procedure was modified to collect the groundwater sample from the first bailer placed in the well. Based on plots of total dissolved solids (**Figure 2-2**), it appears that the change occurred in October 2003 because the TDS values stabilized from that point onward. The use of bailers can disturb the fine sediments that collect on the bottom of a well, which can cause the variations in TDS observed in the early years of sampling. The analysis of the sampling data for this report used the data from October 2003 and later. Under the current procedures, the wells are bailed after sampling to help flush the stagnant water out of the well. It is not clear when the field parameters are collected during this procedure.

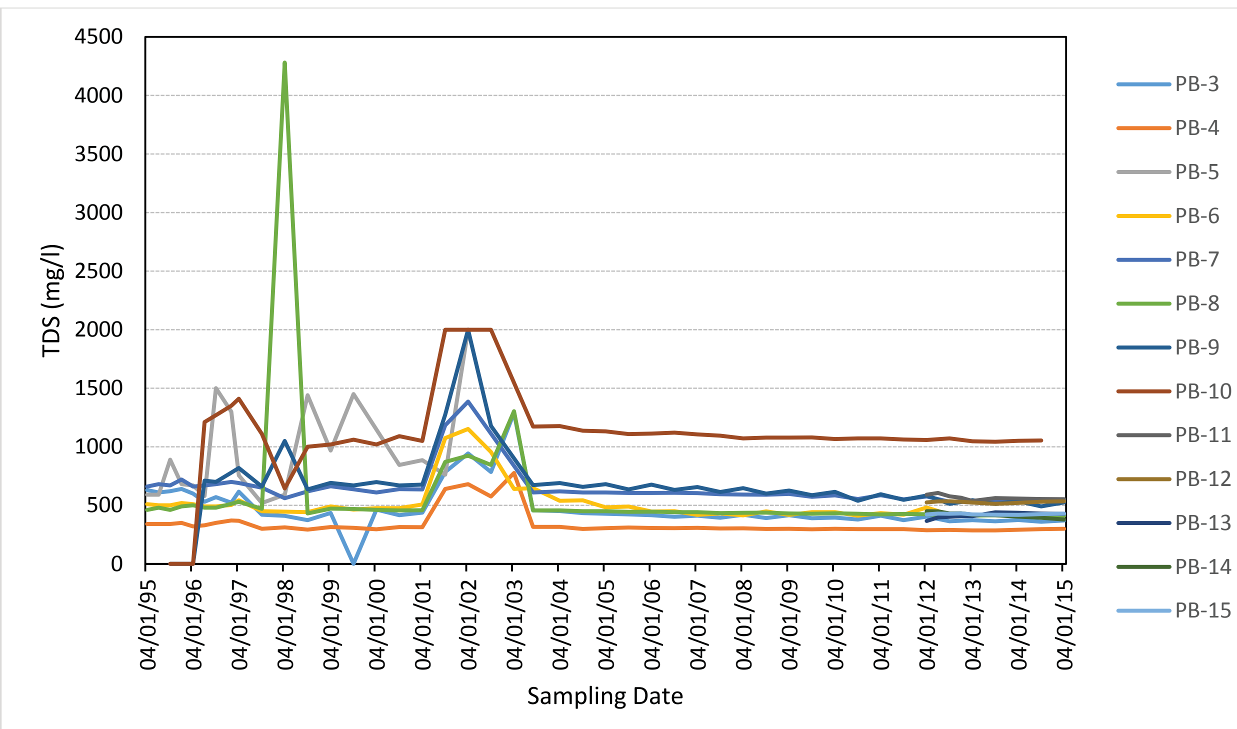


**Figure 2-2. Effect of change in sampling method on turbidity in wells**

At a minimum the sampling procedure for PBSL should be updated to reflect the actual sampling procedure used at the site. However, the current sampling procedure is not considered standard practice for sampling monitoring wells to reflect aquifer conditions. There are two options for sampling available. The first option is to continue the use of the bailers for sampling, but to implement several steps to improve sample integrity. The first step is to clean/decontaminate the sampling equipment prior to use, including a wash with Liquinox™ or a similar detergent, a water rinse, a 10% volumetric methanol and distilled water rinse, a 10% volumetric nitric acid rinse, followed by a final deionized water rinse. This will eliminate the potential for contamination or residual concentrations of constituents from previous sampling events. Disposable gloves should be used when cleaning the bailers. The gloves should be changed before purging and sampling and before proceeding to the next well. The second step for the continued use of bailers would to be to specify a sampling depth within the screened interval of the well for sample collection. This will ensure that the samples are collected from a consistent location each time, if it is not currently done. The location should be a couple of feet off the bottom of the well to prevent disturbing sediment that may have settled at the bottom of the well casing.

The second alternative for sampling is to switch to a low flow purging and sampling technique. This method would provide samples that had minimal physical and chemical alterations as a result of sampling, follow a specified EPA sampling procedure, and simplify sampling events if dedicated pumps are used in the wells. A low flow sampling system pumps water at a very low flow rate from the middle of the screened interval to pull water from the formation into the well casing with minimal draw down and without excessive purging. This provides consistent samples, improves sample accuracy, reduces sample variability, and increases the well life by reduced pumping stress. A quote for a low flow sampling system for all 13 wells was obtained from QED for discussion purposes, and is included in Appendix 2-A. The system evaluated would include a permanent installation in the wells, and would ensure that samples are collected from the same depth during each sampling event. An investment in a low flow sampling procedure would improve data quality, so the cost of implementing the system using Canyon County personnel was compared to sampling costs using the current procedure, and using an outside consultant. **Table 2-2** summarizes estimated equipment and labor costs associated with the different sampling options.

**Table 2-2. Estimated Sampling Costs**

| | Bailing | | Low Flow by Landfill Staff | | Low flow by Outside Contractor | |
|---|---|---|---|---|---|---|
| | **Units** | **Cost** | **Units** | **Cost** | **Units** | **Cost** |
| Personnel | 28 hours | $65 hour | 28 hours | $65 hour | 32 hours | $60 hour |
| Truck & Laborer | | $2,800 event | | $0 event | | $0 event |
| Total Cost | | $4,620 | | $1,820 | | $1,920 |
| Assumptions | 18-20 hours sampling | | 1.5 to 2 hours/well | | 1.5 to 2 hours/well | |
| | 5 hours preparation/handling | | 19.5 to 26 hours/event | | 19.5 to 26 hours/event | |
| | 4 hours decontamination/cleaning | | 5 hours preparation/sample handling | | 5 hours preparation/handling | |
| | | | | | 4 hours travel time<br>All equipment is provided by the County | |

Based on these numbers and the cost estimate provided it would take 22 sampling events or approximately 11 years to realize the cost savings from using the current bailer system versus the installation of a low flow sampling procedure. Therefore, the main advantage of the low flow sampling procedure would be an increase in data quality.

### 2.3.2 *Sampling Results*

Groundwater samples have been collected at PBSL since 1995. Samples have not always been obtained from PB-5, PB-6, and PB-7 due to low flow or the wells being dry. These wells are located in the unconfined aquifer, which has very low permeability and a small saturated zone thickness.

### *2.3.2.1 Metals*

EPA regulations (40 CFR, Part 264.97) include general ground-water monitoring requirements for RCRA facilities and waste disposal units. The regulations include discussions of well placement, construction, and other variables needed in a groundwater monitoring program to adequately establish background levels. Various statistical methods may be used in the analysis of the data. Background levels of metals or organic contaminants in groundwater have not been established for the PBSL because the groundwater monitoring program is conducted voluntarily. However, a review of the data indicates that samples from some of the wells have concentrations above detection limits for arsenic (As), barium (Ba), cadmium (Cd), copper (Cu), chromium (Cr), nickel (Ni), and zinc (Zn). Using the sample data after the sample turbidity became less variable in October 2003; the information was analyzed for these various metals using a regression analysis to evaluate trends in the data and the range for natural background conditions.

Arsenic

On January 22, 2001, the EPA adopted a rule that changed the drinking water standard for arsenic from 0.05 mg/l to 0.01 mg/l. Drinking water systems were required to comply with this rule by January 23, 2006. For the groundwater wells at PBSL, the detection limit for As is currently 0.003 mg/l, but prior to 2009 it was 0.005 mg/l. The maximum value found in the groundwater samples was 0.034 mg/l in PB-10. The average from October 2003 to the present based on available data is shown in **Table 2-3** for each well sampled for the various constituents detected. In all but a few cases, the average concentrations detected are below the EPA Maximum Contaminant Levels (MCLs), although some individual samples are above these limits. The exception is for As in wells PB-3, PB-11, and PB-14 that have averages slightly above the MCL.

**Table 2-3. Average Concentrations (in mg/l) of Metals in Groundwater, October 2003 - Present**

| | As | Ba | Cd | Cu | Cr | Ni | Zn |
|---|---|---|---|---|---|---|---|
| MCL | 0.01 | 2 | 0.005 | 1.3 | 0.1 | UR | UR |
| PB-3 | 0.0106 | 0.2600 | 0.0005 | 0.0100 | 0.0032 | 0.0263 | 0.0117 |
| PB-4 | 0.0063 | 0.4267 | 0.0005 | 0.0100 | 0.0095 | 0.0404 | 0.0211 |
| PB-6 | 0.0040 | 0.0500 | 0.0005 | 0.0100 | 0.0769 | 0.0205 | 0.0109 |
| PB-7 | 0.0067 | 0.0804 | 0.0007 | 0.0100 | 0.0051 | 0.0279 | 0.0107 |
| PB-8 | 0.0039 | 0.1517 | 0.0005 | 0.0104 | 0.0041 | 0.0271 | 0.0103 |
| PB-9 | 0.0069 | 0.0583 | 0.0006 | 0.0100 | 0.0031 | 0.0275 | 0.0100 |
| PB-10 | 0.0069 | 0.0500 | 0.0005 | 0.0117 | 0.0114 | 0.0329 | 0.0124 |
| PB-11 | 0.0103 | 0.1611 | 0.0005 | 0.0100 | 0.0036 | 0.0200 | 0.0222 |
| PB-12 | 0.0096 | 0.1680 | 0.0005 | 0.0100 | 0.0034 | 0.0200 | 0.0170 |
| PB-13 | 0.0083 | 0.1500 | 0.0005 | 0.0100 | 0.0093 | 0.0244 | 0.2789 |
| PB-14 | 0.0113 | 0.1611 | 0.0005 | 0.0100 | 0.0024 | 0.0222 | 1.2478 |
| PB-15 | 0.0050 | 0.1522 | 0.0005 | 0.0100 | 0.0024 | 0.0233 | 0.0278 |

UR = Unregulated

Evaluation of the arsenic concentration in each well was done using a regression analysis to look at the trend in the data and examine natural variability. **Figures 2-3 through 2-12** show the plots from the regression analysis of the data versus the predicted values. If the data show natural variability it would be expected that the regression analysis would show a horizontal line or a zero slope. If the data shows a trend, then the line may increase or decrease. The parameter that indicates whether or not the trend is significant is called the p value. When the p value is less than 0.05 it indicates that with 95% confidence that there is a trend in the data over the time period examined. For the newer wells, there is only 4 years of data available for the analysis. **Table 2-4** shows a summary of the p values for arsenic. Except for PB-9, the general trend is decreasing whether the trend was significant or not. It is not clear why the trend in arsenic concentrations is increasing in PB-9, but because the maximum concentration observed is a single sample at the MCL of 0.01 mg/l the trend would only be a concern if multiple samples are observed at elevated concentrations in the future. Overall, the results indicate there is some natural variability in the arsenic concentration, that the natural concentration can be up to 3 times greater than the MCL, and that concentrations in that range are considered natural. If the sampling method is changed to a low flow system, some variation in the data may be expected if comparisons are made to the existing data set. This is because the current sampling approach generates water samples that may or may not be representative of the aquifer conditions because of high turbidity levels. If the water in the confined aquifer below PBSL is ever used for drinking water in the future, treatment would be necessary to meet drinking water standards.

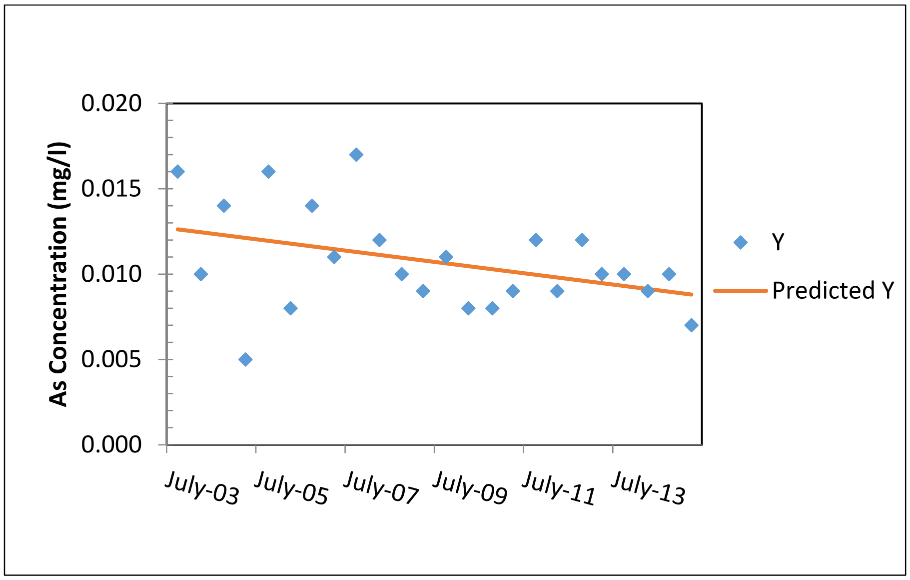


**Figure 2-3. Regression Analysis for Arsenic in PB-3**

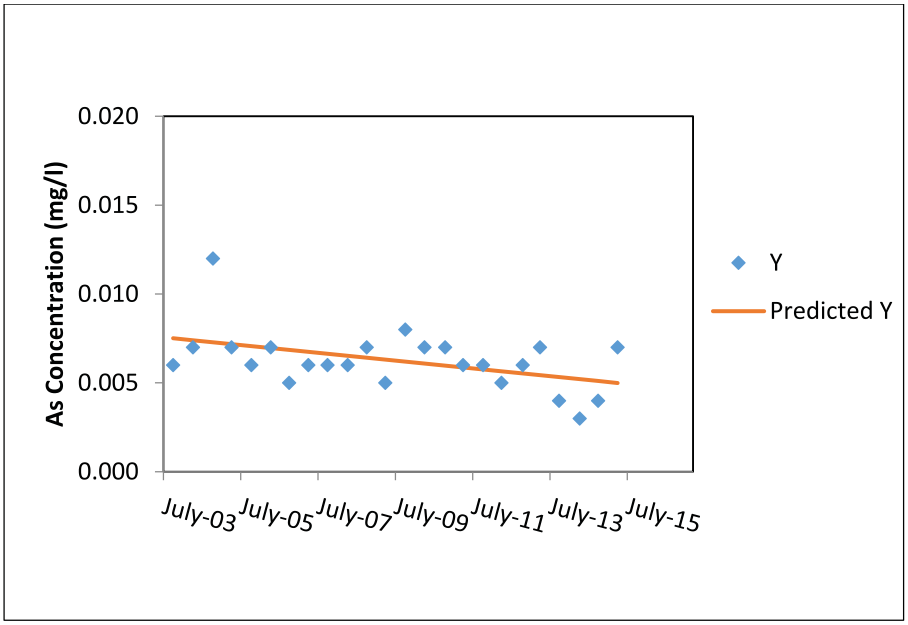


**Figure 2-4. Regression Analysis for Arsenic in PB-4**

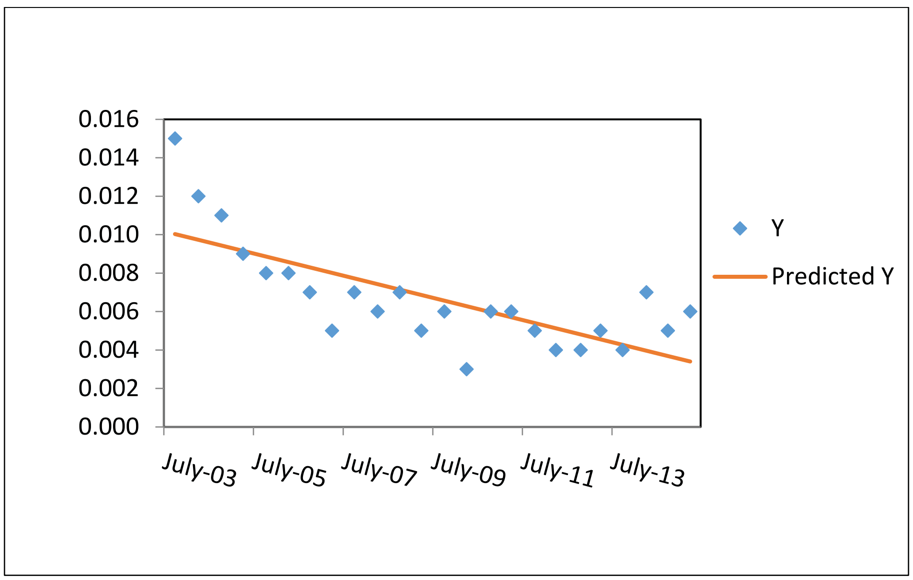


**Figure 2-5. Regression Analysis for Arsenic in PB-7**

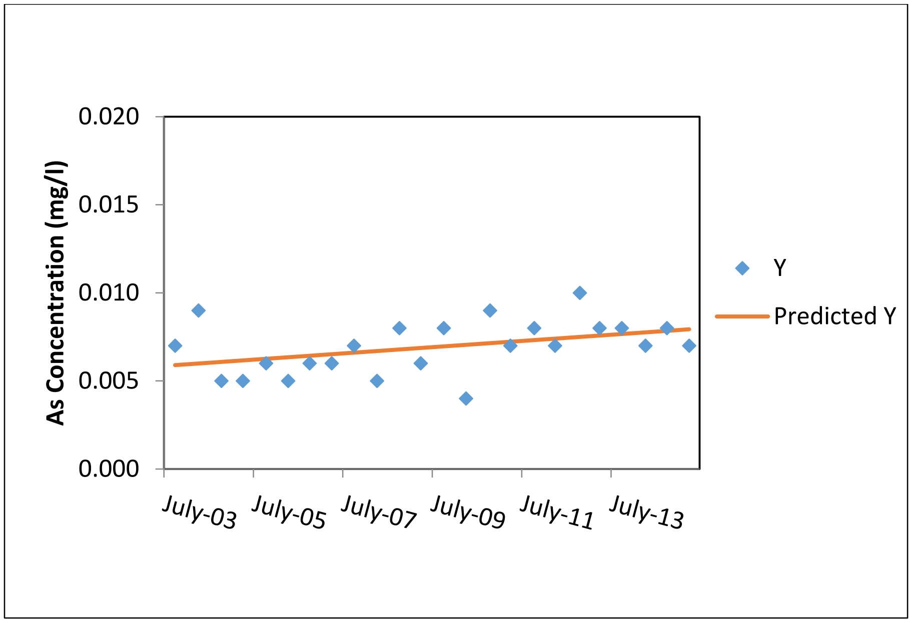


**Figure 2-6. Regression Analysis for Arsenic in PB-9**

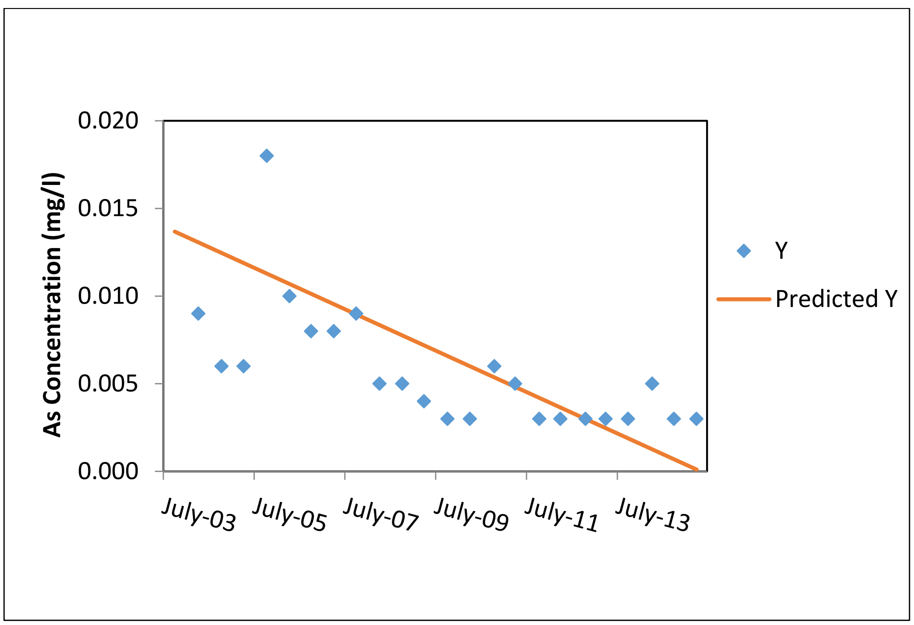


**Figure 2-7. Regression Analysis for Arsenic in PB-10**

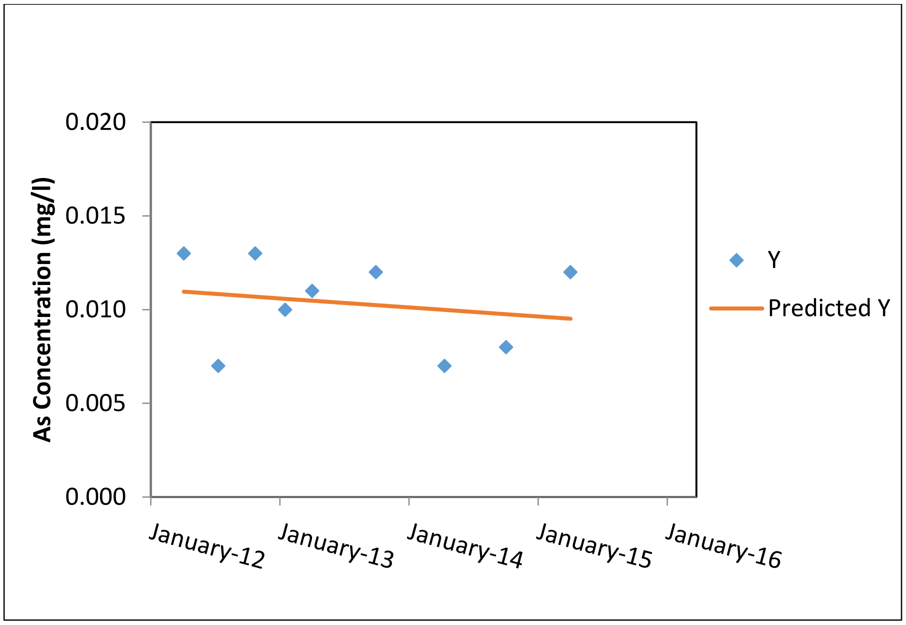


**Figure 2-8. Regression Analysis for Arsenic in PB-11**

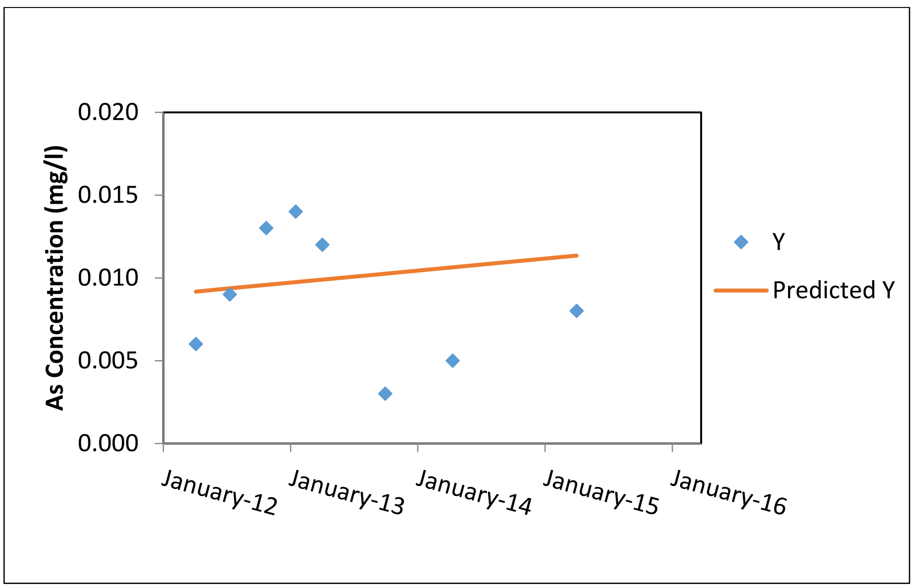


**Figure 2-9. Regression Analysis for Arsenic in PB-12**

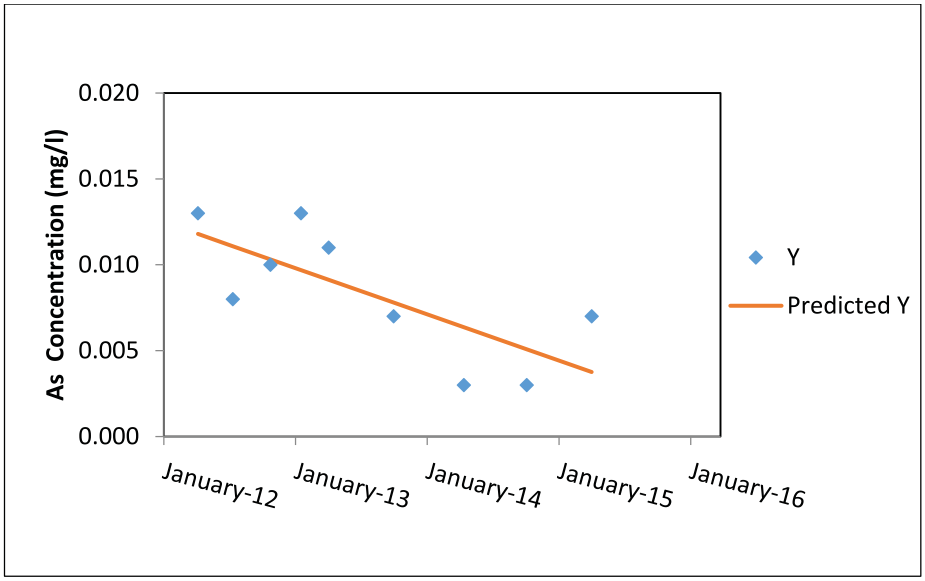


**Figure 2-10. Regression Analysis for Arsenic in PB-13**

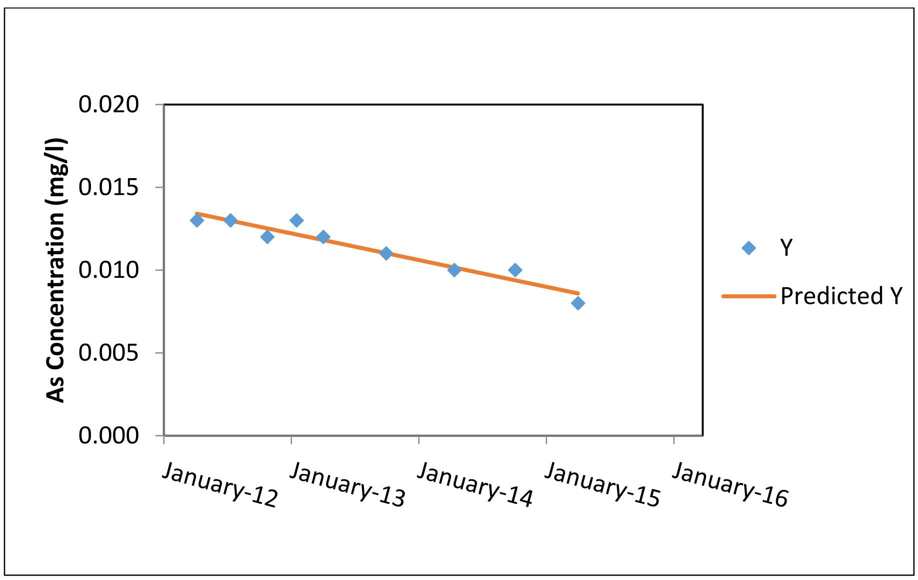


**Figure 2-11. Regression analysis for Arsenic in PB-14**

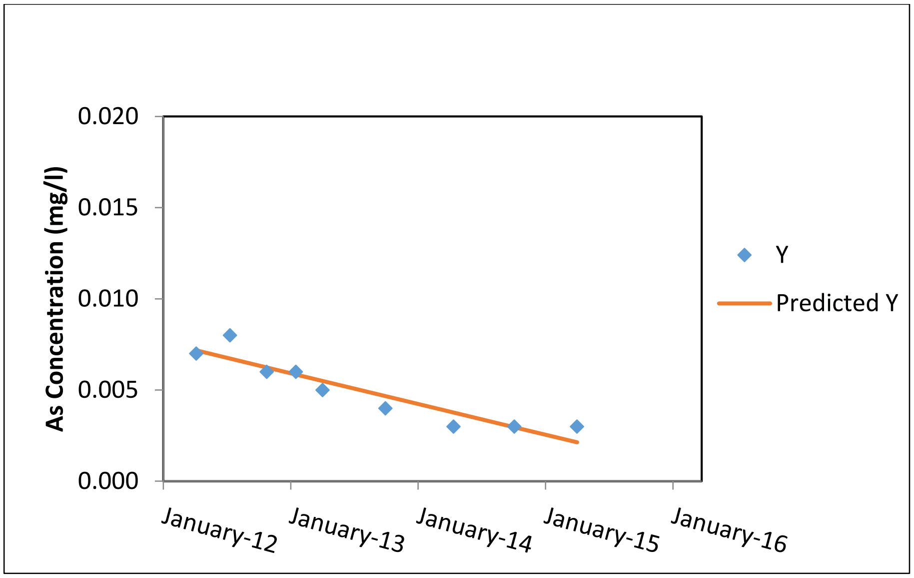


**Figure 2-12. Regression analysis for Arsenic in PB-15**

**Table 2-4. Summary of p values for Arsenic Regression Analysis**

| Well Name | p value | Comment |
|---|---|---|
| PB-3 | 0.0578 | Not Significant, decreasing |
| PB-4 | 0.0257 | Significant, decreasing |
| PB-5 | - | Insufficient Data |
| PB-6 | - | At Detection Limit |
| PB-7 | 4.32E-05 | Significant, decreasing |
| PB-8 | - | At Detection Limit |
| PB-9 | 0.0437 | Significant, increasing |
| PB-10 | 0.0012 | Significant, decreasing |
| PB-11 | 0.6013 | Not Significant |
| PB-12 | 0.7279 | Not Significant |
| PB-13 | 0.0239 | Significant, decreasing |
| PB-14 | 4.57E-05 | Significant, decreasing |
| PB-15 | 0.0003 | Significant, decreasing |

*Barium*

The detection limit for Ba is currently 0.05 mg/l, and the MCL is 2 mg/l. The maximum value found in the groundwater samples has been 0.46 mg/l in PB-4. The average for each of the wells from October 2003 to the present based on available data is shown in **Table 2-3**. The concentration in all samples were all below the maximum concentration limits. Therefore, a regression analysis was not conducted for Ba.

*Cadmium*

The detection limit for Cd is 0.0005 mg/l, and the MCL is 0.005 mg/l. The maximum concentration found in the groundwater samples has been 0.006 mg/l in PB-7 in a single sample during the April 2015 sampling event. There have only been three other samples above the detection limit for Cd, and there have been no consistent trends. A regression analysis was not conducted for Cd.

*Copper*

The detection limit for Cu is 0.01 mg/l, and the MCL is 1.3 mg/l. The maximum concentration found in groundwater samples has been 0.02 mg/l in PB-8 and PB-10 during several sampling events. These values are well below the MCL, and are considered to be the natural background concentration. A regression analysis was not conducted for Cu.

*Chromium*

The detection limit for Cr is 0.002 mg/l, and the MCL is 0.1 mg/l. The maximum concentration found in groundwater samples has been 0.18 mg/l in PB-6. The concentration in this well was at or above the MCL for three sampling events in 2004 and 2005, but has remained below the MCL since that time. The natural background concentration appears to be near or even above the MCL for the site, and a regression analysis was not conducted for Cr.

*Nickel*

The detection limit for Ni is 0.02 mg/l, and an MCL has not been set. The maximum concentration found in groundwater samples has been 0.28 mg/l in PB-6. However, the median for all of the groundwater samples for Ni is 0.02, which indicates that the majority of the samples are on the order of 0.02 mg/l. The natural background concentration appears to be below 0.30 mg/l. A regression analysis was not conducted for Ni.

*Zinc*

The detection limit for Zn is 0.005 mg/l, and an MCL has not been set. The maximum concentration found in groundwater samples has been 3.29 mg/l in PB-14 as a single event. The median for all of the groundwater samples for Zn is 0.01, which indicates that the majority of the samples are on the order of 0.01 mg/l. The single spike in the analysis is likely the result of cross contamination. The natural background concentration appears to be around 0.01 mg/l. A regression analysis was not conducted for Zn.

#### *2.3.2.2 Organic Compounds*

Acetone was found in the sample from monitoring well PB-4 at a concentration of 12.4 mg/l in October 2014. During the April 2015 sampling event, acetone was present in samples from PB-3, PB-4, and PB-13 at concentrations of 10.6, 32.5, and 10.1 mg/l. These wells were sampled on different days, so there is no correlation to sampling order that would explain the results. There are no EPA standards set for acetone in groundwater, but there is a concern about why acetone has begun to show up in the samples. The most likely explanations are either contamination during sampling or introduction at the laboratory. Contamination during sampling could have occurred during handling with reusable work gloves (versus disposable) and/or because the current sampling procedures does not include a sufficient cleaning/decontamination step. Although the sampling procedure uses dedicated bailers, the bailers have apparently not been cleaned for over a decade. This could be tested by filling the bailers with deionized water, then collecting that water for lab analysis. Given the low concentrations, this may or may not indicate if the bailers have been contaminated. The best option is that prior to the October 2015 sampling event, the bailers be cleaned according to an EPA approved cleaning procedure prior to sampling and that new, disposable gloves be used for handing the samplers to ensure cross contamination does not occur. In addition, a sampling blank should be provided to the laboratory for analysis. If after cleaning, the samples still exhibit detectable levels of acetone, then it is strongly recommended that air samples be collected from the wells of concern to test for the presence of VOCs. Given the stratigraphy, arid climate, depth to groundwater, and thickness of the confining layer it is very unlikely that the acetone observed in the samples is the result of landfill leachate reaching the groundwater. In the unlikely event that the air samples contain contaminants, the integrity of the wells should be evaluated.

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# 3.0 BIOSOLIDS ACCEPTANCE

The Landfill is considering accepting Class B biosolids from the Cities of Nampa and Caldwell and is concerned about compliance with applicable regulatory requirements. In addition, the landfill does not want to create an operational issue when handling the biosolids or a localized odor problem that will generate nuisance conditions to area residents, or complaints from neighboring land users. This section of the report summarizes the regulatory requirements for biosolids acceptance and discusses potential methods of handling biosolids.

## 3.1 Biosolids Benefits

Biosolids are rich in both organic matter and essential plant nutrients and can be utilized as a soil amendment and fertilizer. Biosolids act as a soil amendment through the contribution of organic matter. Increased organic matter improves soil physical properties including moisture holding capacity, aggregation, porosity, and tilth. Improvement of these properties facilitates transport of air, water, and nutrients throughout the soil, benefiting the establishment and growth of vegetation.

Biosolids serve as a fertilizer by providing essential micronutrients (e.g. zinc, copper, and iron) and macronutrients (e.g. nitrogen, phosphorus, and potassium) that increase vegetation growth and productivity. The stabilized biosolids provide a slow release source of nutrients that can be utilized by plants for several years following application. The slow release of nutrients may prevent leaching of excess nutrients and possible contamination of groundwater and surface water.

The Landfill can benefit by using biosolids to augment final cover or intermediate cover soil. Key benefits for cover soil are moisture holding capacity and the growth of surface vegetation, which will inhibit erosion and reduce slope maintenance.

## 3.2 Regulatory Requirements

There are various rules that apply to the management of biosolids, including but not limited to the Federal rules under the United States' EPA national program (40 CFR Part 503), Idaho's solid waste rules under Title 39, Chapter 74, Idaho Solid Waste Facilities Act (SWFA) (State of Idaho, 1996), and Idaho Administrative Procedure Act (IDAPA) 58.01.16.650 (State of Idaho 2015), which regulates the use of sludge for soil augmentation and requires an approved sludge disposal/management plan. If the Landfill decided to accept this waste, 40 CFR Part 503 contains the standards for the use or disposal of sewage sludge (biosolids) that would apply. The SWFA follows 40 CFR 257 & 258 and requires that the biosolids meet the paint filter test. If the biosolids pass the paint filter test then the waste is not a liquid and can be accepted as normal solid waste. However, an amendment to Landfill's Operations Plan would be necessary before biosolids could be accepted.

Under the United States' EPA national program (40 CFR Part 503) municipalities and industries have to make sure that biosolids are safely handled to protect public health and environmental quality. The most common method of disposing biosolids is land application. However, 40 CFR Part 503 includes surface disposal, composting, and incineration of biosolids as recognized solutions that can be used to mitigate public health risks.

## 3.3 Land Application

From a Federal regulatory standpoint, if land application of Class B biosolids is considered, pathogen requirements and site restrictions must be met. Pathogen requirements listed under §503.32(b) (2), (3) or (4) consist of testing or treatment. Biosolids may be directly applied to land if the biosolids contain fecal coliform less than 2 million Most Probable Number per gram of total solids (dry weight) or if the biosolids are treated by one of the Processes to Significantly

Reduce Pathogens as described in Appendix B of the regulations. Site restrictions consist of various time periods before the property can be used for growing food crops or turf, grazing animals, or before public access is allowed. Pollutant limits for metals listed in §503.13 apply to land application, including ceiling concentrations, cumulative pollutant loading rates, average concentrations, and annual pollutant loading rates.

Land application of biosolids will also require compliance with the DEQ's Guidance for Land Application of Municipal Biosolids (DEQ, 2011). Key requirements are submission of a biosolids management plan to DEQ, calculation of the application rate, and record keeping/reporting. In addition, 40 CFR Part 503.13 requires cumulative pollutant loading rate (CPLR) monitoring if the metals concentrations of the incoming biosolids exceed Table 3 of 503.13, but are less than the ceiling limits in Table 1 of that section.

## 3.4 Surface Disposal

The placement of biosolids on land for longer than 2 years is typically considered surface disposal (less than 2 years is typically considered storage). If surface disposal is considered and the landfill does not have a liner, maximum pollutant concentrations in the biosolids cannot exceed the values shown in **Table 3-1**:

**Table 3-1. Maximum Concentrations for Surface Disposal**

| Pollutant | Concentration (milligrams per kilogram) |
|---|---|
| Arsenic | 73 |
| Chromium | 600 |
| Nickel | 420 |

In addition, these concentrations are reduced as the distance of the disposal site to the property line decreases. Concentration reductions begin for disposal sites within 150 meters of the property boundary. Pathogen requirements and site restrictions similar to land application must be met. The frequency of monitoring for pollutant concentrations, pathogen density, and vectors is based on the number of metric tons of biosolids disposed of per year. For 290 metric tons or less per year, monitoring once per year is required. For more than 15,000 metric tons per year, monthly monitoring is required.

Any biosolids destined for surface disposal must meet the paint filter test as outlined in 40 CFR 258. Biosolids passing the paint filter test are considered a solid rather than a liquid. The Landfill's Operations Plan must be revised to include a description of how the biosolids will be handled after acceptance.

## 3.5 Composting

Biosolids are considered a feedstock if used for composting with shredded green waste, and are regulated within respective composting regulations. However, compost feedstock may influence regulatory requirements. For example, compost that incorporates biosolids as a feedstock may be subject to more stringent process and quality criteria. These criteria would include meeting pathogen reduction limits, compliance with required sampling and analysis protocols, and the maintenance of compost temperature and retention time records. Furthermore, composts incorporating feedstock other than untreated and unprocessed wood and yard waste may be subject to land application and distribution restrictions.

If a compost operation that includes biosolids as a feedstock is considered it is necessary to show the ability to reduce odors and VOC emissions, and effectively meet the Process to Further Reduce Pathogens (PFRP) and Vector Attraction Reduction (VAR) and ensure that composting facility operators are consistently meeting regulatory requirements. A summary of these requirements and the CFR references are presented in **Table 3-2.**

**Table 3-2. Composting Requirements**

| Requirement | Description | CFR Reference |
|---|---|---|
| Vector Attraction Reduction (VAR) | Biosolids kept under aerobic conditions at an average temperature over 45 deg. C (113 deg. F) for at least 14 days | 40 CFR Part 503.33 (b)(5) |
| Process to Further Reduce Pathogens (PFRP) | Temperature-time-requirement: 55 deg C (131 deg F) for at least 3 days | 40 CFR Part 503.32 (a)(7), Alternative 5 in conjunction with Part 503 App. B (B)(1) |
| | PFRP requirements are met prior to, or at the same time as meeting the VAR requirements | 40 CFR Part 503.32 (a)(2) |

Public access to the compost operation would need to be limited, and there would need to be recordkeeping requirements and testing of the final product. The Landfill's Operations Plan would also need to be revised to include a description of how the biosolids will be handled during the composting operation

Incineration, although allowable from a regulatory standpoint, is not recommended or appropriate for PBSL.

## 3.6 Biosolids Acceptance at the Landfill

Biosolids can be handled at the Landfill in a variety of ways, each with their own regulatory implications. Four general procedures will be discussed, land application, incorporation into the active face, incorporation into soil used for Landfill operations, and use as feedstock for a compost program. The details of each procedure would need to be discussed with the Landfill staff.

Land application of biosolids is a good option because the Landfill has a significant amount of unused property. Any land application program would need to follow DEQ's Guidance for Land Application of Municipal Biosolids and an approved biosolids management plan. The biosolids would be delivered to currently unused landfill property and dumped in a pile or spread by the delivery truck (rear applicator).

The biosolids would then be mixed into the surface soil in order to minimize vectors. Repeat application of biosolids over the same property would only be limited by metals concentrations (40 CFR Part 503.13 – Pollutant Limits) and/or agronomic limits. The biosolids would need to be applied to an area where a crop is grown to agronimically use the nutrients. The crop could be any non-food crop including native grass/hay. The crop needs to be periodically harvested so that nutrient levels on the site do not increase over time. If properly managed and monitored the application of biosolids should have minimal environmental impact.

A drawback to this approach is that landfill equipment may need to be mobilized to the biosolids land application site each time a truck arrives with a load. Mixing biosolids into the soil may require the landfill equipment to come into direct contact with the biosolids. This issue can be mitigated by having equipment specifically dedicated to the land application operation. Odors may also be an issue before and during the mixing operation.

Biosolids can also be incorporated into the active face of the landfill.

Incorporation into the active face may be more convenient for the landfill staff because the landfill equipment is nearby. The pictures show a truck dumping biosolids directly on the active cell, but a variation on this would be preparing a depression in the active face for the truck to dump into. Ideally, biosolids would be delivered to the landfill early in the morning so the biosolids are covered with as many loads of waste as possible.

Drawbacks to this approach are the creation of “soft” spots in the active face and biosolids coming in contact with the landfill equipment and potentially the landfill customers. Odors will also be a concern until the biosolids are buried.

The landfill staff can prepare a low area within the cover soil borrow area for the biosolids to be placed. This approach works best for high water content biosolids that just barely pass the paint filter test. This approach allows the soil to soak up some of the water. It also allows the landfill staff to mix cover soil with the biosolids without having the equipment come in direct contact with the biosolids. After a day or two of drying, the soil/biosolids mixture can be picked up by the scraper and applied as daily cover. This approach has worked well for one landfill in Yuma, Arizona that accepts biosolids from Orange County, California.

A potential drawback to this approach is that during the winter the biosolids may never dry, but rather freeze. During winter months, the biosolids may need to be immediately mixed with soil and used as cover the same day.

Finally, the biosolids can be used as feedstock for a compost operation. The compost operation can be either an aerated static pile (ASP) type or a standard aerobic windrow type. Biosolids would be mixed with shredded green waste to increase the moisture content of the green waste and jump-start the composting process. The biosolids enhances the compost process by adding nutrients, nitrogen, and active microbes. Odors and vectors should be significantly reduced once the windrows start composting (above 131 deg F).

A concern regarding this approach is that the landfill may not want to start a composting program solely to manage biosolids. A composting program is labor intensive and the finished product must be sold or used for landfill final cover reclamation in order for the overall program to be cost effective. Another concern may be public perception. Although property composted biosolids are pathogen free, there is a negative perception associated with sewage sludge.

## 3.7 Landfill Impacts

Incorporation of biosolids into the landfill will add moisture and heavy metals to the fill. The moisture plus active microbes in the biosolids will jump-start the anaerobic decomposition process (similar to an aerobic compost process), leading to an increase in landfill gas production. This additional landfill gas production will be vented to the atmosphere because the landfill does not have an active collection system. Odor complaints may result.

A reduction in overall waste density may be a side effect of incorporating the biosolids into the active face of the landfill because the compactor cannot compact the wet biosolids. Soft spots in the waste fill may create slope stability concerns. In addition, soft spots in the landfill deck may cause trash trucks to get stuck.

The addition of biosolids will increase the overall concentration of heavy metals in the fill. Any leachate generated by the fill may have increased concentrations of heavy metals as a result. The metals in biosolids are particularly mobile because they are water-soluble.

## 3.8 Health And Safety Concerns

There are relatively high concentrations of pathogens (fecal coliform, helminth ova, etc.) in biosolids. Class B biosolids have the highest concentration of pathogens. Contact with eyes, mouth, and exposed skin should be avoided. The best protection is to avoid direct physical contact with the biosolids. Personal protective equipment should be used when there is a possibility that contact will occur. Personal protective equipment includes gloves, goggles/face shield, and Tyvek (or equivalent) suit/boot covers.

Any landfill equipment that comes in direct contact with biosolids should be washed thoroughly at the end of the day. Operators should take particular care when exiting the equipment prior to washing it at the end of the day. Equipment mechanics should also take particular care when disassembling landfill equipment for repairs. Any interior surface to be accessed by the mechanic should be thoroughly pressure washed first.

We recommend that if the County is considering acceptance of biosolids that they request the following test data, at a minimum, from the customer:

- % Solids,
- Metal concentrations per the 503 regulations,
- Fecal coliform concentrations per 503 regulations,
- Total Nitrogen

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# 4.0 LANDFILL GAS EVALUATION

The primary objective of this evaluation is to prepare a landfill gas (LFG) model that can be used to predict the amount of LFG that the Landfill will generate in the coming years. It updates the Methane Monitoring portion of the 1997 Status Report. In addition, this evaluation assesses the impact of accepting biosolids at the PBSL on LFG generation. Background information for this evaluation was obtained from the PBSL Operations Assessment and from documentation provided by Canyon County staff.

The Landfill has been operated by Canyon County since its opening in 1983. It is located in a formerly agricultural area, and has a site certification boundary encompassing approximately 490 acres. A portion of this acreage will used as buffer areas to convey stormwater and to house ancillary facilities. The Landfill is operated by the Area Fill method in which lifts of waste are progressively placed over an area of the Landfill and generally overlaid with daily cover soil at the end of the workday. The current waste footprint covers 74 acres. Intermediate cover is applied to areas that are inactive for extended periods of time.

The peak waste acceptance rate, based on six days per week in 2015, is 1,200 tons per day. Appendix 4-A contains projected waste flow data based on a moderate growth rate of 1.5%.

PBSL will have a finite site life, based on the anticipated waste flow presented in Appendix 4-A, and on the ultimate site capacity. Canyon County intends to modify the configuration of the landfill to maximize air space; therefore, the design capacity of landfill is subject to change.

The Landfill is classified by Idaho DEQ as a MSWLF, which is defined as any solid waste landfill that accepts household waste, household hazardous waste, or conditionally exempt small quantity generator waste. The waste materials disposed since the Landfill opening in 1983 include household, light commercial and business grade trash from Canyon and Owyhee Counties. Materials consisting of construction debris and landscaping trash, such as tree and grass trimmings, have also been placed in the Landfill. The Landfill has a waste screening program in place preventing the disposal of hazardous waste (as defined by 40 CFR § 258.28) and Polychlorinated Biphenyls (PCB). The waste capacity of the Landfill is over 2.5 million megagrams (Mg) which is an important regulatory milestone. In fact, the landfill currently has over 4,000,000 short tons (English units, equivalent to over 3.6 million Mg) in place (see Appendix 4-A for a complete history).

**Table 4-1** contains estimated waste composition values, based on visual observation of waste in place at the landfill. This information can be used to more closely determine the LFG generation capacity of the waste.

PBSL is unlined and a Landfill Gas Extraction System (LFGES) has not been installed. A 600 foot buffer separates the waste footprint from the property line, including easements, drainage channels, access roads, and earthen berms.

The Landfill’s current waste footprint is approximately 74 acres. The estimated volume of waste in-place is over 8 million cubic yards.

**Table 4-1.** Pickles Butte Sanitary Landfill Estimated Waste Composition

| | | Type of Waste | Composition % by weight |
|---|---|---|---|
| 1 | | Dry Recoverable Fiber | 17.60 |
| 2 | | PET UBC's | 0.60 |
| 3 | | HDPOE | 0.80 |
| 4 | | Film Plastics | 5.30 |
| 5 | | Mixed Plastics | 3.40 |
| 6 | | Glass | 0.90 |
| 7 | | Aluminum UBC's | 0.20 |
| 8 | | Mixed Ferrous (Tin & Salvage) | 1.70 |
| 9 | | Mixed Non-Ferrous (Salvage) | 0.10 |
| 10 | | Inerts | 7.30 |
| 11 | | Hazardous Waste | 0.30 |
| 12 | | E-Waste | 1.00 |
| 13 | | Textiles | 7.00 |
| 14 | | Organics | 43.00 |
| | a | Yard Waste | 8.20 |
| | b | Food Waste | 19.10 |
| | c | Clean Wood | 3.40 |
| | d | Treated/Painted Wood | 3.30 |
| | e | Wet/Contaminated Fiber | 6.10 |
| | f | Rubber | 0.90 |
| | g | Allocated Organics | 2.00 |
| 15 | | Fines (<2" items) | 1.30 |
| 16 | | Other | 9.50 |
| | | Total | 100 |
| | | Calculated; | |
| | | Methane Correction Factor (MCF) | 1 |
| | | Degradable Organic Carbon (DOC) | 0.187952 |
| | | Fraction of DOC Dissimilated ($DOC_F$) | 0.494031 |

## 4.1 Applicable Regulatory Requirements

### 4.1.1 *Principal Federal Landfill Regulations*

Under the Resource Conservation and Recovery Act (RCRA), enacted by Congress in 1976 and amended in 1984, landfills that accept municipal solid waste (MSW) are primarily regulated by state, tribal, and local governments. The EPA, however, established criteria for MSWLF's (40 CFR Part 258) under RCRA on October 9, 1991 that MSWLF's must meet in order to stay open. The criteria contain location restrictions, design, and operating standards, groundwater monitoring requirements, corrective actions, financial assurance requirements, LFG migration control, closure requirements, and post closure requirements. Under the design standards, new landfills and lateral expansions that occur on or after October 9, 1993 are required to have liners on the bottom and sides of the landfill prior to waste deposition. In the case of the PBSL native in-place, soil materials have been approved by DEQ in lieu of a geomembrane liner. The regulations also state that all landfills operating after October 9, 1991, must place a final cap over the landfill surface. The placement of liners and caps reduces the potential for subsurface and surface LFG migration and groundwater contamination. While additional federal, state, and local landfill rules and regulations are in place, RCRA represents the primary laws covering land disposal of municipal solid waste.

In particular, 40 CFR §258.23 requires explosive gases control at the PBSL's property boundary. It is our understanding that LFG is currently monitored in groundwater monitoring well casings. This practice is unusual and would be cause for concern if methane found in the groundwater well casings was LFG. Tetra Tech recommends that PBSL install dedicated LFG monitoring probes at the perimeter of the landfill as required by 40 CFR §258.23, unless an exemption from LFG monitoring has been granted by DEQ. The spacing for these probes must be negotiated with DEQ. Probe spacing of up to 1,000 feet on center have been permitted at other landfills.

### 4.1.2 *Principal Federal Landfill Air Emissions Regulations*

Because of the environmental benefits of collecting and controlling LFG, the 1996 EPA Standards of Performance for New Stationary Sources (NSPS), Guidelines for Control of Existing Sources, and the recently published National Emission Standards for Hazardous Air Pollutants (NESHAP), require "large" MSW landfills to collect LFG and combust it to reduce non-methane organic compounds (NMOC) by 98% (or to an outlet concentration ≤ 20 ppmv). Appendix 4-B G contains copies of selected Federal regulations.

A "large" landfill is defined as having a design capacity of at least 2.5 million metric tons and 2.5 million cubic meters. Landfills meeting that threshold must perform an annual calculation to determine if the landfill uncontrolled NMOC emissions rate has exceeded 50 metric tons (megagrams) per year. Canyon County has elected to perform a Tier II calculation to document that the landfill has not exceeded this threshold. Landfills exceeding the limit must install a landfill gas collection and control system (GCCS). The current PBSL Tier 2 projects that the NMOC emission rate will be 33.3 Mg/year in 2014, and will exceed 50.4 Mg/year in 2026.

The NSPS and NESHAP require that gas collection systems be well designed and properly operated. They require gas collection from all areas of the landfill, monthly monitoring at each collection well, and monitoring of surface methane emissions to ensure that the collection system is operating properly and to reduce fugitive emissions. Code of Federal Regulations 40 Part 60 (40 CFR 60), Subpart WWW (Standards of Performance for Municipal Solid Waste Landfills or NSPS) is typically the driving force requiring the construction and installation of LFG extraction systems at landfills (US EPA, 1996).

The solid waste industry is waiting for the EPA to publish new NSPS regulations in the federal register, Code of Federal Regulations 40 Part 60 (40 CFR 60), Subpart XXX. Contained in the new Subpart XXX is a reduced NMOC threshold of 34 metric tons (megagrams) per year, down from the current 50 Mg/year. This new NMOC limit may impact PBSL. The following is an excerpt from 40 CFR 60, Subpart XXX:

***Section 60.33f Emission Guidelines for municipal solid waste landfill emissions***

*(a) Landfills. For approval, a State plan must require each owner or operator of an MSW landfill having a design capacity of greater than or equal to 2.5 million Mg by mass and 2.5 million cubic meters by volume to collect and control MSW landfill emissions at each MSW landfill that meets the following conditions:*

*(1) The landfill has accepted waste at any time since November 8, 1987, or has additional design capacity available for future waste deposition.*

*(2) The landfill commenced construction, reconstruction, or modification on or before July 17, 2014.*

*(3) The landfill has an NMOC emission rate greater than or equal to 34 megagrams per year or the Tier 4 surface emissions report shows a surface emission concentration of 500 parts per million methane or greater.*

*(4) A landfill in the closed subcategory that has an NMOC emission rate greater than or equal to 50 megagrams per year or the Tier 4 surface emissions report shows a surface emission concentration of 500 parts per million methane or greater.*

New Emissions Guidelines (EG) regulations apply to existing landfills. The key date for applicability has been tentatively set as July 17, 2014. If this date appears in the final EG rule, the PBSL may be subject to the lower NMOC threshold of 34 Mg/year. Once the new regulations are published in the Federal Register, Tetra Tech can evaluate which threshold is applicable to the PBSL.

From an October 6, 2015 communication with EPA staff:

> *"The 34 Mg/yr threshold only applies to the proposed NSPS and emission guidelines. The 50 Mg/yr threshold applies until the agency [EPA] takes final action (issues a final rule). Rules must be followed as written until they are revised or amended by final rule."*

Final comments on the proposed EPA NSPS/EG rules are due October 26, 2015. Finalized rules are expected the first quarter 2016. State regulatory agencies have 9 months from the date the final rules are published in the Federal Register to promulgate regulations that comply with the new rules. If the new rules trigger the installation of a gas collection and control system, a landfill will have 30 months from the date that the 34 Mg/year NMOC emission rate is exceeded to have a LFG collection system installed. Therefore, if the proposed EPA NSPS/EG rules are published as currently written, the PBSL would have no more than 39 months from the date of publication in the Federal Register to install the system.

#### 4.1.3 *Tier 2 NMOC Concentration*

PBSL has a total capacity greater than 2.5 million megagrams or 2.5 million cubic meters (3,269,877 cubic yards). Therefore, it needs to comply with paragraph (b)(2) of Section 60.752 of 40 CFR 60, and provide calculation of an NMOC emissions rate using the procedures specified in Section 60.754 (Tier 1, 2, and 3 calculations) of 40 CFR 60. The most recent Tier 2 was performed on December 2014 and is in effect for a five-year period. The NMOC concentration obtained from this Tier 2 Analysis was 485 parts per million by volume (as hexane). This value was used for the subsequent modeling contained in this report.

The new NSPS regulations will contain a new method of determining NMOC emissions from landfills, known as Tier 4. The Tier 4 analysis will reportedly consist of surface monitoring for NMOC emissions through the landfill cover.

#### 4.1.4 *Greenhouse Gas Emissions Regulations*

The EPA has promulgated Greenhouse Gas (GHG) reporting requirements. Reporting of GHG emissions began on September 30, 2011. Landfills with emissions exceeding 25,000 metric tons per year of $CO_2$ must report. Landfills are currently required to report both biogenic and anthropogenic emissions. PBSL is above the 25,000 metric ton limit and therefore must report GHG emissions to the EPA on an annual basis. PBSL generated 84,613 MT of $CO_2$ for the reporting year 2014.

## 4.2 LFG Generation Estimates

The LFG generation estimate is an important planning tool that can be approached from three perspectives. One perspective is regulatory compliance. From this perspective, an LFG flow rate that is near the upper range of theoretically possible LFG generation is preferred to ensure that all generated LFG is being collected, and that both surface and lateral LFG migration is being controlled. Estimating higher LFG generation is conservative in this case. This scenario could be termed maximum gas flow design.

Under a maximum gas flow design a financial risk arises when the landfill is required to install a collection system before it is required. This may be acceptable if it is critical for the project owner to maintain migration control, limit surface emissions, and control odors.

A LFG flow rate estimate that is near the lower range of theoretically possible LFG generation could be termed minimum gas flow design and would be the second scenario. A disadvantage of a minimum gas flow scenario is that it may not allow sufficient time for the landfill to budget for the installation of a collection system and the landfill may run the risk of being out of compliance with regulatory requirements.

A third scenario involves changing gas flow design. This scenario acknowledges that actual LFG generation changes from year to year based on the age of the waste and the waste composition. This scenario requires waste composition information and that some assumptions be made regarding future changes in waste composition. The PBSL may choose to accept bio solids in the future, which could change the shape of the LFG generation curve going forward. A model run assuming additional moisture and more organic material has been performed to determine the impact of this decision.

### 4.2.1 *Landfill Gas Generation Modeling Approach*

The LFG modeling approach for this evaluation consisted of using the EPA LandGEM model (Version 3.02, May 2005) using existing site input parameters. A second LFG model consisting of the IPCC Guidelines for National Greenhouse Gas Inventories method, modified by the State of California Air Resources Board (CARB), was also used. The CARB LFG model uses site specific waste composition values and the degradable organic content (DOC) of the waste. The waste composition can be varied by year to adjust for changes. For the biosolids simulations, the organic fraction of PBSL waste was adjusted up from 43% organic matter to 55% organic matter, and the methane generation rate constant was increased from 0.02 to 0.05/yr. This change in waste composition was assumed to be implemented in 2015, and continue unchanged through 2040.

### 4.2.2 *Landfill Gas Generation Modeling*

One of the input parameters the model requires is the Landfill's known waste acceptance rate. Solid waste flow was determined using information supplied by Canyon County. The estimated volume of refuse in place at the site is another key parameter used by the EPA's LandGEM model to develop a projection of potential methane generation. Other input parameters were adjusted to reflect the presumed moisture content and varying rates of decomposition associated with different fractions of the waste stream. The model estimates peak methane generation one year after the last year of waste disposal, with a decline in production thereafter. The waste acceptance rates are shown in Appendix 4-A.

LFG production parameters were selected to reflect the methane generation for an arid landfill. Actual recoverable methane may be different than the predicted generation. Also, regulatory default values for the Methane Generation Potential, $L_o$, and Methane Generation Rate Constant, k, may not be representative of the specific conditions at the Landfill, and may overestimate flow rates for system design. The selection of these parameters is discussed below.

- Methane Generation Potential ($L_0$)

  In the landfill gas generation equation, the methane generation potential value represents the theoretical maximum yield (expected volume of gas per unit mass of refuse). Determining the maximum theoretical yield of a unit mass of municipal solid waste can be complex. Either of two methods can be used: 1) stoichiometric or 2) biodegradability. Both methods require extensive sampling, time consuming lab analysis, and complex analytical procedures. Both methods rely extensively on a characteristic sample of the waste stream.

  The AP-42 minimum value for the methane generation potential is 100 cubic meters per megagram. Generation model runs were prepared for values of 100, 170, and a calculated site-specific value based on waste composition.

- Methane Generation Rate Constant (k)

  AP-42 allows the use of a k value of 0.02/year for arid regions that have less than 25 inches of rainfall per year. Tetra Tech personnel visually evaluated the moisture content of the waste being delivered to PBSL. Because the landfill is located in the western portion of the United States, and annual precipitation is less than 12 inches per year, a low gas generation rate was assigned. A value of 0.02/year was used for this generation estimate and reflects a relatively dry waste mass and slow decomposition rates. However, for the LFG generation model run with the addition of biosolids, a value of 0.05/year was used to reflect the increase in moisture associated with biosolids.

- Model Results

  The modeled results are shown as Appendices 4-C, 4-D, 4-E, and 4-F. The model parameters and resulting methane generation rates are shown as on Tables 4-2 through 4-5 below. The model runs in Attachments D and E are based on an assumed organic content of 55%, which includes biosolids addition after 2015.

**Table 4-2. LandGEM Minimum Methane Generation Rates, 2015**

| | |
|---|---|
| Methane Potential, $m^3/Mg$ ($L_0$) | 100 |
| Methane Generation Constant, $yr^{-1}$ (k) | 0.02 |
| Modeled Methane Generation Rate for 2015, SCFM | 398 |

See Appendix 4-C for Model Results

**Table 4-3. LandGEM Maximum Methane Generation Rates, 2015**

| | |
|---|---|
| Methane Potential, $m^3/Mg$ ($L_0$) | 170 |
| Methane Generation Constant, $yr^{-1}$ (k) | 0.02 |
| Modeled Methane Generation Rate for 2015, SCFM | 677 |

See Appendix 4-D for Model Results

**Table 4-4. Tetra Tech Estimated Methane Generation Rates Based on CARB and No Biosolids, 2015**

| | |
|---|---|
| Methane Potential, $m^3/Mg$ ($L_0$) | Custom, 43% Organics |
| Methane Generation Constant, $yr^{-1}$ (k) | 0.02 |
| Modeled Methane Generation Rate for 2015, SCFM | 485 |

See Appendix 4-E for Model Results

**Table 4-5. Tetra Tech Estimated Methane Generation Rates Based on CARB with Biosolids, 2015**

| | |
|---|---|
| Methane Potential, $m^3/Mg$ ($L_0$) | Custom, 55% Organics |
| Methane Generation Constant, $yr^{-1}$ (k) | 0.05 |
| Modeled Methane Generation Rate for 2015, SCFM | 903 |

See Appendix 4-F for Model Results

### 4.2.3 *Landfill Gas Quality*

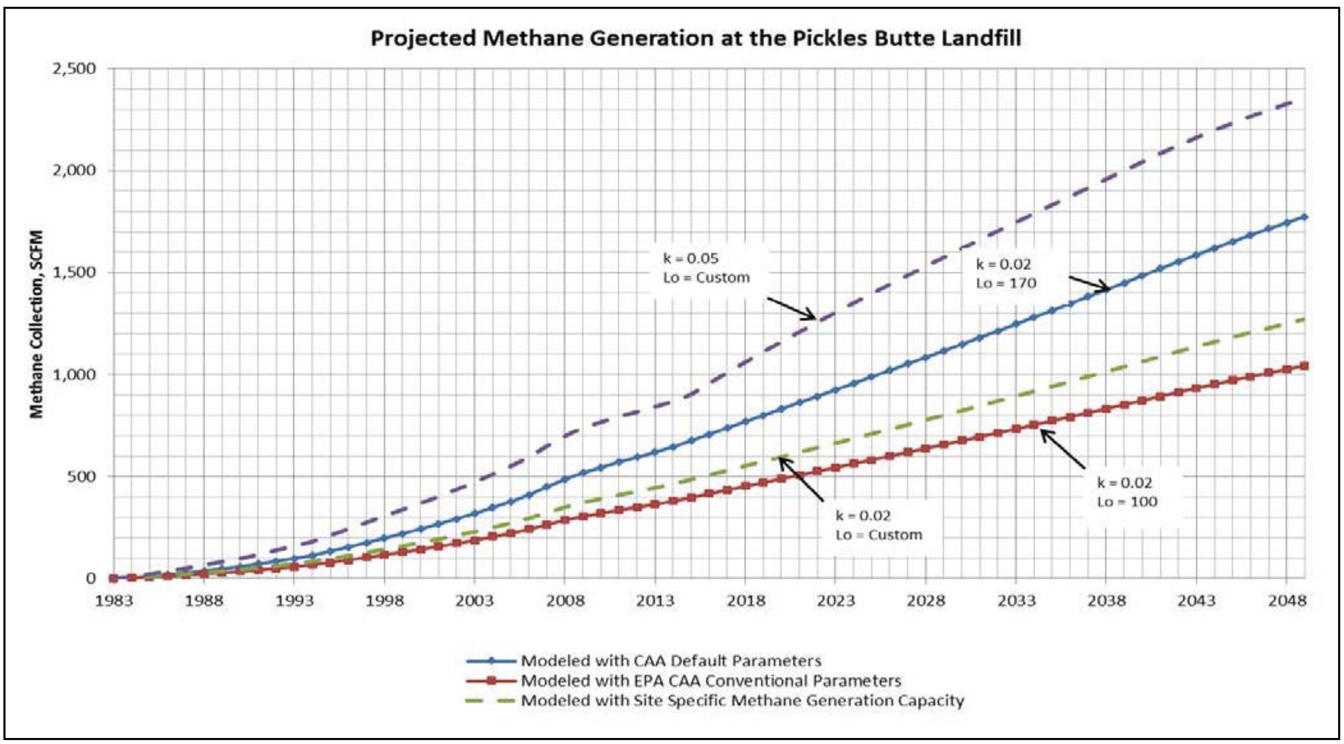
If the PBSL decided to install a landfill gas collection and control system (GCCS), the actual methane concentration of the LFG collected would initially be 55% methane and 45% carbon dioxide. This composition reflects pure LFG as it is generated within the landfill. Once a GCCS has been in operation for a period of time the LFG composition typically changes, and there is typically an increase in nitrogen and oxygen and a decrease in methane.

Because the methane content of the LFG will vary, the results of the model runs report standard cubic feet per minute (scfm) of pure methane. The pure methane number can be divided by the methane content to obtain the LFG flow rate. As an example, assuming pure landfill gas with a methane content of 55% and the methane flow rate in Table 5 of 903 scfm, the LFG flow rate would be 903 ÷ 0.55 = 1,642 scfm.

### 4.2.4 *Modeling Analysis Results*

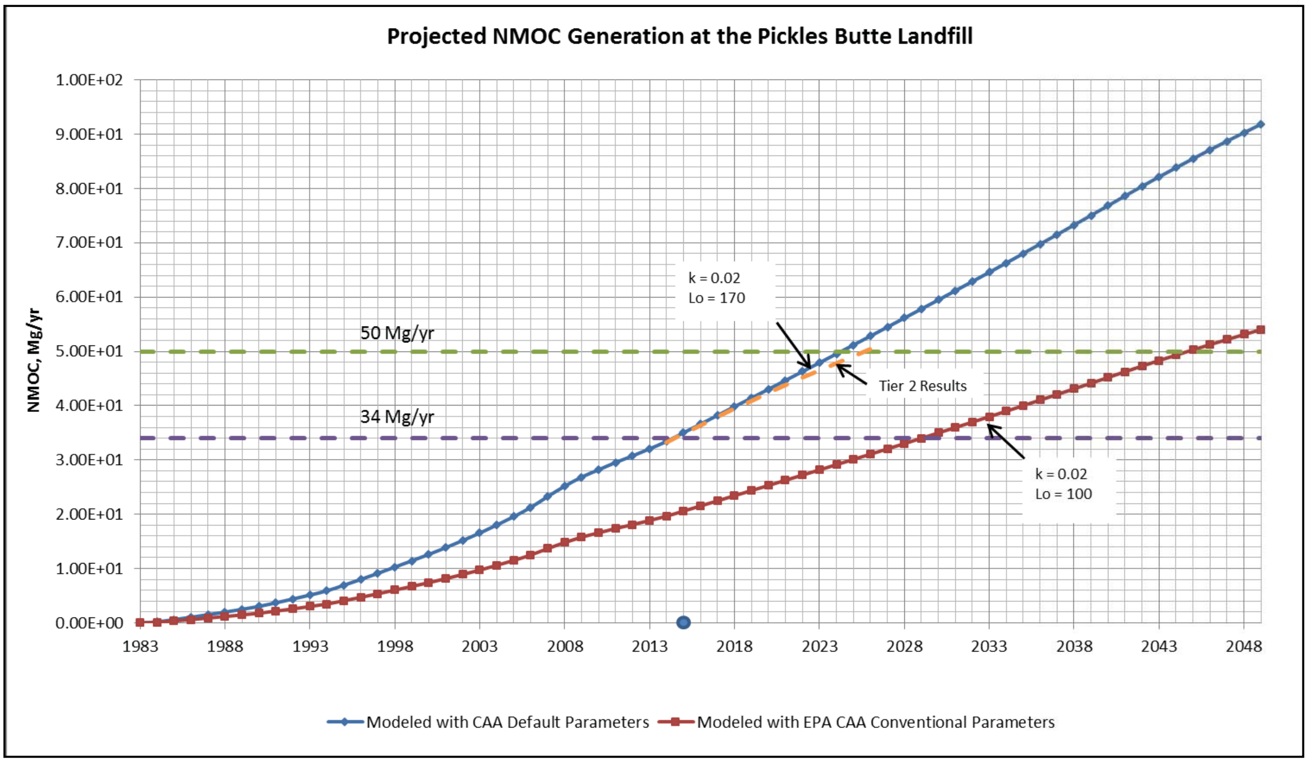
The projected methane generation graph below shows the modeling results. A larger version of these graphs can be found in Appendix 4-G of the report. These curves were extended to the year 2050. LFG generation curves typically peak one year after closure. Because the closure date is undetermined at this time, the models assume waste is continuously accepted from 1983 to 2050.

The lower red LandGEM curve is the minimum gas generation scenario, using the arid parameters and a lower methane generation capacity. The blue LandGEM curve is the maximum methane generation scenario without biosolids addition. These model inputs are the Clean Air Act defaults with a relatively high methane generation capacity value. The green curve was generated using the Tetra Tech/CARB model and a calculated methane generation capacity based on an assumed waste composition (based on visual inspection of the waste during our site visit). The upper purple curve was generated using the Tetra Tech/CARB model and assumes a higher moisture content and a higher percentage of organic material beginning in 2015 through 2050. Tetra Tech believes the green curve may most accurately reflect LFG generate at the PBSL without the addition of biosolids. The purple curve represents the upper limit of LFG production with the addition of a significant amount of biosolids.




The projected NMOC generation graph below shows the modeling results of NMOC generation at PBSL using the most recent Tier 2 NMOC concentration of 485 ppmv. The mass of NMOC's generated by PBSL should not change much based on the amount of LFG generated. This is because anaerobic decomposition of in place waste is not the primary source of NMOC. Anaerobic decomposition of waste produces 55% methane and 45% carbon dioxide. The majority of the NMOC's are contained within the waste itself when the waste is placed and compacted at the landfill. Therefore, as the amount of LFG generated within the landfill increases the concentration of NMOC's generally decreases, resulting in the same total NMOC mass emissions rate. The decomposition of some plastics that can produce NMOC's during degradation would be a minor contributor to the total NMOC mass emissions rate.

The graph shows a range of possible target dates for the installation of a GCCS at the PBSL. Assuming the blue curve and the proposed Subpart XXX NMOC threshold of 34 Mg/yr., the landfill would be required to begin the design of the GCCS now. Assuming the blue curve and the current Subpart WWW NMOC threshold of 50 Mg/yr., the landfill would not be required to begin the design of the GCCS until 2024. The actual NMOC generation rate probably falls between the blue and red curves because an $L_0$ value of 170 overstates the actual methane generation potential of the waste in the PBSL. In Tetra Tech's opinion, the most likely scenario is that PBSL will not fall under the new Emissions Guidelines Subpart Cf due to the future lateral expansion, which will occur after July 17, 2014. Rather, the PBSL would be subject to the new NSPS Subpart XXX, and therefore would be subject to the lower 34 Mg/yr. threshold.




### 4.2.5 *Pickles Butte Sanitary Landfill Expansion*

The existing Landfill will be expanded laterally in the future. The placement of additional MSW in the expansion area will extend the life of the landfill. However, LFG generation is influenced by the rate of MSW placement. If the daily tonnage coming into the landfill doubles, the amount of LFG generated the following year can be expected to double.

## 4.3 Recommendations

Tetra Tech recommends that once the new NSPS and EG regulations are published in the Federal Register the regulatory status of the PBSL be revisited. This may include seeking guidance from regulators. If the new 34 Mg/year NMOC threshold does apply to the PBSL, then the design of a GCCS for the site must begin. If the 50 Mg/year NMOC threshold still applies to the PBSL, then the County may have until 2024 to install a GCCS.

The cost to install a GCCS, LFG processing skid and flare may range from $25k to $40k per acre, depending upon the design of the system. LFG collection can consist of horizontal pipes that are buried in the waste as filling progresses, or vertical wells that are drilled in the waste after placement. It has been our experience that landfill owners prefer installing horizontal collectors as filling progresses, but this scenario requires advanced planning.

Canyon County may also want to review the need to install perimeter LFG probes, as required by 40 CFR §258.23. Unless the County has written documentation approving the current practice of monitoring in groundwater well casings, the installation of perimeter LFG probes may be necessary.

The County may also benefit from exploring the Tier IV option for measuring NMOC emissions if this option is included in the final version of 40 CFR 60, Subpart XXX. The current PBSL Tier 2 NMOC emission rate was estimated to be 33.3 Mg/year in 2014. The Tier IV option may result in a lower NMOC emission rate.

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# 5.0 PRELIMINARY SLOPE STABILITY EVALUATION

This section of the report details the preliminary slope stability evaluation of the Conceptual Fill Plan for Landfill. Tetra Tech performed stability analyses and seismic evaluation of the proposed cell geometries to verify satisfactory stability or to indicate if flatter slopes are required to achieve stability. Cross-sections used in this preliminary stability evaluation were those generated by the Conceptual Fill Plan that is presented in Section 6 of this report **(Figures 6-1** through **6-13**).

## 5.1 Project Description

Based on the Conceptual Fill Plan, planned Phases 1 through 4 of the Pickles Butte Sanitary Landfill consist of approximately 74 acres of unlined cells. These phases are further described in Section 1.15 of this report. Proposed fill slopes are planned to be on the order of 5H:1V (horizontal to vertical) to 4H:1V, with maximum waste fill depths on the order of 170 feet. Proposed excavation slopes are planned to be on the order of 2H:1V to 2.5H:1V or less, with maximum cut depths on the order of 75 to 80 feet. The finished fill slopes will consist of a sequence of slopes with 20-foot wide storm water/erosion control benches for every 40 feet of elevation gain. The reasons for selecting the lower angle slopes includes more effective erosion and stormwater control on the final slopes.

## 5.2 Purpose and Scope of Services

Administrative rules for the Idaho Solid Waste Facilities Act (Idaho Statutes, Title 39 – Health and Safety, Chapter 74, Section 39-7407) for the DEQ’s administration of MSWLFs require that,

> *“A MSWLF unit shall not be located: … (ii)within seismic impact zones except as provided in 40 CFR §258.14;”*

The EPA, in 40 CFR §258.14, defines a seismic impact zone as;

> *“…an area with a ten percent or greater probability that the maximum horizontal acceleration…will exceed 0.10g in 250 years.”*

The EPA requires that MSWLF units located within a seismic impact zone shall demonstrate that all landfill containment structures are designed to resist the maximum horizontal acceleration in lithified earth material for the site. Based on the USGS National Seismic Hazard Mapping application, the peak horizontal ground acceleration at the project site having a 10 percent probability of exceedance in any 250-year period is 0.11g, which exceeds the criteria above and therefore classifies or designates the site by rule definition to be within a seismic impact zone.

The purpose of this preliminary study is to demonstrate that the conceptual cell design of Phases 2 through 4 of the Pickles Butte Sanitary Landfill meets the requirements for the following containment structures:

- Phase 3 Maximum Section (Section N667100)
- Phase 4 Maximum Section (Section N667900)
- Phase 3 Temporary Cut Slope (Section N667100)

## 5.3 Preliminary Analysis

A geotechnical evaluation for the Landfill was previously completed in 1998 Holladay Engineering Company (Holladay, 1998b). Tetra Tech reviewed the existing soil strength data in the 1998 report to select conservative soil strength values for the preliminary slope stability evaluation. Waste material shear strengths were selected based on published ranges of material strength data (Bray, et al. 2009). Conservative (lower bound) shear strength values were used to evaluate slope stability for static and seismic conditions.

**Table 5.1** presents the material values that were assumed for this analysis:

**Table 5-1. Material Strength Properties**

| Material | Unit Weight (pcf) | Friction Angle (deg) | Cohesion (psf) |
|---|---|---|---|
| Waste Fill | 75 | 28 | 300 |
| Native Soil | 110 | 30 | 100 |

Tetra Tech reviewed the most recent published USGS probabilistic earthquake hazard information for seismic events with a 10 percent probability of exceedance in a 250-year period (USGS 2008 NSHMP PSHA Interactive Deaggregation Web Application), as current state of practice warrants, to select a peak spectral horizontal acceleration (PSHA). Based on our review of the USGS probabilistic earthquake hazard information, including site specific deaggregation characteristics of the Maximum Credible Earthquake (MCE), including magnitude, distance, and probability, a PSHA of 0.26g was selected to represent the extreme seismic case.

Based on recommendations in the EPA's Seismic Design Guidance for MSWLF (1995), the maximum horizontal acceleration was reduced by 50 percent to represent the average horizontal acceleration for the given slope. In this case, 50 percent of the maximum horizontal acceleration (0.26g) yields an average horizontal acceleration of 0.13g. An adjusted horizontal acceleration of 0.13g was therefore applied for pseudo-static analysis of the modeled slope configurations.

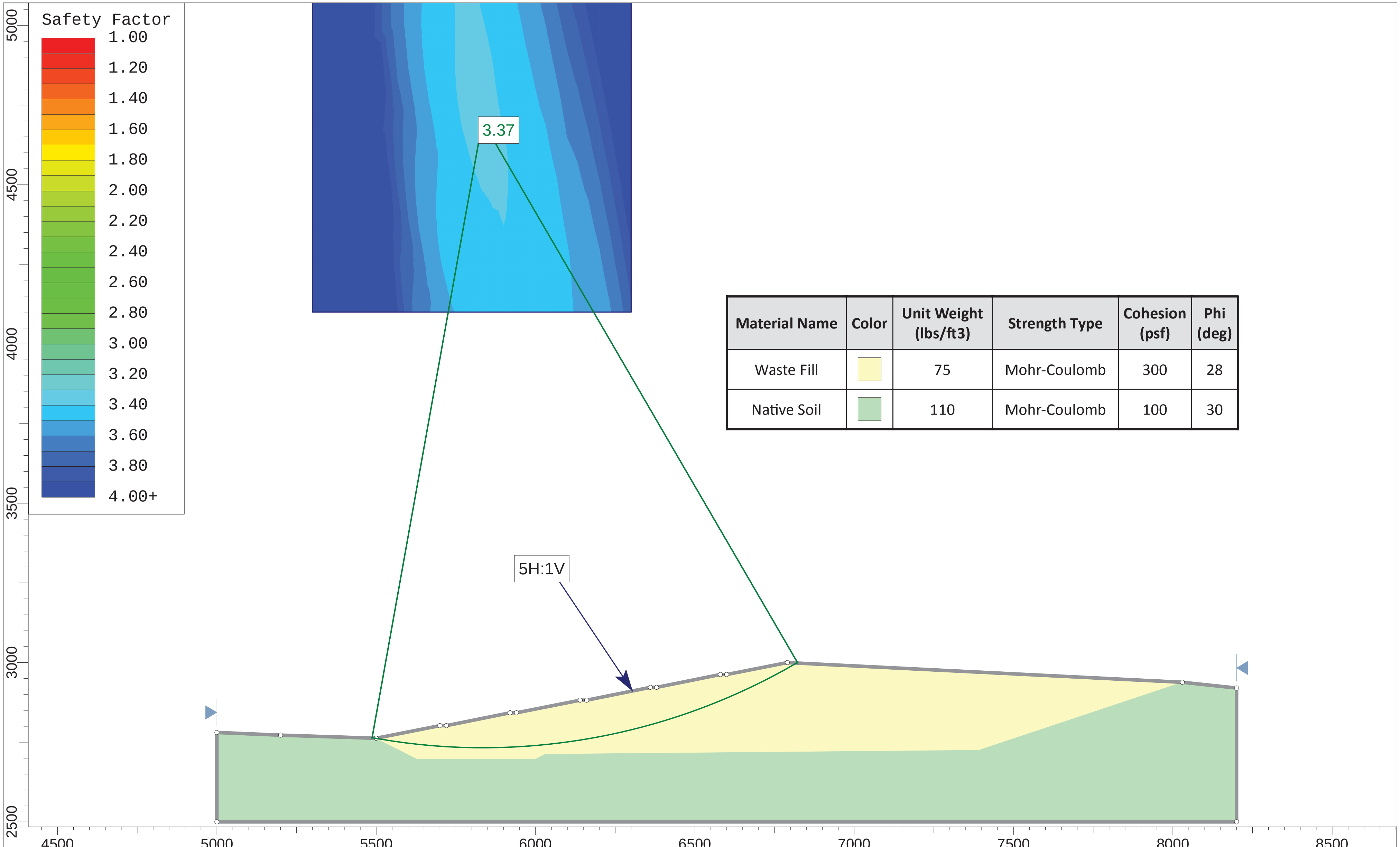
Slope stability and pseudo-static analyses were performed using the computer program SLIDE v.6, developed by Rocscience, Inc., to determine the factors of safety of critical slip surfaces using both circular and block failure searches and vertical slice limit equilibrium methods. Because the landfill is unlined, the potential of a critical interface between the waste fill and the natural subgrade soil is low. Therefore, circular failure analyses were performed at the critical sections. A screening analysis for block failure was performed to verify the potential for failure along the waste-soil interface is low compared to circular failure through the waste fill. A static, circular failure analysis was also performed on the critical (2H:1V) temporary cut slope.

The EPA recommends a minimum factor of safety (FS) of 1.5 for static slope stability analysis and a FS of 1.3 for pseudo-static slope stability analysis, based on Table 2-4 of the EPA's Solid Waste Disposal Facility Criteria Technical Manual (1998).

Based on the Conceptual Fill Plan cross-sections, the critical slope conditions identified were Section N667100 and Section 667900. A summary of the analysis results is presented in **Table 5-2; Figures 5-1 through 5-5** are the corresponding output plots.

**Table 5-2. Summary of Slope Stability Analysis**

| Section | Figure Number(s) | Safety Factor | |
|---|---|---|---|
| | | Static Analysis, Circular Failure | Pseudo-static Analysis, Circular Failure |
| Phase 3 Maximum Section (Section N667100) | 1 and 2 | 3.37 | 1.92 |
| Phase 4 Maximum Section (Section N667900) | 3 and 4 | 2.79 | 1.71 |
| Phase 3 Temporary Cut Slope (Section N667100) | 5 | 1.63 | - |



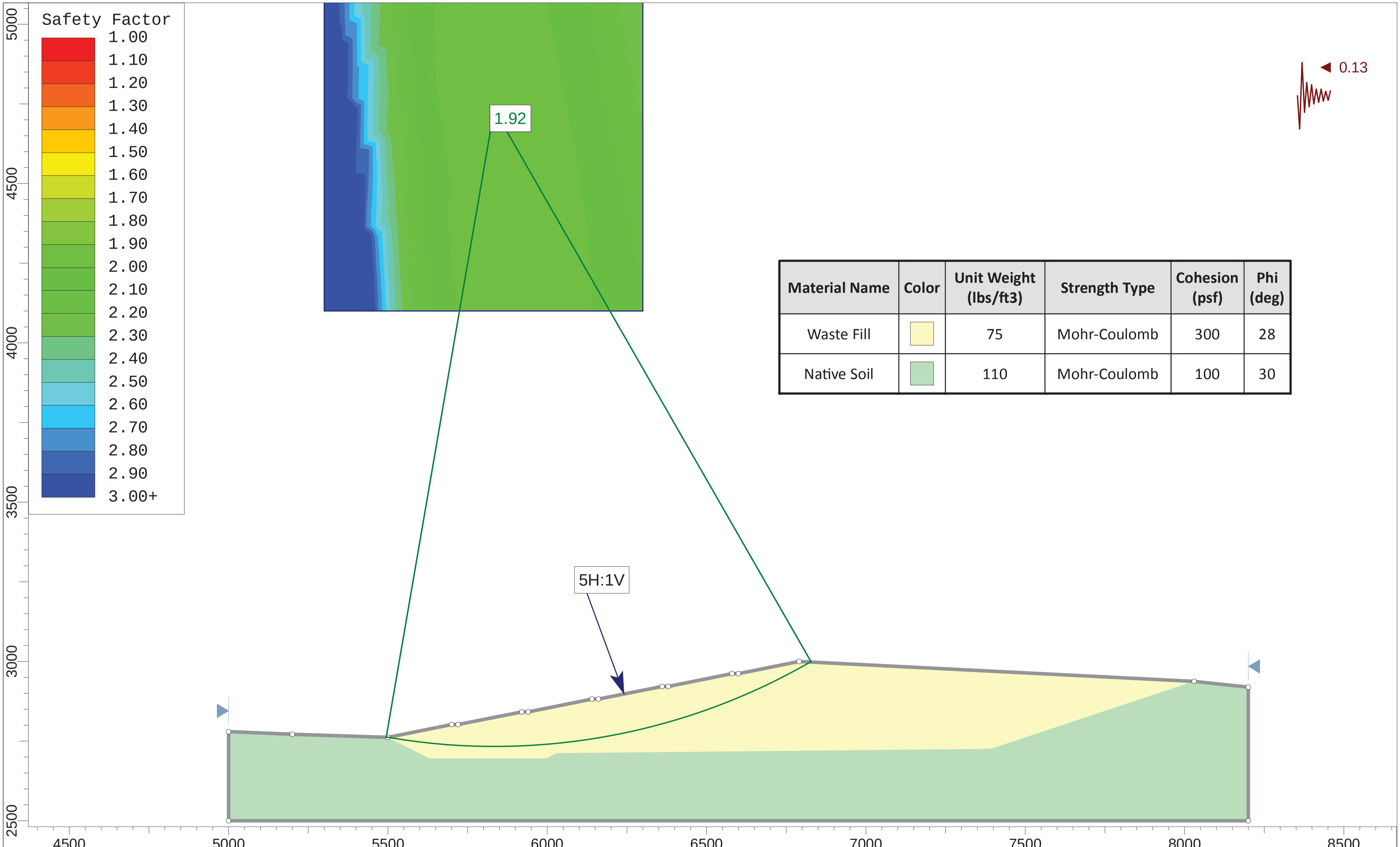

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) |
|---|---|---|---|---|---|
| Waste Fill | | 75 | Mohr-Coulomb | 300 | 28 |
| Native Soil | | 110 | Mohr-Coulomb | 100 | 30 |

rocscience

| | |
|---|---|
| *Project* | Pickles Butte Landfill |
| *Analysis Description* | Section N667100 - 5H:1V, Static, Circular Analysis |
| *Drawn By* | JRD |
| *Scale* | 1:5000 |
| *Company* | Tetra Tech |
| *Date* | 9/28/2015 |
| *File Name* | N667100 stat-circ.slim |

SLIDEINTERPRET 6.036

**Figure 5-1**

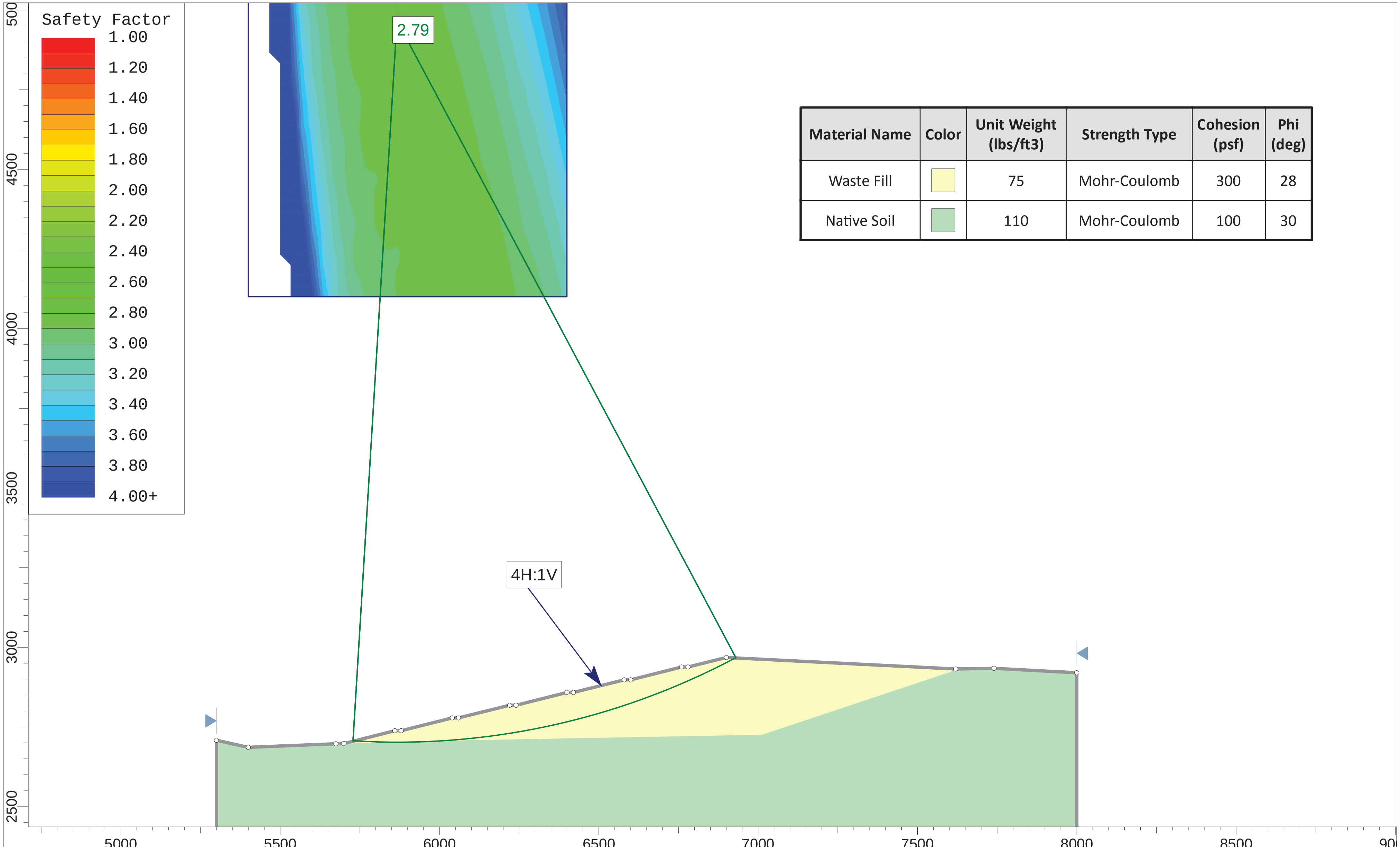



| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) |
|---|---|---|---|---|---|
| Waste Fill | | 75 | Mohr-Coulomb | 300 | 28 |
| Native Soil | | 110 | Mohr-Coulomb | 100 | 30 |

| | |
|---|---|
| Project | Pickles Butte Landfill |
| Analysis Description | Section N667100 - 5H:1V Slope, Seismic, Circular Analysis |
| Drawn By | JRD |
| Scale | 1:5000 |
| Company | Tetra Tech |
| Date | 9/28/2015 |
| File Name | N667100 EQ-circ.slim |

SLIDEINTERPRET 6.036

**Figure 5-2**

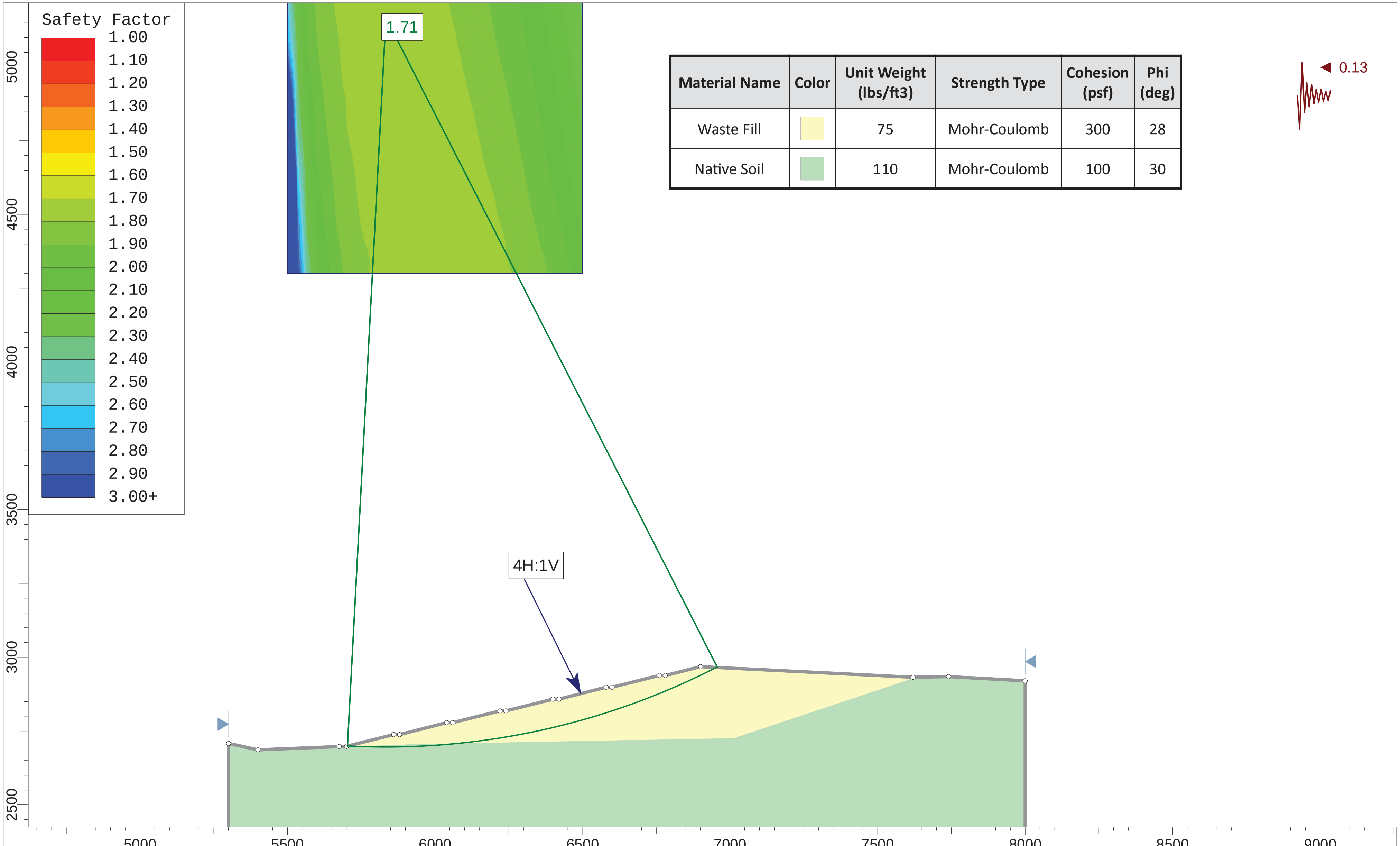



| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) |
|---|---|---|---|---|---|
| Waste Fill | | 75 | Mohr-Coulomb | 300 | 28 |
| Native Soil | | 110 | Mohr-Coulomb | 100 | 30 |

| | | | |
|---|---|---|---|
| *Project* | Pickles Butte Landfill | | |
| *Analysis Description* | Section N667900 - 4H:1V Slope, Static, Circular | | |
| *Drawn By* JRD | *Scale* 1:5000 | *Company* | Tetra Tech |
| *Date* | 9/29/2015 | *File Name* | N667900 stat-circ.slim |

SLIDEINTERPRET 6.036

**Figure 5-3**



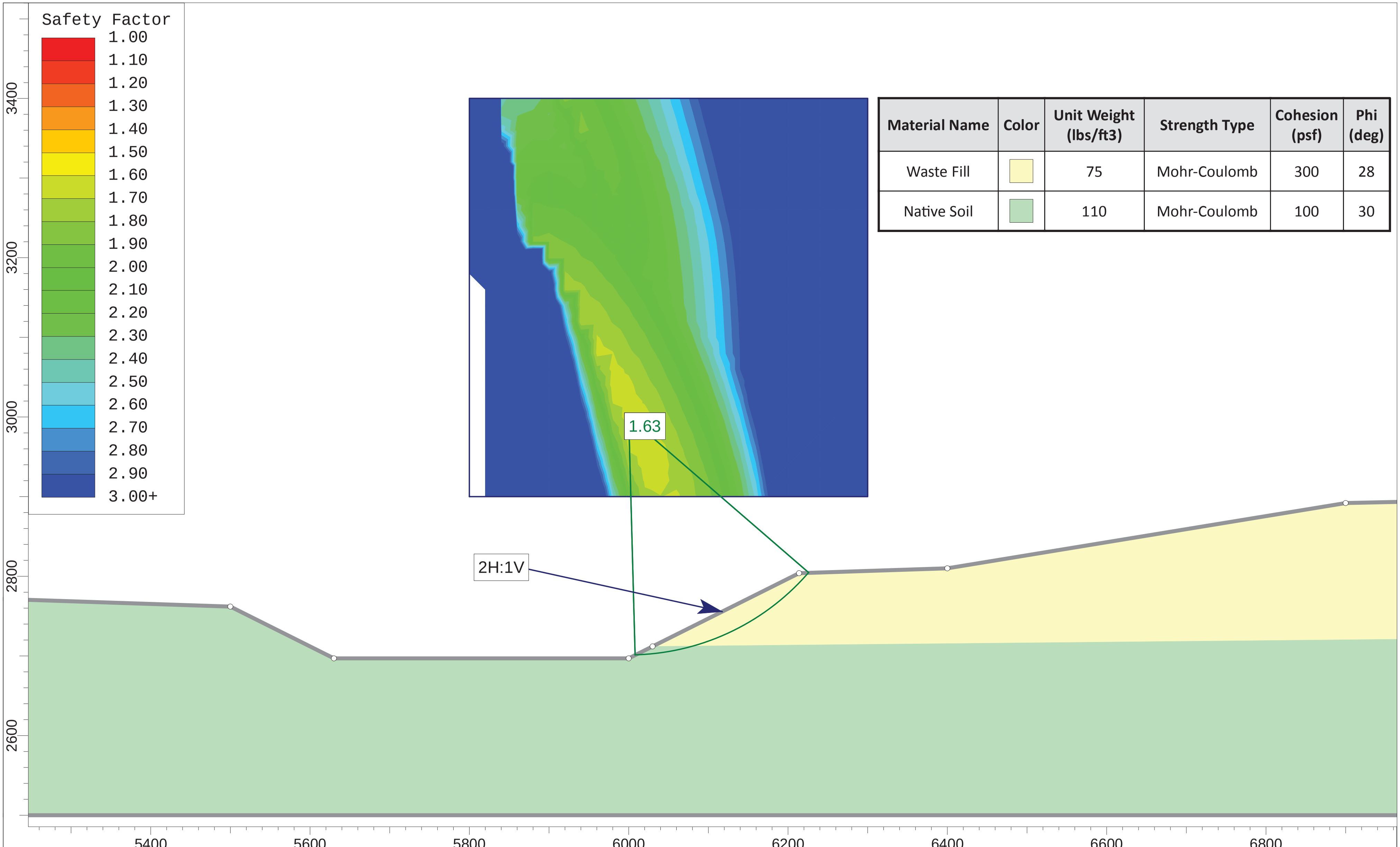

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) |
|---|---|---|---|---|---|
| Waste Fill | | 75 | Mohr-Coulomb | 300 | 28 |
| Native Soil | | 110 | Mohr-Coulomb | 100 | 30 |

rocscience

SLIDEINTERPRET 6.036

| | | | |
|---|---|---|---|
| *Project* | Pickles Butte Landfill | | |
| *Analysis Description* | Section N667900 - 4H:1V Slope, Seismic, Circular Analysis | | |
| *Drawn By* | JRD | *Scale* 1:5400 | *Company* Tetra Tech |
| *Date* | 9/29/2015 | *File Name* | N667900 EQ-circ.slim |

**Figure 5-4**




| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) |
|---|---|---|---|---|---|
| Waste Fill | | 75 | Mohr-Coulomb | 300 | 28 |
| Native Soil | | 110 | Mohr-Coulomb | 100 | 30 |

| | | | |
|---|---|---|---|
| Project | Pickles Butte Landfill | | |
| Analysis Description | Section N667100 - Temp Cut Slope, Static, Circular Analysis | | |
| Drawn By | JRD | Scale | 1:2000 |
| Company | Tetra Tech | | |
| Date | 10/6/2015 | File Name | N667100 temp stat-circ.slim |

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**Figure 5-5**

When the pseudo-static analysis indicates a factor of safety of equal to or less than 1.3, the containment structure is required to be evaluated utilizing the at least two independent methods to estimate permanent seismic induced displacement of the refuse mass. The displacement analysis methods are typically used as a screening method to evaluate if the structure or slope under analysis is within the range of critical displacement. For design of municipal solid waste landfill facilities, a maximum displacement less than 15 to 30 cm is typically acceptable for design. The pseudo-static analyses did not indicate a factor of safety below 1.3; therefore, a displacement analysis was not performed.

The performance of landfills subjected to strong earthquake ground motions is an extremely complicated process, and all of the variables that affect the behavior are not yet fully understood or capable of being analyzed. The historical performance of landfills subjected to seismic events similar to the design earthquake generally indicates satisfactory performance for the landfills studied.

A conceptual veneer cover slope was also evaluated based on the method presented by Koerner and Soong (1998). Based on a proposed maximum slope angle of 4H:1V (14-degrees), 3 feet of soil cover, a soil-geomembrane interface friction angle and adhesion of 20-degrees and 100 psf, respectively, and the proposed slope geometry and soil properties above, the veneer cover stability factor of safety was calculated to be 2.9.

## 5.4 Conclusions

The material strength properties incorporated in the preliminary seismic evaluation analyses were based on lower bound shear strength values and are considered conservative estimates.

Results of the preliminary seismic evaluation indicate that the Conceptual Fill Plan design for Phases 1 through 4 should meet the requirements of the Administrative rules for the Idaho Solid Waste Facilities Act for the Idaho DEQ's administration of MSWLF.

The preliminary seismic evaluation presented above was performed in accordance with generally accepted standards of the geotechnical engineering profession.

# 6.0 CONCEPTUAL FILL PLAN REPORT & CAPACITY ESTIMATE

This section of the report presents a conceptual fill plan for the landfill area that is currently approved for placement of waste. The purpose of this plan is to develop a conceptual sequence for the fill operations and to estimate the remaining life of the facility as it is currently permitted. The plan also evaluates the overall soil balance for the facility.

## 6.1 Site Design History

The design history of the site is documented within the Hydrogeologic Characterization, Ground Water Monitoring Plan, and Facility Design Report (Holladay, 1994a) and the 1997 Landfill Status Report (Holladay, 1998a).

The original design was prepared by Blakley Engineers in 1973 and included filling three deep coulees or ravines to a top deck elevation of 2900 feet. This essentially matched the existing grade along the east side of the coulees. The capacity of the site was estimated to be 16,000,000 cubic yards. Two of the ravines were east of Perch Road and the third ravine was west of Perch Road. The plan was modified in 1980 to allow public use of the OHV west of the active Landfill are for the maximum time. The modified plan included continuing the placing waste east of Perch Road and not expanding into the area west of Perch Road until necessary.

The facility began accepting waste in April 1983. When the federal Subtitle D rules were implemented in the early 1990's, the County was required to update the facility design and hydrogeologic characterization for approval of the facility by the State of Idaho (Holladay Engineering, July 1994). This design included a fill boundary, which followed the top of three coulees along the east side and crossed Perch Road, as shown on Figure 6 of the 1994 design report (Holladay, 1994a). The design elements included constructing 3:1 exterior slopes and building the fill above grade rather than the flat top proposed in the 1973 design. This significantly increased the overall capacity of the facility to 25,700,000 cubic yards. The 1994 design also included provisions for stormwater control and a conceptual final cover design approach.

Holladay prepared a revised design for the facility as part of the 1997 Landfill Status Report. The footprint for this design is quite similar to the 1994 footprint except the eastern boundary was rounded rather than following the incised contour of the tops of the coulees. This design included constructing 3:1 slopes with benches for stormwater control every 50 vertical feet. The final top deck was proposed to reach an elevation of 3054 feet. Incorporation of the stormwater benches reduced the overall capacity of the facility to 21,500,000 cubic yards. Our understanding is that the 1997 Landfill Status Report was never submitted to the Idaho DEQ so the 1994 design is the currently approved plan.

The 1997 Status Report also evaluated a conceptual plan for expansion called the Total Canyon Design. This design includes expanding the footprint to the west and constructing the landfill to the same height and slope configuration. This design would increase the capacity of the landfill to 64,500,000 cubic yards.

## 6.2 Current Situation

The waste design boundary shown in the 1994 Design Report has been modified by the actual operation. The 1994 boundary showed the southern and eastern limits being defined by the top ridgeline of three coulees. Since that time, the County has "rounded off" the eastern and southern boundaries with a footprint that is larger than that shown on the 1994 documents. This "rounded design boundary" is shown on Figure 10 of the 1997 Updated Status Report (Holladay, 1998a), which was never submitted to the DEQ. This "rounded boundary" is similar to the current waste limit; however, the County has expanded the waste footprint significantly to the east beyond the footprint proposed in 1997 as shown on **Figure 6-1 in Appendix 6-A** . The current waste limit covers 74.2 acres. The design boundary will need to be updated when the new fill plan is submitted to the DEQ.

The County is constructing 15-20 foot high lifts. In recent history, the lifts have progressed from north to south. The crew grades each lift so that positive drainage is maintained across the top deck from east to west. Storm water control benches have been constructed every 20-40 feet of elevation along the western fill slope.

## 6.3 Proposed Fill Sequence and Design Criteria

The Tetra Tech/Great West team has developed the conceptual fill plan based on the following:

- Stability analysis of landfill
- Site topographic map from October 2014 (Miller Creek Aerial Mapping)
- Site inspection
- Discussions with PBSL Director on preferred fill sequence and slope criteria

Tetra Tech completed an analysis of landfill stability and determined that the exterior slopes could be constructed at a ratio of up to 4:1 (four feet horizontal for each one foot vertical), and still provide the landfill with an adequate safety factor for stability (See Section 5 of this report). However, operational experience at the site has determined that a lower angle is more functional because of the difficulty establishing vegetation on finished slopes because of the arid climate and minimal topsoil that is available on-site for reclamation of the slopes.

The County has historically filled the existing finished slopes between 6:1 and 5:1. They would prefer to continue to fill exterior slopes at 5:1 except in the Phase 2 area (discussed later in this report). The reasons for selecting the lower angle slope (5:1) include more effective erosion and stormwater control on the final slopes. In addition, the largest slope will be along the western side of the fill that will likely be overlapped with the expansion of the landfill footprint in the future. We anticipate that the expansion design will be similar to that shown in the 1997 Total Canyon conceptual design. Tetra Tech recommends that a 20-foot wide storm water/erosion control bench be constructed for each 40 feet vertical of slope. The final design criteria for the conceptual fill plan are included in **Table 6-1**.

**Table 6-1. Conceptual Fill Plan Design Criteria**

| Item | Criteria |
|---|---|
| Fill Slopes | 5:1 (4:1 in Phase 2 Fill area) |
| Height between Stormwater Benches | 40 feet |
| Stormwater Bench Width | 20 feet |
| Minimum Finished Slope | 5% (20:1) |

The landfill has experienced an average growth in waste tonnage of 1.5% in recent history. **Table 6-2** projects the annual and cumulative tonnage for the facility from 2014 through 2045. The information in **Table 6-2** is used later in the report to project the life of each landfill phase.

**Table 6-2. Projected Annual & Cumulative Tonnage**

| Year | Waste Landfilled (tons/yr.) | Cumulative Waste Landfilled (tons) |
|---|---|---|
| 2014 | 211,955 | 211,955 |
| 2015 | 215,134 | 427,089 |
| 2016 | 218,361 | 645,450 |
| 2017 | 221,637 | 867,087 |
| 2018 | 224,961 | 1,092,048 |
| 2019 | 228,336 | 1,320,384 |
| 2020 | 231,761 | 1,552,145 |
| 2021 | 235,237 | 1,787,382 |
| 2022 | 238,766 | 2,026,148 |
| 2023 | 242,347 | 2,268,495 |
| 2024 | 245,982 | 2,514,477 |
| 2025 | 249,672 | 2,764,149 |
| 2026 | 253,417 | 3,017,566 |
| 2027 | 257,219 | 3,274,785 |
| 2028 | 261,077 | 3,535,862 |
| 2029 | 264,993 | 3,800,855 |
| 2030 | 268,968 | 4,069,823 |
| 2031 | 273,002 | 4,342,825 |
| 2032 | 277,097 | 4,619,922 |
| 2033 | 281,254 | 4,901,176 |
| 2034 | 285,473 | 5,186,649 |
| 2035 | 289,755 | 5,476,404 |
| 2036 | 294,101 | 5,770,505 |
| 2037 | 298,513 | 6,069,018 |
| 2038 | 302,990 | 6,372,008 |
| 2039 | 307,535 | 6,679,543 |
| 2040 | 312,148 | 6,991,691 |
| 2041 | 316,830 | 7,308,521 |
| 2042 | 321,582 | 7,630,103 |
| 2043 | 326,406 | 7,956,509 |
| 2044 | 331,302 | 8,287,811 |
| 2045 | 336,271 | 8,624,082 |
| **Total** | **8,624,082** | |

## 6.4 Phase 1 Fill Plan

Phase 1 consists of completing the fill on the current waste footprint. The County is placing the last full lift (15-20 ft. deep) within the southern third of the existing waste footprint. One more partial lift will placed on the waste footprint once that last full lift is complete. The northern third of the current landfill top deck matches elevation of the historic eastern ridgeline. The Landfill Director wants to delay placement of waste in this area because the next lift would be visible off site from the east.

Constructing the landfill above the historic ridge would make the site visible from several ranches and households east of the facility. This is the only direction from which the site will be readily visible for at least 30 years. We recommend the County consider installing visual screening along the east side of the landfill. This would consist of planting native, drought resistant trees along this boundary. The survivability of the trees could be enhanced by installing a drip irrigation system. Eventually with the Phase 4 fill plan, the landfill will become visible from the east and planting trees now would allow time for growth before the landfill reaches an elevation where it becomes visible. Tetra Tech's botanists in Boise can make a recommendation for appropriate species for the visual barrier.

This final lift will cover approximately two-thirds of the existing waste footprint and will be constructed to match the elevation of the historic ridgeline to minimize visibility to the east. The landfill top deck has been filled to this point with a cross slope from east to west of approximately 2%. The Director would like to complete the final lift in this same manner and place the minimum final 5% top deck grade as part of Phase 4 after completing Phases 1 to 3, as described below. **Figures 6-2 through 6-10 in Appendix 6-A** (Cross sections N 666,500 to N 668,100) show the conceptual fill configuration under Phase 1 and the addition of future waste in Phase 4 that will achieve the minimum 5% grade for the final fill.

The capacity estimate for Phase 1 is based off the most recent topographic map, which was completed in October 2014. Phase 1 had 2.3 years of capacity remaining as of October 2014. Therefore, there are 1.3 years remaining as of the date of this report. **Table 6-3** summarizes capacity estimates, life remaining, and needed soil volumes under the current daily operation and **Table 6-4** summarizes the same criteria if the landfill switched to a system utilizing alternative daily cover (ADC).

## 6.5 Phase 2 Fill Plan

Phase 2 consists of filling a triangular area northwest of the existing fill footprint. The boundary of this area is shown on **Figure 6-1 in Appendix 6-A**. This area is within the approved design boundary and represents a significant volume of waste disposal because of the overlapping air space created over the existing waste footprint. One reason the County wants to fill this area next is there is a large (approximately 60 feet high) historic waste slope that was constructed at an approximate slope angle of 1:1. Placing fill in this area would effectively buttress this waste slope. Soil will not be excavated from this expansion area because of an abandoned well in this area (PB-1) and the limited footprint available to conduct waste excavation,

The Director would like to keep the Phase 2 fill area east of Perch Road. The reason is to delay impacts to the Jubilee Park OHV recreational area west of the current perimeter fence. This results in a slight modification and reduction to the 1994 design boundary in this area. The Phase 2 slopes will be constructed at 4:1 so that the historic 1:1 slope can be completely covered and additional capacity developed above the historic waste footprint (See **Figures 6-8, 6-9 and 6-10 in Appendix 6-A** (Cross Sections N667,700; N667,900; and N668,100) for details. Phase 2 has 5.2 years of capacity under projected tonnage and current operational efficiency.

**Table 6-3. Conceptual Lift Plan Capacity, Life Estimates, Cover Soil Volume Needed Using the Current Daily Cover Operation**

| Phase | Capacity (CY) | Tonnage (Tons) | Cumulative Tonnage (Tons) | Life (Yrs) | Cover Soil Volume (CY) | Cumulative Soil Volume (CY) |
|---|---|---|---|---|---|---|
| Phase 1 | 856,000 | 503,000 | 503,000 | 2.3 | 268,000 | 268,000 |
| Phase 2 | 1,983,000 | 1,166,000 | 1,669,000 | 5.2 | 620,000 | 888,000 |
| Phase 3 | 547,2000 (2) | 3,219,000 | 4,888,000 | 12.5 | 1,710,000 | 2,598,000 |
| Phase 4 | 3,804,000 | 2,238,000 | 7,126,000 | 7.7 | 1,189,000 | 3,787,000 |
| **Total** | **12,115,000** | **7,126,000** | **-** | **27.7** | **3,787,000** | **-** |

(1) Life is based on last topographic map prepared in October 2014

(2) Phase 3 capacity includes proposed excavation of west borrow area

**Table 6-4. Conceptual Lift Plan Capacity, Life Estimates, and Cover Soil Volume Needed Using Alternative Daily Cover Operation**

| Phase | Capacity (CY) | Tonnage (Tons) | Cumulative Tonnage (Tons) | Life (Yrs) | Cover Soil Volume (CY) | Cumulative Soil Volume (CY) |
|---|---|---|---|---|---|---|
| Phase 1 | 856,000 | 552,000 | 552,000 | 2.6 | 143,000 | 143,000 |
| Phase 2 | 1,983,000 | 1,416,000 | 1,968,000 | 6.2 | 331,000 | 474,000 |
| Phase 3 | 5,472,000 (2) | 3,909,000 | 5,877,000 | 14.6 | 912,000 | 1,386,000 |
| Phase 4 | 3,804,000 | 2,717,000 | 8,594,000 | 8.5 | 634,000 | **2,020,000** |
| **Total** | **12,115,000** | **8,594,000** | **-** | **31.9** | **2,020,000** | **-** |

(1) Life is based on last topographic map prepared in October 2014

(2) Phase 3 capacity includes proposed excavation of west borrow area

## 6.6 Phase 3 Fill Plan

Phase 3 consists of filling the current soil borrow area in the southwest portion of the design boundary. This fill will provide significant overlap of the western portion of the existing waste footprint. The top of the fill will match the top deck slope elevations created under the Phase 1 and Phase 2 fill operation (See **Figure 6-8**, Cross Section N667,700). The argument for this approach is that it maximizes the amount of time that County can stay on the existing design boundary, which is where the perimeter fence is constructed. The County also wants to maximize the length of time that the public can use OHV portion of Jubilee Park outside the fenced boundary. The fill volume also includes excavating additional material from within the West Borrow Area as shown on cross sections N666,500 to N667,700 (**Figures 6-7 to 6-8** in Appendix 6-A).

Phase 3 has 12.5 years of capacity under the projected tonnage and current operational efficiency.

## 6.7 Phase 4 Fill Plan

Phase 4 consists of completing the top deck fill created by Phases 1-3. A minimum 5% grade will be constructed from the historic ridge to match the western slopes created under Phases 1-3. The 5% crown will make waste visible from the east, but the very gradual slope will minimize visibility issues because it will have more of a natural appearance (See **Figures 6-2 through 6-12 in Appendix 6-A**). With the completion of Phase 4 the final elevation of the fill would be approximately 3010 feet. With the addition of a vegetative visual screen, we do not expect visibility to be a public relations problem for the PBSL. Phase 4 has 7.7 years of capacity at projected tonnage and current operational efficiency.

## 6.8 Daily Cover and Soil Balance

The Operational Assessment completed as part of the Landfill Status Report calculated the current operations performance criteria for the landfill based on aerial mapping conducted at the facility. These criteria were used to determine the soil usage and tonnage capacity in each phase within **Table 6-3**. Measured criteria included the following:

- Waste to soil ratio - 2.2:1
- Compacted waste density - 1,690 lb/cy
- Volume per ton ratio - 1.7 CY/Ton

The operations criteria used for developing **Table 6-4** (ADC) included the following:

- Waste to soil ratio 5:1
- Compacted waste density 1,690 lb/cy
- Volume per ton ratio 1.4 CY/Ton

The PBSL currently excavates most of the daily cover for its operation from the West Borrow Area. The East Borrow Area is used to provide gravel for road and lift stabilization.

A conceptual cut plan was developed for maximizing the amount of soil that can be excavated from the West Borrow Area. Under this plan, the bottom of the West Borrow Area will be graded to drain at a minimum slope of 2% to the north, see **Figure 6-13 in Appendix 6-A** (Cross Section A-A'). Side slopes of the excavation will be excavated at 2:1. Tetra Tech examined the stability of this proposed excavation slope and height and determined that it has an adequate safety factor. Approximately 1,072,000 cubic yards of additional material can be excavated as of October 2014 from the West Borrow Area under this plan.

**Table 6-3** shows that adequate daily cover material is available from the West Borrow Area to complete all of Phases 1 and 2 as well as 1.5 years into Phase 3 under the current operational approach. This approach provides approximately 9 years of daily cover availability before the County will need to develop a new soil borrow area to provide the remainder of the daily cover material needed for Phases 3 and 4.

**Table 6-4** shows that that adequate daily cover material is available from the West Borrow Area to complete Phase 1 and 2 as well as 5.5 years into Phase 3 under the ADC alternative. This approach provides approximately 14.3 years of daily cover availability before the County will need to develop a new soil borrow area.

## 6.9 Conclusions and Recommendations

The analysis in this report indicates that the County has approximately 27 years of remaining capacity within the approved landfill design boundary. The life can be extended by approximately 15% by implementing ADC measures. If the County is in agreement with the conceptual plan presented in this report, we recommend the County first proceed with the development and DEQ approval of a detailed cut and fill plan. This process could take approximately six to eight months to complete. The cut and fill plan would provide specific information PBSL can use to construct the final and intermediate slopes to the proper grades and heights. The detailed fill plan would also provide detailed design information for the proper height and dimensions of stormwater benches that would be needed to control stormwater at the site. Benches will also provide access for final cover maintenance.

We recommend the County plant a vegetative visual barrier in order to mitigate future visibility concerns along the eastern side of the landfill; Tetra Tech can be consulted on appropriate species and irrigation requirements, if the County elects to proceed with this recommendation.

Depending on whether the County continues to use the current approach or implements ADC, the West Borrow Area will be fully excavated in 9 to 14 years. The County then will need to begin excavating cover soils from a new borrow area. Typically, the borrow area would located and designed to serve as the next cell for disposal of waste at the landfill. For PBSL this requires development of a plan in conjunction with an expansion licensing effort.

After approval of the cut and fill plan, the County will need to decide when to proceed with the design and licensing of the expansion area. PBSL has already completed a hydrogeologic investigation of the proposed expansion area. The EPA published new draft landfill gas rules in August 2015, which are currently in the comment period. One concern of the County and the Tetra Tech team was that implementation of the expansion might trigger the lower regulatory emissions limit for the PBSL and require installation of active gas collection infrastructure sooner than if the PBSL did not expand. After further review of the proposed rules, our opinion is that the PBSL is already subject to the lower regulatory limit proposed under the draft rule.

The federal rule is expected to be finalized early in 2016. States will have nine months to finalize their rules after the Federal rules are finalized. The EPA will then have four months to approve the State plans. Therefore, it is estimated that it will be mid-2017 before there is a final gas rule in place that impacts the PBSL. Once the rule is in place, the facility will have 30 months to install a gas collection system (late 2019).

We recommend the PBSL delay implementation of the expansion licensing until mid-2017 when the landfill gas rules are finalized. This will provide the County plenty of time to complete the process under its terms if difficulties are encountered during the regulatory approval process with the State. This will also allow adequate time to obtain approval for the expansion area so that the next borrow area is planned and available for excavation when the West Borrow area excavation has been completed.

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# 7.0 STORMWATER

An analysis of stormwater control was conducted for this status report update. This analysis included identification and evaluation of existing run-on and run-off controls along with recommendations for additional and/or improved controls where necessary.

A 25-year, 24-hour storm event (a criterion meeting that contained in the EPA's Solid Waste Disposal Facility Criteria Technical Manual, revised April 1998, and the Code of Federal Regulations, Title 40, Section 258.26 (40 CFR 258.26) was used to calculate design flows for the Landfill's on-site and off-site drainage features. The National Oceanic and Atmospheric Administration (NOAA) Atlas 2, Volume 5 provided the estimated 25-year, 24-hour precipitation value of 1.80 inches (**Appendix 7-A**). Utilizing AutoCAD software, the existing 2014, 2-foot landfill topography was divided into drainage tributaries. This was only possible by including the following recommended features into a preliminary design:

1) Inwardly pitched haul road/drainage benches that divide portions of the west fill face. This allows control of the stormwater rather than allowing it to continue downslope for very long distances. Such long distances of travel would cause excessive erosion of the west fill face cover (**Figure 7-1**);
2) Additional drainage channels, culverts and berms to manage and direct on-site stormwater away from or around future excavation and filling areas, and direct it to on-site retention basins; and,
3) Additional drainage channels and berms to divert off-site flow around the current site and future excavation/filling areas (See Stormwater plan Sheets located in **Appendix 7-B**).

The United States Army Corps of Engineers (USACE) Hydrologic Engineering Center's Hydrologic Modeling Software (HEC-HMS) was used for hydrology calculations estimating stormwater flows from each tributary and at each concentration point (CP, combination of tributaries); (**Table 7-1 to 7-4**). Hydraulic calculations for stormwater run-off control features were performed with the Bently software program FlowMaster (**Appendix 7-C**). The required retention basin storage capacities were prepared using an Excel spreadsheet based on the conical area method (**Appendix 7-D**).

Based on these stormwater calculations, the stormwater system improvements depicted in the Pickles Butte Landfill Status Report Update Project plan set (**Appendix 7-B**) will result in reduced future erosion rates and road crossing maintenance requirements. However, this analysis was performed assuming all stormwater control features as in-place. Therefore, it is important that the storm water improvements are prioritized and incorporated into the Capital Improvement Plan (CIP) to ensure that required features are installed as required.

Finally, although improved stormwater controls will result in reduced future erosion rates and road crossing maintenance requirements, storm event run-off will still include significant sediment transport. Modified and/or additional controls may become necessary in the future. It is critical for the viability of stormwater controls that maintenance take place after each storm event. Required maintenance would typically consist of sediment removal from stormwater conveyance structures and retention basins as well as repairing rills formed in slopes and erosion of berms. Disregard of such maintenance will inevitably, no matter how good the design, cause loss of conveyance capacity and a failure of the stormwater control system. The extents and costs of necessary repairs caused by disregard of routine maintenance would far exceed those incurred had routine maintenance been performed.

## 7.1 Regulations

As noted above, a 25-year, 24-hour storm event was used to calculate design flows for the Landfill's on-site and off-site drainage features. This criterion meets that contained in the *EPA's Solid Waste* Disposal *Facility Criteria Technical Manual, revised April 1998,* and the *Code of Federal Regulations, Title 40, Section 258.26* (40 CFR 258.26).

The e-CFR website (http://www.ecfr.gov/cgi-bin/ECFR?page=browse) as of October, 2015 states the following in Title 40, Chapter 1, Subchapter 1, Part 258, Subpart C, §258.26:

Title 40: Protection of Environment

PART 258 – CRITERIA FOR MUNICIPAL SOLID WASTE LANDFILLS

Subpart C – Operating Criteria

**§258.26 Run-on/run-off control systems**.

(a) Owners or operators of all MSWLF units must design, construct, and maintain:

(1) A run-on control system to prevent flow onto the active portion of the landfill during the peak discharge from a 25-year storm;

(2) A run-off control system from the active portion of the landfill to collect and control at least the water volume resulting from a 24-hour, 25-year storm.

(b) Run-off from the active portion of the landfill unit must be handled in accordance with §258.27(a) of this part.

[56 FR 51016, Oct. 9, 1991; 57 FR 28627, June 26, 1992]

The Landfill's ultimate outfalls have not been altered from their existing operating plan configuration. Outfall 1 (CPA7*; 20.78 ac) is at Basin A on the Landfill's southeast side. Outfall 2 (CPB1; 5.94 ac) is at Basin B on the Landfill's east side. Outfall 3 (CPC1; 1.86 ac) on the Landfill's northeast side. Outfall 4 (CPD21*; 114.57 ac) is on the Landfill's west side (**Appendix 7-B**, see index sheet).

The latitude (43.494406° N) and longitude (-116.704111° W) of the Landfill were used to estimate Precipitation Frequency Estimates (in inches) based on data from the NOAA Atlas 2, Volume 5. The estimated 25-year, 24-hour precipitation is 1.80 inches (Appendix 7-A Figure 28 – Isopluvials of 25-yr, 24-hr Precipitation in Tenths of an Inch). The program FlowMaster was used to design and evaluate the stormwater control elements. The channel velocities were checked for the 25-year, 24-hour storm event to ensure excessive erosion does not result.

## 7.2 Drainage Control

The existing facility drainage control is accomplished with a combination of sloped top deck, mid-slope roads/drainage benches (**Figure 7-1**), channels, and culverts. This existing system is well maintained, but has some shortcomings during larger storm events. It is important that these items are addressed prior to commencement of the planned Phase 2 and Phase 3 excavation and filling operations. This is because both Phase 2 and Phase 3 are located down-slope of the current fill slope. As such, improved and/or additional controls are required to direct stormwater around these future operations. The following paragraphs detail a proposed method of merging existing drainage controls with new or improved controls and results in an improved overall drainage control methodology.

The existing topography and stormwater drainage were carefully examined and evaluated. The facility was then delineated into drainage tributaries using existing and improved and/or additional features (**Appendix 7-B**).

First, potential run-on areas were identified. Potential run-on Region 1 is along the far southeast boundary. The existing roadside ditch should be sufficient to prevent run-on from making a northward crossing of Missouri Avenue. However, a berm should be added along the southwest edge of the intersection of Missouri Avenue and Perch Road. Potential run-on Region 2 is significant and impacts the south and southwest regions of the facility's southern and western sides. This is run-off from Pickles Butte and must be diverted by use of a berm and/or channel to prevent run-on from entering the facility's planned Phase 3 operations (**Appendix 7-B**).

Descriptions of the conveyance within each of the site's four drainage areas are presented below. Referencing the Plan Set, which includes a schematic of Basin Tributaries, Junctions, & Routing, is recommended (**Appendix 7-B**).

*Area A*

The entrance area (Area A) in the far southeast region of the facility contains seven tributaries, as described below.

- Area A1 flow is captured by an existing channel along its north side. This channel extends to the east edge of Perch Road. Flow from A1 is conveyed by a culvert into A2 at CPA1 (4.0 cfs).
- Area A2 flow is conveyed northward by a channel prior to a culvert crossing at CPA2* (5.0 cfs) into Basin A.
- Area A3 flows northeast, where it is conveyed by a culvert at CPA3 (1.0 cfs) into A4.
- Area A4 flow is captured and conveyed by a channel along its north edge to a culvert at CPA4* (6.4 cfs) and into A5.
- Area A5 flows are conveyed northward by a channel to a culvert a CPA5* (7.4 cfs) and into A6.
- Area A6 flows are conveyed eastward by a channel to a culvert at CPA6* (9.7 cfs) and into Basin A.
- Area A7 is the Basin A area. The total combined flow into Basin A is A7* (16.6 cfs).

*Area B*

Area B on the east side captures flow in between Area A and the perimeter access roads high point divide. This CPB1 flow (9.0 cfs) is directed to Basin B.

*Area C*

Area C is located just north of Area B, captures flows along the east side at CPC1 (3.0 cfs), and directs them to Basin C.

*Area D*

Area D encompasses the remaining current on-site flows. It is subdivided into 21 subareas, as described below.

- Area D1 flow is captured along its west edge by a combination of inward pitched haul roads and drainage channels and conveyed southward to CPD2* (37.1 cfs).
- Area D2 flow is captured along its southwest corner and west side and conveyed northward by this same pitched road and channel methodology to CPD2* (37.1 cfs). This flow is conveyed via culvert to Area D3.
- Area D3 flow is then conveyed southward to CPD3* (41.9 cfs) where it crosses via culvert into Area D6 and is conveyed to CPD6* (61.5 cfs).
- Area D4 flow is conveyed to CPD4 (14.0 cfs) and crossed through a culvert into Area D6.

- Area D5 flow is conveyed to CPD5* (29.0 cfs) and into Area D6.
- Area D6 flow is conveyed to CPD6* (61.5 cfs) where it is crossed through a culvert into Area D9.
- Area D7 flow is conveyed to CPD7 (7.0 cfs) and crossed through a culvert into Area D8.
- Area D8 flow is conveyed to CPD8* (15.0 cfs) and crossed through a culvert into Area D9.
- Area D9 flow is conveyed to CPD9* (66.8 cfs) and crossed through a culvert into Area D18 (note that it may be possible to combine CPD9* and CPD17* flows and convey them through a single culvert to Area D18).
- Area D10 flow is conveyed to CPD10 (7.0 cfs) and into Area D11.
- Area D11 flow is conveyed to CPD11* (9.6 cfs) and crossed through a culvert into Area D12.
- Area D12 is conveyed to CPD12* (11.7 cfs) and crossed through a culvert to CPD14* (12.7 cfs). Note that Area D12 currently has a low lying region immediately east of the proposed Phase 2 excavation area. It is therefore important that this region have a berm and culvert to prevent flow entering into the proposed excavation.
- Area D13 flow is conveyed to CPD13 (1.0 cfs) and crossed through a culvert into Area D14.
- Area D14 flow is conveyed to CPD14* (12.7 cfs) and crossed through a culvert into Area D19.
- Area D15 is conveyed to CPD15 (2.0 cfs) and crossed though a culvert into Area D17.
- Area D16 flow is conveyed via channel along its east and north side to CPD16* (7.0 cfs) and into Area D17.
- Area D17 flow is conveyed via channel along its east side to CPD17* (68.3 cfs) and crossed through a culvert into Area D18.
- Area D18 flow is conveyed via channel along its east side to CPD18* (79.0 cfs) and into Area D19.
- Area D19 flow is conveyed via channel along its east side to CPD19* (79.2 cfs) and crossed through a culvert to Basin D.
- Area D20 flow is conveyed via roadside channel along the west side of Perch Road and then around the proposed Phase 3 excavation area to CPD20 (5 cfs) and into Basin D.
- Area D21 is the Basin D area. The total combined flow into Basin D is D21* (82.1 cfs).

In summary, the existing/proposed facility drainage control is accomplished with a combination of an existing sloped top deck, inward pitched haul roads (the existing roads do not currently appear to have enough pitch to capture and convey stormwater), drainage channels, culverts and berms. Typical stormwater capture methods for the west fill face are depicted in **Figure 7-1**.

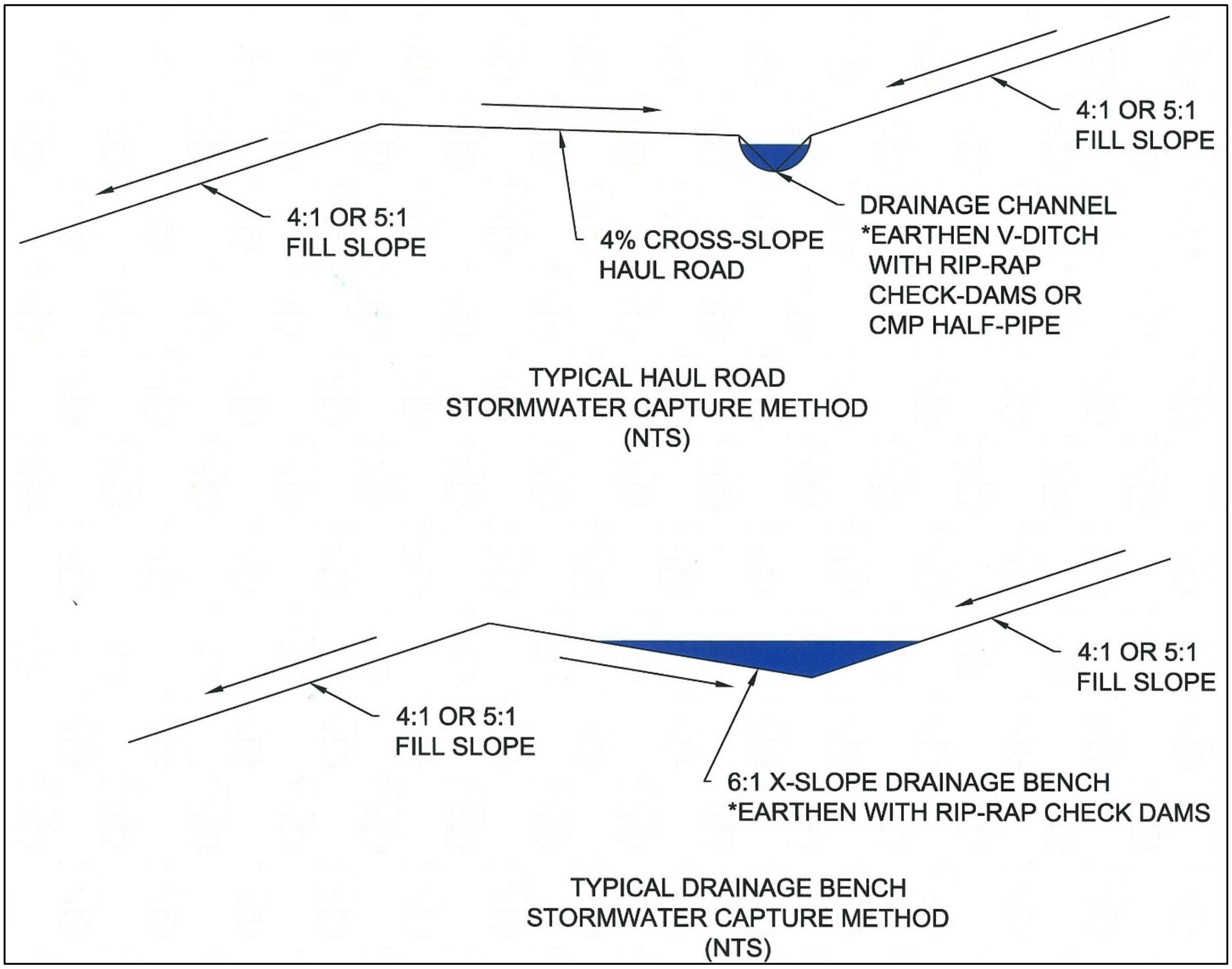


**Figure 7-1. West Fill Face Stormwater Capture Methods**

Pitching of the roads away from features to be protected is an important aspect of the presented mix of existing and proposed stormwater control methodologies. For example, the perimeter road around the proposed Phase 3 excavation should be pitched away from the excavation. Similarly, Area D17 should be pitched to drain eastward. Areas D18 and D19 are special case in that they should be pitched away from both the proposed Phase 2 and Phase 3 excavations; i.e. a channel down their centers.

All permanent stormwater control features should be protected from erosion by combinations of riprap, geotextile, and compacted, engineered fill materials. Intermediate features such channels along the insides of fill face drainage benches may be earthen but may require rip-rap check dams to prevent excessive stormwater velocities and resultant erosion. Routine maintenance following storm events is critical to the success of any stormwater control design.

## 7.3 Hydrology Methodology

The 2014 existing 2-foot Landfill topography was divided into tributaries utilizing AutoCAD software. The peak flows were calculated for each tributary and at each concentration point (combination of tributaries). The HEC-HMS software was utilized to perform hydrology calculations to estimate the stormwater run-off flows from each tributary (**Tables 7-1 to 7-4**). Conservatively, no canopy or infiltration losses were included in the modeling. The SCS Unit Hydrograph transform method with a Standard (PRF 484) graph type and 15-minute lag time was used for each tributary. The Lag routing method with no infiltration and a 15-minute lag time was used for routing of flows through tributaries. Based upon the Landfill's location, an SCS Type II Storm was selected as the synthetic rainfall distribution.

### 7.3.1 *Rainfall Data*

The guidelines set forth in the *EPA's Solid Waste Disposal Facility Criteria Technical Manual, revised April 1998*, and 40 CFR 258.26, call for the peak discharge flows to be estimated for a 25-year, 24-hour storm event. The latitude and longitude for the Landfill was taken from Google Earth. The latitude is 43.494406° N, the longitude is -116.704111° W. Based on this information, the NOAA Atlas 2, Volume 5 provided the estimated 25-year, 24-hour precipitation as 1.80 inches (**Appendix 7-A**).

### 7.3.2 *Stormwater Run-off Data*

A summary of the tributaries and flow at concentration points is shown in the **Table 7-1 through Table 7-4**:

**Table 7-1. 25-Year, 24-Hour Run-off Summary Table – Basin A**

| End Discharge | Tributary Area Name | Area (acres) | Run-off (cfs) | ∑Area (acres) | ∑Run-off (cfs) | Discharge To |
|---|---|---|---|---|---|---|
| Basin A (CPA7*) | A1 | 2.71 | 4.0 | 2.71 | 4.0 | A2 |
| | A2 | 4.35 | 2.0 | 4.35 | 2.0 | BASIN A |
| | A2* | - | - | 7.06 | 5.0 | BASIN A |
| | A3 | 0.95 | 1.0 | 0.95 | 1.0 | A4 |
| | A4 | 4.13 | 6.0 | 4.13 | 6.0 | A5 |
| | A4* | - | - | 5.08 | 6.4 | A5 |
| | A5 | 1.46 | 2.0 | 1.46 | 2.0 | A6 |
| | A5* | - | - | 6.54 | 7.4 | A6 |
| | A6 | 5.22 | 8.0 | 5.22 | 8.0 | BASIN A |
| | A6* | - | - | 15.38 | 9.7 | BASIN A |
| | A7 | 1.96 | 3.0 | 1.96 | 3.0 | BASIN A |
| | A7* | - | - | 20.78 | 16.6 | BASIN A |

**Table 7-2. 25-Year, 24-Hour Run-off Summary Table – Basin B**

| End Discharge | Tributary Area Name | Area (acres) | Run-off (cfs) | ∑Area (acres) | ∑Run-off (cfs) | Discharge To |
|---|---|---|---|---|---|---|
| Basin B (CPB1) | B1 | 5.94 | 9.0 | 5.94 | 9.0 | BASIN B |

**Table 7-3. 25-Year, 24-Hour Run-off Summary Table – Basin C**

| End Discharge | Tributary Area Name | Area (acres) | Run-off (cfs) | ∑Area (acres) | ∑Run-off (cfs) | Discharge To |
|---|---|---|---|---|---|---|
| Basin C (CPC1) | C1 | 1.86 | 3.0 | 1.86 | 3.0 | BASIN C |

**Table 7-4. 25-Year, 24-Hour Run-off Summary Table – Basin D**

| End Discharge | Tributary Area Name | Area (acres) | Run-off (cfs) | ∑Area (acres) | ∑Run-off (cfs) | Discharge To |
|---|---|---|---|---|---|---|
| Basin D (CPD21*) | D1 | 5.89 | 9.0 | 5.89 | 9.0 | D3 |
| | D2 | 18.18 | 28.0 | 18.18 | 28.0 | D3 |
| | D2* | - | - | 24.07 | 37.1 | D3 |
| | D3 | 6.60 | 10.0 | 6.60 | 10.0 | D6 |
| | D3* | - | - | 30.67 | 41.9 | D6 |
| | D4 | 9.09 | 14.0 | 9.09 | 14.0 | D6 |
| | D5 | 9.62 | 15.0 | 9.62 | 15.0 | D6 |
| | D5* | - | - | 18.71 | 29.0 | D6 |
| | D6 | 6.01 | 9.0 | 6.01 | 9.0 | D9 |
| | D6* | - | - | 55.39 | 61.5 | D9 |
| | D7 | 4.42 | 7.0 | 4.42 | 7.0 | D9 |
| | D8 | 5.04 | 8.0 | 5.04 | 8.0 | D9 |
| | D8* | - | - | 9.46 | 15.0 | D9 |
| | D9 | 1.89 | 3.0 | 1.89 | 3.0 | D18 |
| | D9* | - | - | 66.74 | 66.8 | D18 |
| | D10 | 4.44 | 7.0 | 4.44 | 7 | D11 |
| | D11 | 3.34 | 5.0 | 3.34 | 5.0 | D12 |
| | D11* | - | - | 7.78 | 9.6 | D12 |
| | D12 | 5.26 | 8.0 | 5.26 | 8.0 | D19 |
| | D12* | - | - | 13.04 | 11.7 | D19 |
| | D13 | 0.61 | 1.0 | 0.61 | 1.0 | D14 |
| | D14 | 0.51 | 1.0 | 0.51 | 1.0 | D19 |
| | D14* | - | - | 14.17 | 12.7 | D19 |
| | D15 | 0.96 | 2.0 | 0.96 | 2.0 | D17 |
| | D16 | 3.45 | 5.0 | 3.45 | 5.0 | D17 |
| | D16* | - | - | 4.42 | 7.0 | D17 |
| | D17 | 1.12 | 2.0 | 1.12 | 2.0 | D18 |
| | D17* | - | - | 72.29 | 68.3 | D18 |
| | D18 | 0.99 | 2.0 | 0.99 | 2.0 | D19 |
| | D18* | - | - | 87.44 | 79.0 | D19 |
| | D19 | 1.11 | 2.0 | 1.11 | 2.0 | BASIN D |
| | D19* | - | - | 88.55 | 79.2 | BASIN D |
| | D20 | 3.07 | 5.0 | 3.07 | 5.0 | BASIN D |
| | D21 | 22.94 | 36.1 | 22.94 | 36.1 | BASIN D |
| | D21* | - | - | 114.57 | 82.1 | BASIN D |

## 7.4 Stormwater Run-off Control

Hydraulic calculations, based on the Manning's Formula, for stormwater run-off control features were performed with the FlowMaster program. Stormwater control features and parameters for the 25-year, 24-hour storm event are shown in the **Tables 7-5 and 7-6**.

**Table 7-5. Summary of Culverts and Parameters for 25-Year, 24-Hour Storm Event**

| Culvert | Upstream Elev. [Ft] | Downstream Elev. [Ft] | Length [Ft] | Slope [Ft/Ft] | Normal Depth [Ft] | Dia. [Ft] | Disch. [Cfs] | Vel. [Ft/S] | # Culverts / Cfs Each |
|---|---|---|---|---|---|---|---|---|---|
| CPA1 | 2955 | 2952 | 64 | 0.047 | 0.78 | 1.0 | 4.0 | 6.1 | 1 |
| CPA2* | 2906 | 2904 | 18 | 0.111 | 0.66 | 1.0 | 5.0 | 9.0 | 1 |
| CPA3 | 2945 | 2942 | 59 | 0.051 | 0.33 | 1.0 | 1.0 | 4.5 | 1 |
| CPA4* | 2936 | 2934 | 45 | 0.044 | 0.78 | 1.5 | 6.4 | 6.9 | 1 |
| CPA5* | 2917 | 2916 | 28 | 0.036 | 0.91 | 1.5 | 7.4 | 6.6 | 1 |
| CPA6* | 2916 | 2911 | 64 | 0.078 | 0.85 | 1.5 | 9.7 | 9.4 | 1 |
| CPC1 | 2922 | 2921 | 24 | 0.042 | 0.65 | 1.0 | 3.0 | 5.5 | 1 |
| CPD2* | 2897 | 2895 | 49 | 0.041 | 1.31 | 2.0 | 37.1 | 8.7 | 2 / 19 |
| CPD3* | 2881 | 2877 | 62 | 0.065 | 1.20 | 2.0 | 41.9 | 10.7 | 2 / 21 |
| CPD4 | 2866 | 2865 | 121 | 0.008 | 1.44 | 2.5 | 14.0 | 4.4 | 1 |
| CPD6* | 2852 | 2850 | 30 | 0.067 | 1.60 | 2.0 | 61.5 | 11.5 | 2 / 31 |
| CPD7 | 2824 | 2823 | 92 | 0.011 | 1.05 | 2 | 7.0 | 4.2 | 1 |
| CPD8* | 2824 | 2823 | 52 | 0.019 | 1.47 | 2 | 15.0 | 6.1 | 1 |
| CPD9* | 2810 | 2807 | 51 | 0.059 | 1.44 | 2.5 | 66.8 | 11.6 | 2 / 34 |
| CPD11* | 2807 | 2802 | 46 | 0.109 | 0.76 | 1.5 | 9.6 | 10.7 | 1 |
| CPD12* | 2794 | 2768 | 332 | 0.078 | 0.96 | 1.5 | 11.7 | 9.8 | 1 |
| CPD13 | 2781 | 2778 | 45 | 0.067 | 0.30 | 1.0 | 1.0 | 5.0 | 1 |
| CPD14* | 2768 | 2761 | 56 | 0.125 | 0.86 | 1.5 | 12.7 | 12.0 | 1 |
| CPD15 | 2879 | 2872 | 59 | 0.119 | 0.38 | 1.0 | 2.0 | 7.4 | 1 |
| CPD17* | 2812 | 2807 | 74 | 0.068 | 1.4 | 2.5 | 68.3 | 12.4 | 2 / 35 |
| CPD19* | 2706 | 2702 | 93 | 0.043 | 1.80 | 2.5 | 79.2 | 10.6 | 2 / 40 |
| CPD20 | 2735 | 2734 | 31 | 0.032 | 0.74 | 1.5 | 5.0 | 5.7 | 1 |

**Note:** Assumes all culverts are corrugated metal pipe (CMP) with a roughness coefficient of 0.024

**Table 7-6. Summary of Channels and Parameters for 25-Year, 24-Hour Storm Event**

| Channel | Upstream Elev. [Ft] | Downstream Elev. [Ft] | Length [Ft] | Slope [Ft/Ft] | Roughness Coefficient | Normal Depth [Ft] | Dia. [Ft] | Discharge [Cfs] | Vel. [Ft/S] |
|---|---|---|---|---|---|---|---|---|---|
| CPA1-HALF-CMP | 2988 | 2955 | 499 | 0.066 | 0.024 | 0.54 | 1.5 | 4.0 | 7.1 |
| CPA1-V-DITCH-6"-RIPRAP | 2988 | 2955 | 499 | 0.066 | 0.069 | 0.83 | - | 4.0 | 2.9 |
| CPA2*-HALF-CMP | 2960 | 2906 | 1125 | 0.048 | 0.024 | 0.66 | 1.5 | 5.0 | 6.7 |
| CPA2*-V-DITCH-6"-RIPRAP | 2960 | 2906 | 1125 | 0.048 | 0.069 | 0.96 | - | 5.0 | 2.7 |
| CPA3-HALF-CMP | 2954 | 2945 | 308 | 0.029 | 0.024 | 0.38 | 1.0 | 1.0 | 3.7 |
| CPA3-V-DITCH-EARTHEN | 2954 | 2945 | 308 | 0.029 | 0.020 | 0.36 | - | 1.0 | 3.8 |
| CPA4*-HALF-CMP | 2942 | 2936 | 709 | 0.008 | 0.024 | 0.98 | 2.5 | 6.4 | 3.6 |
| CPA4*-V-DITCH-EARTHEN | 2942 | 2936 | 709 | 0.008 | 0.020 | 0.93 | - | 6.4 | 3.7 |
| CPA5*-HALF-CMP | 2934 | 2917 | 467 | 0.036 | 0.024 | 0.78 | 2.0 | 7.4 | 6.6 |
| CPA5*-V-DITCH-6"-RIPRAP | 2934 | 2917 | 467 | 0.036 | 0.069 | 1.18 | - | 7.4 | 2.7 |
| CPA6*-HALF-CMP | 2916 | 2915 | 391 | 0.003 | 0.024 | 1.48 | 3.0 | 9.7 | 2.8 |
| CPA6*-V-DITCH-EARTHEN | 2916 | 2915 | 391 | 0.003 | 0.020 | 1.31 | - | 9.7 | 2.8 |
| CPD2*-V-DITCH-EARTHEN | 2917 | 2897 | 983 | 0.020 | 0.020 | 1.51 | - | 37.1 | 8.1 |
| CPD3*-V-DITCH-EARTHEN | 2895 | 2881 | 1051 | 0.013 | 0.020 | 1.72 | - | 41.9 | 7.1 |
| CPD4-V-DITCH-EARTHEN | 2896 | 2866 | 1341 | 0.022 | 0.020 | 1.03 | - | 14.0 | 6.6 |
| CPD6*-V-DITCH-6"-RIPRAP | 2865 | 2852 | 704 | 0.018 | 0.069 | 2.97 | - | 61.5 | 3.5 |
| CPD7-V-DITCH-6"-RIPRAP | 2888 | 2824 | 1443 | 0.044 | 0.069 | 1.44 | - | 14.0 | 3.8 |
| CPD8*-V-DITCH-6"-RIPRAP | 2870 | 2824 | 906 | 0.051 | 0.069 | 1.44 | - | 15.0 | 3.6 |
| CPD9*-HALF-CMP | 2823 | 2810 | 383 | 0.034 | 0.024 | 1.92 | 4.0 | 66.8 | 11.2 |
| CPD9*-V-DITCH-6"-RIPRAP | 2823 | 2810 | 383 | 0.034 | 0.069 | 2.72 | - | 66.8 | 4.5 |
| CPD11*-HALF-CMP | 2926 | 2807 | 1125 | 0.106 | 0.024 | 0.67 | 2.0 | 9.6 | 10.4 |
| CPD11*-V-DITCH-6"-RIPRAP | 2926 | 2807 | 1125 | 0.106 | 0.069 | 1.06 | - | 9.6 | 4.3 |
| CPD12*HALF-CMP | 2802 | 2794 | 792 | 0.010 | 0.024 | 1.17 | 3.0 | 11.7 | 4.56 |
| CPD12*-V-DITCH-6"-RIPRAP | 2802 | 2794 | 792 | 0.010 | 0.069 | 1.78 | - | 11.7 | 1.9 |
| CPD13-HALF-CMP | 2806 | 2781 | 285 | 0.088 | 0.024 | 0.40 | 1.0 | 1.9 | 6.6 |

**Table 7-6. Summary of Channels and Parameters for 25-Year, 24-Hour Storm Event**

| Channel | Upstream Elev. [Ft] | Downstream Elev. [Ft] | Length [Ft] | Slope [Ft/Ft] | Roughness Coefficient | Normal Depth [Ft] | Dia. [Ft] | Discharge [Cfs] | Vel. [Ft/S] |
|---|---|---|---|---|---|---|---|---|---|
| CPD13-V-DITCH-6"-RIPRAP | 2806 | 2781 | 285 | 0.088 | 0.069 | 0.60 | - | 1.9 | 2.7 |
| CPD14*-HALF-CMP | 2778 | 2768 | 83 | 0.120 | 0.024 | 0.75 | 2.0 | 12.7 | 11.8 |
| CPD14*-V-DITCH-6"-RIPRAP | 2778 | 2768 | 83 | 0.120 | 0.069 | 1.15 | - | 12.7 | 4.8 |
| CPD15-HALF-CMP | 2922 | 2879 | 471 | 0.091 | 0.024 | 0.40 | 1.0 | 2.0 | 6.7 |
| CPD15-V-DITCH-6"-RIPRAP | 2922 | 2879 | 471 | 0.091 | 0.069 | 0.61 | - | 2.0 | 2.7 |
| CPD16-HALF-CMP | 2983 | 2872 | 1592 | 0.070 | 0.024 | 0.60 | 1.5 | 5.0 | 7.7 |
| CPD16-V-DITCH-6"-RIPRAP | 2983 | 2872 | 1592 | 0.070 | 0.069 | 0.90 | - | 5.0 | 3.1 |
| CPD17*-HALF-CMP | 2872 | 2812 | 647 | 0.093 | 0.024 | 1.56 | 3.5 | 68.3 | 16.4 |
| CPD17*-V-DITCH-6"-RIPRAP | 2872 | 2812 | 647 | 0.093 | 0.069 | 2.27 | - | 68.3 | 6.6 |
| CPD18*-HALF-CMP | 2807 | 2761 | 503 | 0.091 | 0.024 | 1.71 | 3.5 | 79.0 | 16.9 |
| CPD18*-V-DITCH-6"-RIPRAP | 2807 | 2761 | 503 | 0.091 | 0.069 | 2.41 | - | 79.0 | 6.8 |
| CPD19*-HALF-CMP | 2761 | 2704 | 451 | 0.126 | 0.024 | 1.56 | 3.5 | 79.2 | 19.1 |
| CPD19*-V-DITCH-6"-RIPRAP | 2761 | 2704 | 451 | 0.126 | 0.069 | 2.27 | - | 79.2 | 7.7 |
| CPD20-V-HALF-CMP | 2994 | 2736 | 3897 | 0.066 | 0.024 | 0.65 | 1.5 | 5.7 | 7.7 |
| CPD20-V-DITCH-6"-RIPRAP | 2994 | 2736 | 3897 | 0.066 | 0.069 | 0.95 | - | 5.7 | 3.1 |

## 7.5 Retention Pond Storage

The required retention basin storage capacities were prepared using an Excel spreadsheet based on the conical area method (**Appendix 7-D**). To strike a balance between seasonal differences a run-off coefficient of 0.7 was selected. A typical value may be 0.55 during most of the year. However, during portions of the year when snow cover and/or freezing ground is present, the run-off coefficient would be 1.0, meaning no infiltration would occur.

**Table 7-7** summarizes the basin design criteria and actual capacities.

**Table 7-7. 25-Year, 24-Hour Storm Event**

| Basin | Tributary Area (acres) | Run-off (cfs) | Volume Required (acre-ft.) | Volume Provided (acre-ft.) |
|---|---|---|---|---|
| A (CPA7*) | 20.78 | 16.6 | 2.18 | 2.34 |
| B (CPB1) | 5.94 | 9.0 | 0.62 | 0.87 |
| C (CPC1) | 1.86 | 3.0 | 0.20 | 0.20 |
| D (CPD21*) | 114.57 | 82.1 | 12.03 | 13.20 |

## 7.6 Adequacy of Design

Based on these stormwater calculations, the stormwater system improvements depicted in the Pickles Butte Landfill Status Report Update Project plan set (**Appendix 7-B**) will result in reduced future erosion rates and road crossing maintenance requirements. However, this analysis was performed assuming that all stormwater control features as described in this report will be used. Therefore, it is important that the storm water improvements are prioritized and incorporated into the CIP. **Table 7-8** summarizes the status of the stormwater features evaluated, and would the basis for the development of a CIP. It is important to note that some of the existing features may need to be modified per the evaluation.

**Table 7-8. Existing versus Proposed Stormwater Controls**

| Storm Water Controls | | Existing | Proposed | Notes |
|---|---|---|---|---|
| Culverts[3] | CPA1 | X | | 1 |
| | CPA2* | X | | 1 |
| | CPA3 | X | | 1 |
| | CPA4* | X | | 1 |
| | CPA5* | X | | 1 |
| | CPA6* | X | | 1 |
| | CPC1 | | X | |
| | CPD2* | | X | |
| | CPD3* | | X | |
| | CPD4 | | X | |
| | CPD6* | X | | 1 |
| | CPD7 | | X | |
| | CPD8* | | X | |
| | CPD9* | | X | |
| | CPD11* | | X | |
| | CPD12* | | X | |
| | CPD13 | | X | |
| | CPD14* | | X | |
| | CPD15 | X | | 1 |
| | CPD17* | | X | |
| | CPD19* | | X | |
| | CPD20 | | X | |
| **Channels[4]** | CPA1-HALF-CMP<br>CPA1-V-DITCH-6"-RIPRAP | X | | 1 |
| | CPA2*-HALF-CMP<br>CPA2*-V-DITCH-6"-RIPRAP | X | | 1, 2 |
| **Channels[4]** | CPA3-HALF-CMP<br>CPA3-V-DITCH-EARTHEN | | X | |
| | CPA4*-HALF-CMP | X | | 1, 2 |

**Table 7-8. Existing versus Proposed Stormwater Controls**

| Storm Water Controls | | Existing | Proposed | Notes |
|---|---|---|---|---|
| | CPA4*-V-DITCH-EARTHEN | | | |
| | CPA5*-HALF-CMP | X | | 1 |
| | CPA5*-V-DITCH-6"-RIPRAP | | | |
| | CPA6*-HALF-CMP | X | | 1 |
| | CPA6*-V-DITCH-EARTHEN | | | |
| | CPD2*-V-DITCH-EARTHEN | | X | |
| | CPD3*-V-DITCH-EARTHEN | | X | 1, 2 |
| | CPD4-V-DITCH-EARTHEN | | X | |
| | CPD6*-V-DITCH-6"-RIPRAP | | X | |
| | CPD7-V-DITCH-6"-RIPRAP | | X | |
| | CPD8*-V-DITCH-6"-RIPRAP | | X | |
| | CPD9*-HALF-CMP | | X | |
| | CPD9*-V-DITCH-6"-RIPRAP | | | |
| | CPD11*-HALF-CMP | | X | |
| | CPD11*-V-DITCH-6"-RIPRAP | | | |
| | CPD12*HALF-CMP | | X | |
| | CPD12*-V-DITCH-6"-RIPRAP | | | |
| | CPD13-HALF-CMP | | X | |
| | CPD13-V-DITCH-6"-RIPRAP | | | |
| | CPD14*-HALF-CMP | | X | |
| | CPD14*-V-DITCH-6"-RIPRAP | | | |
| | CPD15-HALF-CMP | X | | 1, 2 |
| | CPD15-V-DITCH-6"-RIPRAP | | | |
| | CPD16-HALF-CMP | X | | 1, 2 |
| | CPD16-V-DITCH-6"-RIPRAP | | | |
| | CPD17*-HALF-CMP | X | | 1, 2 |
| | CPD17*-V-DITCH-6"-RIPRAP | | | |
| | CPD18*-HALF-CMP | X | | 1, 2 |
| | CPD18*-V-DITCH-6"-RIPRAP | | | |
| | CPD19*-HALF-CMP | | X | |
| | CPD19*-V-DITCH-6"-RIPRAP | | | |
| | CPD20-V-HALF-CMP | | X | |
| | CPD20-V-DITCH-6"-RIPRAP | | | |
| **Basins** | A (CPA7*) | | X | |
| | B (CPB1) | | X | |
| | C (CPC1) | X | | |
| | D (CPD21*) | | X | |
| **Roads** | | X | | 5, 6 |
| **Berms** | | | X | 7 |

**NOTES**

1) Modify As Required Per Proposed
2) Partially Complete
3) Cmp & Rip-Rap Channels Presented As Comparison - In Most Cases Cmp Culvert Velocities Exceed The Recommended Maximum Of 8 Feet Per Second
4) Additional Cmp Culverts Are In-Place Since 2014 Topography - Check Against & Merge With Proposed Controls
5) All Roads Are In-Place Except For Those Around The North Of Phase 2 And South & West Of Phase 3
6) All Roads Require Modification (Reverse-Pitch) To Keep Stormwater Within Proposed Tributaries/Channels
7) Includes Continuous Off-Site Berm Along South & West (Major Run-On Prevention From Pickles Butte; Includes Phase 3), From Southeast Corner North To Basin A (Including East Side Of Basin A), In Between East Fill Face And Perimeter Road, East Side Of Basin B, East Side Of Basin C, Along North Side Of Phase 2 (Minor Region), & At Low Portion Of Tributary D12 Immediately Above East Side Of Phase 2

Finally, although improved stormwater controls will result in reduced future erosion rates and road crossing maintenance requirements, storm event run-off will still include significant sediment transport. Modified and/or additional controls may become necessary in the future. It is critical for the viability of stormwater controls that maintenance take place after each storm event. Required maintenance might typically consist of sediment removal from stormwater conveyance structures and retention basins, as well as repairing rills formed in slopes and erosion of berms. Disregard of such maintenance will inevitably, no matter how good the design, cause loss of conveyance capacity and a failure of the stormwater control system. The extents and costs of necessary repairs caused by disregard of routine maintenance would far exceed those incurred had routine maintenance been performed.

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# 8.0 CLOSURE/POST-CLOSURE MAINTENANCE COST ESTIMATE

The EPA, as part of 40 CFR Part 258.7 (Subtitle D) criteria, requires that each landfill in operation after April 9, 1997 provide financial assurance sufficient to cover the cost of third party closure and post-closure care of the landfill. The EPA financial assurance requirements are included by reference in Title 39, Chapter 74, Idaho Code from 40 CFR Part 258 as amended. A cost estimate has been prepared in order to establish the basis for the proper level of funding to close and provide post-closure maintenance for the Landfill in an environmentally sound manner. The cost estimate was prepared based on the proposed closure design and post-closure maintenance procedures presented in the December 2012 Operations and Maintenance Manual. This estimate was then combined with an estimate for construction management/quality assurance services and a contingency cost for closure to determine the total cost estimate. The closure and post-closure cost estimate serves as the basis to fund the Landfill closure account over the life of the landfill.

## 8.1 Closure Cost Estimate

40 CFR Part 258.60 requires that the closure cost estimate be based on the largest area of the landfill ever requiring a final cover at any time during the active life of the landfill. The site design is for up to 116 acres; however, the largest area that would be open prior to the start of final cover application is the current landfill footprint of 74.2 acres. The financial assurance cost estimate will need to be updated as the landfill footprint increases. In addition to the cost for the current landfill footprint, the DEQ has requested the closure cost estimate for the final 116-acre build-out of the landfill. The closure plan features are grouped into categories for convenience in presenting the cost estimate. The total closure cost estimates are shown in **Tables 8-1** through **8-4,** and present two different types of final cover for each acreage scenario. The current final cover design is a capillary break. Equivalent performance at a lower cost may be obtained by using a 4-foot thick monolithic soil final cover. A brief description of the components included in each category is given below.

### 8.1.1 *Final Cover*

The currently approved final cover is a capillary break cover consisting of gravel, soil cover, and geotextile. **Tables 8-1** and **8-2** present the cost for placement of this cover. The proposed alternative final cover consists of a four-foot thick monolithic soil cover constructed with on-site soils. The cost for the alternative final cover is presented in **Tables 8-3** and **8-4**. The cost of constructing both types of final covers includes site preparation, removal of soils from onsite stockpiles, soil compaction, and site grading.

### 8.1.2 *Final Cover Construction Quality Assurance Monitoring And Testing*

Costs for construction quality assurance and monitoring and testing include the final cover placement tests, inspections and reporting.

### 8.1.3 *Final Cover Hydroseeding*

This category covers the cost of seeding the final cover area for erosion control. It includes preparing the soil, and planting native vegetative materials by hydroseeding. The closure cost estimate is based on non-irrigated open space for the end use of the site.

### 8.1.4 *Surface Water Management*

Costs for the drainage system include placement of temporary Best Management Practices (BMPs), installing downdrains, and constructing berms for all internal and external drainage structures. Costs for desilting or detention basins are not included because we assume that those improvements will be built prior to closure.

**Table 8-1. Pickles Butte Sanitary Landfill Current Footprint (74.2 Acres) Capillary Break Cover Closure Cost Estimate (2015)**

| Item No. | Item | Qty | Units | Unit Cost | Total |
|---|---|---|---|---|---|
| 1 | Mobilization, Survey, General and Supplemental Conditions | 1 | LS | $450,000 | $450,000 |
| 2 | Final Cover Construction (see below for cost details) | 74.2 | Acres | $44,568 | $3,306,946 |
| 3 | Surface Water Management | 74.2 | Acres | $20,000 | $1,484,000 |
| 4 | Preliminary Grading | 74.2 | Acres | $10,900 | $808,780 |
| 5 | Final Cover Hydroseeding | 74.2 | Acres | $1,000 | $74,200 |
| 6 | Demolition | 1 | LS | 150,000 | $150,000 |
| 7 | Construction Quality Assurance | 30 | Wk | $4,500 | $135,000 |
| 8 | Engineering Design | 1 | LS | $300,000 | $300,000 |
| 9 | Construction Management | 39 | Wk | $6,750 | $263,250 |
| | | | | Subtotal | $6,972,176 |
| | | | | Contingency (20%) | $1,394,435 |
| | | | | **Total** | **$8,366,611** |

| Capillary Break Cover Costs, Per Acre | |
|---|---|
| Gravel (assumes 12-inch thick layer) | $7,300 |
| Soil Cover (assumes 36-inch thick layer) | $24,200 |
| Geotextile | $13,068 |
| **Total Cost Per Acre** | **$44,568** |

**Notes:**

1 Typical costs for item 1 range between 5 to 10 percent of total construction cost; approximately 7 percent was used for this estimate.

2 Assumes $4.50 per cubic yard of gravel material (supply assumed to be available from the existing gravel borrow area on site), $5 per CY of soil material, and $0.30 per square foot of filter fabric installation. Gravel material will be more costly to excavate and place than a typical monocover material; and a thinner veneer of soil material above a geotextile will be significantly more expensive due to the requirement for use of low ground pressure equipment that will be needed to spread and compact the material above the geotextile along with the likeliness that all the slopes will have to be over-built horizontally and then cut back to final thickness.

3 Assumes $20,000 per acre to include temporary BMPs, installation of downdrains, berms for all internal and external drainage structures.

4 Assumes $0.25 per square foot for remedial grading to meet sub-grade elevations.

5 Based on typical construction costs for final vegetation establishment.

6 Estimated cost to remove several small buildings and scale facilities.

7 Assumes 30 weeks of CQA services at $4,400 per week for a 40-hour week for CQA staff at $100/hour and 5 days of per diem.

8 Engineering costs are estimated to be approximately 5 percent of total construction for a project of this size.

9 Assumes a 39-week construction period, 40-hour week for a construction manager at $150/hour and 5 days of per diem.

**Table 8-2. Pickles Butte Sanitary Landfill Full Build Out (116 Acres) Capillary Break Cover Closure Cost Estimate (2015)**

| Item No. | Item | Qty | Units | Unit Cost | Total |
|---|---|---|---|---|---|
| 1 | Mobilization, Survey, General and Supplemental Conditions | 1 | LS | $672,370 | $672,370 |
| 2 | Final Cover Construction (see below for cost details) | 116 | Acres | $44,568 | $5,169,888 |
| 3 | Surface Water Management | 116 | Acres | $20,000 | $2,320,000 |
| 4 | Preliminary Grading | 116 | Acres | $10,900 | $1,264,400 |
| 5 | Final Cover Hydroseeding | 116 | Acres | $1,000 | $116,000 |
| 6 | Demolition | 1 | LS | $150,000 | $150,000 |
| 7 | Construction Quality Assurance | 45 | Wk | $4,500 | $202,500 |
| 8 | Engineering Design | 1 | LS | $513,883 | $513,883 |
| 9 | Construction Management | 40 | Wk | $9,563 | $382,500 |
| | | | | Subtotal | $10,791,541 |
| | | | | Contingency (20%) | $2,158,308 |
| | | | | **Total** | **$12,949,849** |

| **Capillary Break Cover Costs, Per Acre** | |
|---|---|
| Gravel (assumes 12-inch thick layer) | $7,300 |
| Soil Cover (assumes 36-inch thick layer) | $24,200 |
| Geotextile | $13,068 |
| **Total Cost Per Acre** | **$44,568** |

**Notes:**

1 Typical costs for item 1 range between 5 to 10 percent of total construction cost; approximately 7 percent was used for this estimate.

2 Assumes $4.50 per cubic yard of gravel material (supply assumed to be available from the existing gravel borrow area on site), $5 per CY of soil material, and $0.30 per square foot of filter fabric installation. Gravel material will be more costly to excavate and place than a typical monocover material; and a thinner veneer of soil material above a geotextile will be significantly more expensive due to the requirement for use of low ground pressure equipment that will be needed to spread and compact the material above the geotextile along with the likeliness that all the slopes will have to be over-built horizontally and then cut back to final thickness.

3 Assumes $20,000 per acre to include temporary BMPs, installation of downdrains, berms for all internal and external drainage structures.

4 Assumes $0.25 per square foot for remedial grading to meet sub-grade elevations.

5 Based on typical construction costs for final vegetation establishment.

6 Estimated cost to remove several small buildings and scale facilities.

7 Assumes 30 weeks for one full-time and one part-time CQA Staffperson for CQA services at $4,750 per week for a 40 hour week for CQA staff at $100/hour and 5 days of per diem.

8 Engineering costs are estimated to be approximately 5 percent of total construction for a project of this size.

9 Assumes a 40 week construction period, 40 hour week for a construction manager at $150/hour and 5 days of per diem and 20 week period. 40 hour week for a construction supervisor at $125/hour and five days of per diem.

**Table 8-3. Pickles Butte Sanitary Landfill Current Footprint (74.2 acres) Monolithic Cover Closure Cost Estimate (2015)**

| Item No. | Item | Qty | Units | Unit Cost | Total |
|---|---|---|---|---|---|
| 1 | Mobilization, Survey, General and Supplemental Conditions | 1 | LS | $450,000 | $450,000 |
| 2 | Final Cover Construction (assumes 4-feet thick soil layer) | 74.2 | Acres | $25,800 | $1,914,360 |
| 3 | Surface Water Management | 74.2 | Acres | $20,000 | $1,484,000 |
| 4 | Preliminary Grading | 74.2 | Acres | $10,900 | $808,780 |
| 5 | Final Cover Hydroseeding | 74.2 | Acres | $1,000 | $74,200 |
| 6 | Demolition | 1 | LS | $150,000 | $150,000 |
| 7 | Construction Quality Assurance | 30 | Wk | $4,750 | $142,500 |
| 8 | Engineering Design | 1 | LS | $300,000 | $300,000 |
| 9 | Construction Management | 39 | Wk | $6,750 | $263,250 |
| | | | | Subtotal | $5,587,090 |
| | | | | Contingency (20%) | $1,117,418 |
| | | | | **Total** | **$6,704,508** |

**Notes:**

1 Typical costs for item 1 range between 5 to 10 percent of total construction cost; approximately 7 percent was used for this estimate.

2 Assumes $4 per cubic yard for excavation, movement, placement, and compaction. Assumes material is available on-site and no processing is required.

3 Assumes $20,000 per acre to include temporary BMPs, installation of downdrains, berms for all internal and external drainage structures.

4 Assumes $0.25 per square foot for remedial grading to meet sub-grade elevations.

5 Based on typical construction costs for final vegetation establishment.

6 Estimated cost to remove several small buildings and scale facilities.

7 Assumes 30 weeks of CQA services at $4,400 per week for a 40-hour week for CQA staff at $100/hour and 5 days of per diem.

8 Engineering costs are estimated to be approximately 5 percent of total construction for a project of this size.

9 Assumes a 39-week construction period, 40-hour week for a construction manager at $150/hour and 5 days of per diem.

## Table 8-4. Pickles Butte Sanitary Landfill Full Build Out (116 acres) Monolithic Cover Closure Cost Estimate (2015)

| Item No. | Item | Qty | Units | Unit Cost | Total |
|---|---|---|---|---|---|
| 1 | Mobilization, Survey, General and Supplemental Conditions | 1 | LS | $520,000 | $520,000 |
| 2 | Final Cover Construction (assumes 4-feet thick soil layer) | 116 | Acres | $25,800 | $2,992,800 |
| 3 | Surface Water Management | 116 | Acres | $20,000 | $2,320,000 |
| 4 | Preliminary Grading | 116 | Acres | $10,900 | $1,264,400 |
| 5 | Final Cover Hydroseeding | 116 | Acres | $1,000 | $116,000 |
| 6 | Demolition | 1 | LS | $150,000 | $150,000 |
| 7 | Construction Quality Assurance | 30 | Wk | $4,500 | $202,500 |
| 8 | Engineering Design | 1 | LS | $400,000 | $400,000 |
| 9 | Construction Management | 39 | Wk | $9,563 | $382,500 |
| | | | | Subtotal | $8,348,200 |
| | | | | Contingency (20%) | $1,669,640 |
| | | | | **Total** | **$10,017,840** |

**Notes:**

1 Typical costs for item 1 range between 5 to 10 percent of total construction cost; approximately 7 percent was used for this estimate.

2 Assumes $4 per cubic yard for excavation, movement, placement, and compaction. Assumes material is available on-site and no processing is required.

3 Assumes $20,000 per acre to include temporary BMPs, installation of downdrains, berms for all internal and external drainage structures.

4 Assumes $0.25 per square foot for remedial grading to meet sub-grade elevations.

5 Based on typical construction costs for final vegetation establishment.

6 Estimated cost to remove several small buildings and scale facilities.

7 Assumes 30 weeks for one full-time and one part-time CQA Staffperson for CQA services at $4,750 per week for a 40-hour week for CQA staff at $100/hour and 5 days of per diem.

8 Engineering costs are estimated to be approximately 5 percent of total construction for a project of this size.

9 Assumes a 40-week construction period, 40-hour week for a construction manager at $150/hour and 5 days of per diem and 20-week period. 40-hour week for a construction supervisor at $125/hour and five days of per diem.

**Table 8-5. Pickles Butte Sanitary Landfill Annual Post-Closure Cost Estimate (2015)**

| Item No. | Item | Qty | Units | Unit Cost | Total |
|---|---|---|---|---|---|
| 1 | Final Cover Inspection and Maintenance | 1 | LS | $3,500 | $3,500 |
| 2 | Access Road Maintenance | 1 | LS | $2,500 | $2,500 |
| 3 | Drainage Control System Maintenance | 1 | LS | $5,000 | $5,000 |
| 4 | Site Security Inspection/Maintenance/Repair | 1 | LS | $2,500 | $2,500 |
| 5 | Survey Monument Inspection/Maintenance and Survey | 1 | LS | $3,000 | $3,000 |
| 6 | Landscape Maintenance | 1 | LS | $2,000 | $2,000 |
| 7 | Groundwater Monitoring System Maintenance | 1 | LS | $3,000 | $3,000 |
| 8 | Groundwater Monitoring | 1 | LS | $6,000 | $6,000 |
| 9 | Landfill Gas Monitoring | 1 | LS | $9,000 | $9,000 |
| 10 | Site Administration | 1 | LS | $20,000 | $20,000 |
| | | | | Subtotal | $56,500 |
| | | | | Contingency (20%) | $11,300 |
| | | | | Subtotal Annual Post-Closure Maintenance Cost | $67,800 |
| | | | | **Total 30 Year Post-Closure Maintenance Cost** | **$2,034,000** |

Notes:

1 Cost (labor and equipment) are included with the cost and hours for the post-closure maintenance and monitoring staff in Item 10. Materials used for the minor cover repairs are the materials stockpiled on-site from cleaning of the desilting basins. Assumes that major cover soils repair is below the vegetative layer of the final cover and only occurs once every ten years, so total annual cost reflected is 1/10 of the total cost. Soil used for cover repairs is from on-site stockpile.

2 Costs include asphalt crack repair-liquid filler and hot asphalt. Soil used for repairs of unpaved roads are from on-site stockpiles.

3 Estimated cost ($25,000 total every five years or $5,000/year) for replacement of 100 LF of the downdrain channels and two bench crossings every five years provided by contractor cost estimate. The estimated cost for replacement of the downdrain channel includes excavation, subgrade finish, and shotcrete. The estimated cost for the bench crossing includes excavation, AC berms, and subgrade finish. Additionally, costs include mobilization and demobilization, demolition of the channels, and disposal of the demo material off-site. Estimated cost for repairs of minor cracks are included in Site Administration hours (Item 10) for labor. Materials are included in access road maintenance materials (Item 2).

4 Cost and time for the inspections are included with the post-closure maintenance and monitoring staff in Item 10. Assumes replacement of approximately 500 lf of fencing every five years.

### 8.1.5 *Demolition*

This category includes costs for dismantling and removing the fee collection building and landfill scales including backfill of the scale pits. It also includes removing other small buildings and the office if not required for post-closure activities.

### 8.1.6 *Construction Management*

The construction management cost for the Landfill is based on the closure construction period. This cost is based on a 39-week estimated construction schedule.

### 8.1.7 *Engineering Design And Support*

This category includes costs for design support and for preparing construction-level engineering design plans and specifications for bid purposes. This cost is assumed to be five percent of the construction cost.

### 8.1.8 *Contingency*

A 20 percent contingency factor has been added to the construction cost estimate.

## 8.2 Post-Closure Maintenance Cost Estimate

The post-closure maintenance cost estimate has been prepared utilizing information contained in the December 2012 Operations and Maintenance Manual, and estimates of manpower, materials and equipment to maintain the Landfill in compliance with current applicable regulations.

The total annual maintenance and monitoring cost estimate for post-closure is shown on **Table 8-5**. The total 30-year post-closure cost estimate was calculated by multiplying the annual cost estimate from **Table 8-5** by 30 years. The 30-year post-closure cost obligation does not factor in inflation or interest over the funding period but assumes the rates will be similar. The actual future value of the 30-year total may be different.

It should be noted that the maintenance and monitoring costs presented have been projected utilizing current regulations and applicable requirements. In the event that changes occur in the regulatory conditions pertaining to the Landfill, these estimates will need to be adjusted accordingly. A brief description of the components included in each category is given below.

### 8.2.1 *Final Cover Inspection And Maintenance*

This cost includes inspection and maintenance of the final cover and assumes that any major final cover soil repairs are below the vegetative layer and only occur once every ten years. Soil used for cover repairs is assumed to come from an on-site stockpile.

### 8.2.2 *Access Road Maintenance*

This cost includes maintenance and repair of the main access road and dirt roads on the landfill including crack repair and re-grading. Soil used for unpaved roads is assumed to come from an on-site stockpile.

### 8.2.3 *Drainage Control System Maintenance*

This cost assumes replacement of 100 LF of the downdrain channels and two bench crossings every five years. The estimated cost for replacement of the downdrain channel includes excavation, subgrade finish, and shotcrete. The estimated cost for the bench crossing includes excavation, asphaltic concrete berms, and subgrade finish. Costs also include mobilization and demobilization, demolition of the channels, and disposal of the demolition material off-site.

### 8.2.4 *Site Security Inspection/Maintenance/Repair*

This cost assumes replacement of 500 linear feet of fencing every five years.

### 8.2.5 *Landscape Maintenance*

This cost includes erosion control (installation of erosion blanket, silt fencing, and hydroseeding), weed control (hand pulling and spraying), and reseeding (application of compost, soil amendments, and seed).

### 8.2.6 *Groundwater Monitoring System Maintenance*

This cost assumes general maintenance of the groundwater monitoring system including replacement of one groundwater well every 15 years and redevelopment of the wells, as necessary.

### 8.2.7 *Groundwater Monitoring*

This cost assumes semi-annual sampling and reporting.

### 8.2.8 *Landfill Gas Monitoring*

This cost assumes quarterly surface monitoring, semi-annual monitoring of buildings, and reporting.

#### 8.2.9 *Site Administration*

This item includes costs for scheduled inspections and reporting as well as annual permit fees and utilities.

#### 8.2.10 *Contingency*

A 20 percent contingency factor has been added to the annual post-closure maintenance and monitoring cost estimate.

## 8.3 Demonstration Of Financial Responsibility

In accordance with 40 CFR, Subpart G and Title 39, Chapter 74 of the Idaho Code, an operator must demonstrate financial assurance for the proper closure and post-closure maintenance. According to the Operations and Maintenance Manual, dated December 2012, the financial assurance mechanisms for the Pickles Butte Sanitary Landfill are in the form of a Local Government Financial Test and restricted cash account. Each year, the amount of financial assurance and the choice of funding instrument is reviewed and approved by the DEQ.

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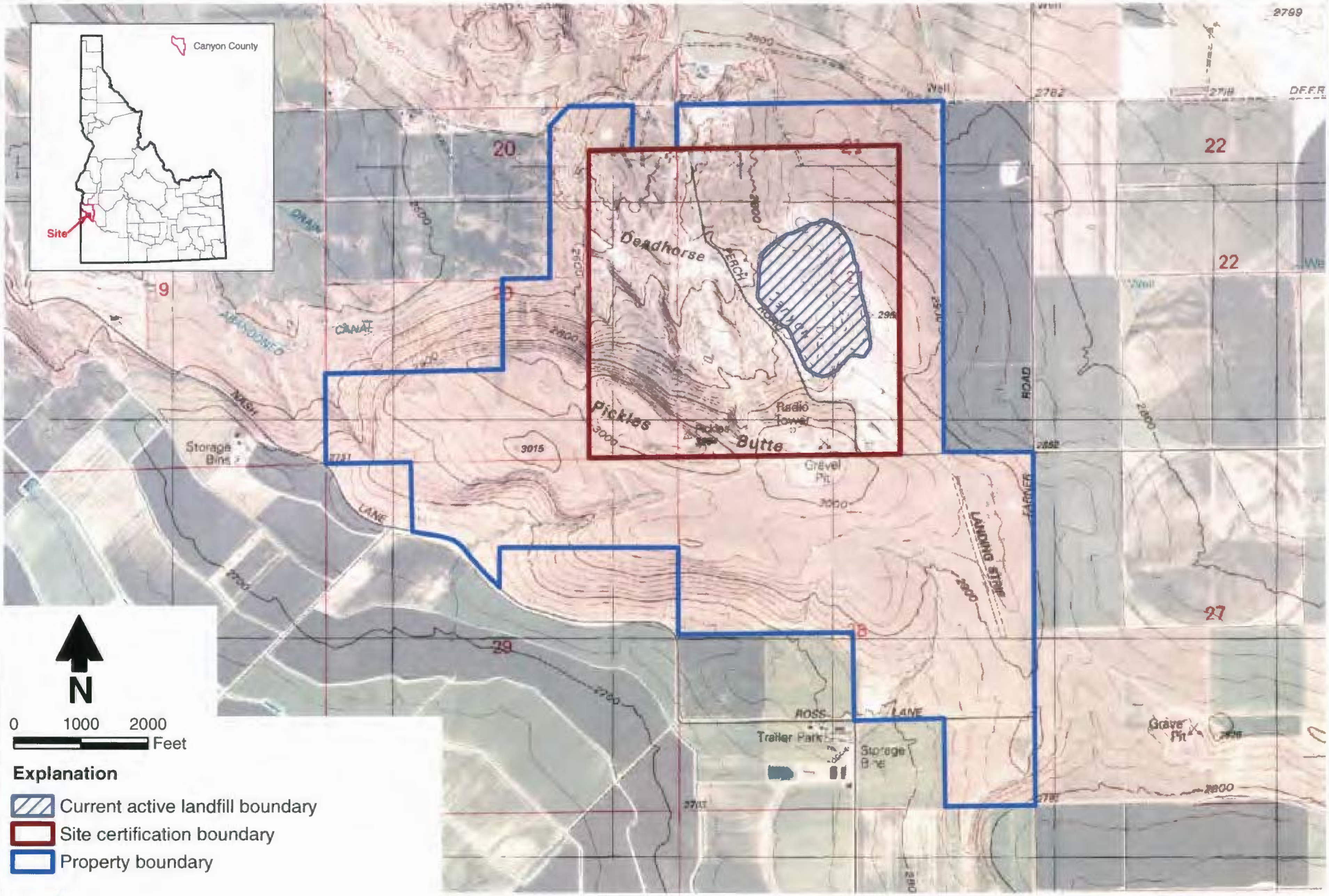
# APPENDIX 1-A
# SITE CERTIFICATION BOUNDARY

S:/PROJECTS/ES09.0154_PICKLES/GIS/MXDS/SITE_CERT/F01_SITE_LOCATION_MAP.MXD 017060




PICKLES BUTTE SANITARY LANDFILL

**Site Location Map**

*Daniel B. Stephens & Associates, Inc.*
06/07/2010
JN ES09.0154

Figure 1

# APPENDIX 1-B
# WASTE DISPOSAL RECORDS

Tonnage and MegaGram Records since Landfill Opened
Annual Tonnage for Greenhouse Gas Calculations
Year is defined by Oct 1 through Sept 30.
* 1983 April 1 through Sept 30.

| | Tons | Megagrams |
|---|---|---|
| 1983* | 18478 | 16768 |
| 1984 | 39503 | 35847 |
| 1985 | 42206 | 38299 |
| 1986 | 45074 | 40902 |
| 1987 | 48117 | 43663 |
| 1988 | 51345 | 46593 |
| 1989 | 54770 | 49701 |
| 1990 | 68472 | 62134 |
| 1991 | 72649 | 65925 |
| 1992 | 77081 | 69946 |
| 1993 | 81980 | 74392 |
| 1994 | 108065 | 98063 |
| 1995 | 113424 | 102926 |
| 1996 | 119,707 | 108627 |
| 1997 | 125,389 | 113783 |
| 1998 | 127,329 | 115543 |
| 1999 | 131,723 | 119531 |
| 2000 | 140,418 | 127421 |
| 2001 | 149,789 | 135924 |
| 2002 | 155,874 | 141446 |
| 2003 | 170,110 | 154365 |
| 2004 | 178,582 | 162052 |
| 2005 | 195,572 | 177470 |
| 2006 | 228,320 | 207187 |
| 2007 | 222,475 | 201883 |
| 2008 | 204,433 | 185511 |
| 2009 | 176,284 | 159968 |
| 2010 | 179,175 | 162591 |
| 2011 | 169,137 | 153482 |
| 2012 | 178,124 | 161637 |
| 2013 | 188,611 | 171153 |
| 2014 | 211,955 | 192337 |
| Totals | 4,074,170 | 3,697,069 |

# PICKLES BUTTE SANITARY LANDFILL

**TONNAGE RECORDS SINCE SCALE INSTALLATION**

| | 1994/1995 | 1995/1996 | 1996/1997 | 1997/1998 | 1998/1999 | | 1999/2000 | | 2000/2001 | | 2001/2002 | | 2002/2003 | | 2003/2004 | | 2004/2005 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | GROSS | NET | GROSS | NET | GROSS | NET | GROSS | NET | GROSS | NET | GROSS | NET | GROSS | NET |
| OCTOBER | | 11,038 | 10,957 | 10,830 | 11,013 | 11,013 | 11,156 | 11,142 | 12,614 | 12,605 | 13,519 | 13,514 | 15,044 | 15,021 | 15,127 | 14,391 | 14,925 | 14,409 |
| NOVEMBER | | 10,034 | 9,526 | 8,934 | 9,444 | 9,444 | 10,803 | 10,703 | 12,266 | 12,203 | 12,208 | 12,136 | 12,867 | 12,794 | 12,274 | 12,194 | 15,163 | 14,604 |
| DECEMBER | | 7,609 | 8,901 | 9,136 | 10,327 | 10,327 | 10,475 | 10,467 | 10,401 | 10,122 | 10,199 | 9,792 | 12,378 | 11,874 | 12,991 | 12,982 | 13,426 | 13,414 |
| JANUARY | | 8,078 | 9,181 | 9,327 | 8,764 | 8,764 | 9,754 | 9,750 | 10,164 | 10,159 | 11,703 | 11,696 | 12,237 | 12,230 | 11,353 | 11,344 | 12,794 | 12,641 |
| FEBRUARY | 7,372 | 7,895 | 7,853 | 8,029 | 9,032 | 9,032 | 9,999 | 9,914 | 9,935 | 9,866 | 9,757 | 9,400 | 11,562 | 11,388 | 10,984 | 10,983 | 12,881 | 12,871 |
| MARCH | 10,605 | 8,619 | 10,332 | 9,840 | 11,548 | 11,548 | 12,059 | 11,998 | 15,241 | 14,920 | 11,595 | 11,270 | 13,592 | 13,491 | 16,214 | 16,197 | 16,095 | 16,090 |
| APRIL | 8,768 | 10,738 | 10,967 | 11,269 | 11,586 | 11,567 | 11,974 | 11,960 | 13,146 | 13,084 | 14,608 | 13,984 | 15,178 | 15,144 | 17,124 | 16,969 | 17,512 | 16,958 |
| MAY | 10,939 | 12,125 | 12,393 | 12,288 | 11,491 | 11,427 | 13,827 | 13,780 | 14,818 | 14,141 | 16,037 | 15,514 | 16,596 | 15,758 | 16,602 | 15,553 | 19,368 | 19,346 |
| JUNE | 10,636 | 10,226 | 11,307 | 11,878 | 12,581 | 12,435 | 12,875 | 12,701 | 13,615 | 13,481 | 14,731 | 14,720 | 15,558 | 15,545 | 17,857 | 17,828 | 19,424 | 18,868 |
| JULY | 10,666 | 11,312 | 11,367 | 11,912 | 11,600 | 11,583 | 11,599 | 11,581 | 13,604 | 13,084 | 15,470 | 14,871 | 15,879 | 15,780 | 17,181 | 17,066 | 17,512 | 17,498 |
| AUGUST | 12,113 | 11,731 | 10,853 | 11,857 | 12,462 | 12,445 | 13,919 | 13,819 | 14,371 | 14,288 | 15,254 | 15,171 | 15,669 | 15,647 | 16,729 | 16,634 | 21,297 | 21,270 |
| SEPTEMBER | 9,728 | 10,300 | 11,753 | 12,028 | 12,146 | 12,138 | 13,361 | 12,603 | 12,335 | 11,835 | 14,365 | 13,807 | 15,632 | 15,437 | 16,463 | 16,441 | 18,638 | 18,505 |
| Annual Total | 80,827 | 119,707 | 125,389 | 127,329 | 131,994 | 131,723 | 141,801 | 140,418 | 152,510 | 149,789 | 159,446 | 155,874 | 172,191 | 170,110 | 180,899 | 178,582 | 199,034 | 196,474 |
| Adjusted Tonnage for Recycling | | | | | | 131,723 | | 140,418 | | 149,789 | | 155,874 | | 170,110 | | 178,582 | | 195,572 |
| Tons Recyled | | | | | | 271 | | 1,383 | | 2,721 | | 3,572 | | 2,081 | | 2,317 | | 3,462 |
| Pounds Recycled | | | | | | 542,000 | | 2,766,000 | | 5,442,380 | | 7,144,240 | | 4,162,460 | | 4,634,640 | | 6,924,040 |
| Mega Grams | 73,346 | 108,627 | 113,783 | 115,543 | | 119,531 | | 127,421 | | 135,924 | 144,688 | 141,446 | 156,254 | 154,365 | 164,155 | 162,052 | 180,611 | 177,470 |
| Gross % increase | | 48.10 | 4.75 | 1.55 | 3.66 | | 7.43 | | 7.55 | | 4.55 | | 7.99 | | 5.06 | | 10.02 | |
| % Recycled | | | | | | 0.21 | | 0.98 | | 1.78 | | 2.24 | | 1.21 | | 1.28 | | 1.74 |
| Net Effective Growth | | | | | | 3.45 | | 6.60 | | 6.67 | | 4.06 | | 9.13 | | 4.98 | | 9.51 |

| | 2005/2006 | | 2006/2007 | | 2007/2008 | | 2008/2009 | | 2009/2010 | | 2010/2011 | | 2011/2012 | | 2012/2013 | | 2013/2014 | | % Change |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GROSS | NET | GROSS | NET | GROSS | NET | GROSS | NET | GROSS | NET | GROSS | NET | GROSS | NET | GROSS | NET | GROSS | NET | |
| OCTOBER | 18,476 | 18,459 | 19,422 | 18,569 | 20,117 | 19,457 | 17,562 | 17,446 | 16117 | 16015 | 14506 | 14020 | 15399.5 | 15391.75 | 16976.1 | 16972.35 | 19384.90 | 19378.64 | 14.19 |
| NOVEMBER | 17,597 | 17,579 | 18,488 | 18,483 | 17,449 | 17,446 | 15,029 | 15,022 | 14960 | 14954 | 14493 | 14487 | 14810.5 | 14797.34 | 16631.7 | 15997.23 | 19129.72 | 19126.28 | 15.02 |
| DECEMBER | 14,622 | 14,615 | 14,684 | 14,204 | 13,190 | 12,754 | 12,953 | 11,776 | 12367 | 12366 | 11659 | 11658 | 12476 | 11912.03 | 12292.76 | 12088.80 | 13174.71 | 12957.15 | 7.17 |
| JANUARY | 15,906 | 15,757 | 15,734 | 15,725 | 13,669 | 13,662 | 11,528 | 11,510 | 11516 | 11510 | 11505 | 11491 | 11416 | 11345.49 | 10922.06 | 10920.73 | 13063.54 | 12452.42 | 19.61 |
| FEBRUARY | 15,897 | 15,359 | 14,679 | 14,540 | 13,089 | 12,913 | 11,285 | 10,972 | 11331 | 10443 | 11595 | 10293 | 11469.1 | 11462.85 | 11887.78 | 11707.00 | 12489.65 | 12027.99 | 5.06 |
| MARCH | 17,989 | 17,968 | 18,655 | 18,172 | 16,226 | 15,966 | 13,082 | 12,653 | 14812 | 14439 | 13215 | 13214 | 13943.2 | 13940.91 | 14827.06 | 14512.25 | 16288.08 | 16143.14 | 9.85 |
| APRIL | 20,618 | 20,585 | 19,880 | 19,860 | 18,754 | 18,356 | 15,820 | 15,745 | 16691 | 16176 | 15790 | 15782 | 16390.6 | 16373.38 | 17357.43 | 17348.42 | 19752.70 | 19149.51 | 13.80 |
| MAY | 24,029 | 23,170 | 23,850 | 22,740 | 20,729 | 20,280 | 17,862 | 17,245 | 16766 | 16751 | 16482 | 15648 | 18171.9 | 17051.45 | 20018.71 | 19133.11 | 21435.51 | 20768.89 | 7.08 |
| JUNE | 22,663 | 21,986 | 20,462 | 20,456 | 19,646 | 19,485 | 16,978 | 16,971 | 18344 | 18213 | 17233 | 17148 | 17290.5 | 17278.33 | 17612.79 | 17264.69 | 18664.17 | 18330.61 | 5.97 |
| JULY | 19,891 | 19,872 | 20,863 | 20,404 | 18,687 | 17,821 | 15,992 | 14,888 | 16684 | 15953 | 14986 | 14984 | 16055 | 16047.23 | 17851.42 | 17835.48 | 20403.21 | 20003.89 | 14.29 |
| AUGUST | 23,677 | 22,893 | 21,069 | 20,447 | 18,200 | 17,629 | 16,285 | 16,283 | 16574 | 16558 | 16123 | 15173 | 18028.6 | 17076.93 | 18875.35 | 18326.52 | 22194.69 | 21507.53 | 17.59 |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SEPTEMBER | 20,945 | 20,929 | 19,217 | 18,875 | 19,269 | 18,663 | 16,477 | 15,862 | 16060 | 15797 | 15921 | 15239 | 15551.7 | 15445.88 | 17368.97 | 16521.43 | 20394.75 | 20116.31 | 17.42 | 2013 Sum |
| Annual Total | 232,311 | 229,173 | 227,005 | 222,475 | 209,025 | 204,433 | 180,852 | 176,372 | 182,223 | 179,175 | 173,507 | 169,137 | 180,998 | 178,124 | 192,622 | 188,628 | 216,376 | 211,962 | 12.33 | 192,622 |
| Adjusted Tonnage for Recycling/fence | | 228,320 | | 222,475 | | 204,432.69 | | 176,284 | | 179,175 | | 169,137 | | 178,124 | 192,605 | 188,611 | 216,369 | 211,955 | | |
| Tons Recyled | | 3,991 | | 4,530 | | 4,592 | 2.53% | 4,570 | 1.67% | 3,048 | 2.52% | 4,370 | 1.59% | 2,874 | 2.07% | 3,994.08 | 2.04% | 4,413.27 | | |
| Pounds Recycled | | 7,982,560 | | 9,060,300 | | 9,183,840 | | 9,139,260 | | 6,095,900 | | 8,739,040 | | 5,748,180 | | 7,988,160 | | 8,826,540 | | |
| Mega Grams | 210,808 | 207,187 | 205,994 | 201,883 | 189,678 | 185,511 | | 159,968 | | 162,591 | | 153,482 | | 161,637 | | 171,169 | | 192,337 | | |
| Gross % incre | 16.72 | | -2.28 | | -7.92 | | -13.48 | | 0.76 | | -4.78 | | 4.32 | | 6.41 | | 12.33 | | | |
| % Recycled | | 1.72 | | 2.00 | | 2.20 | | 2.53 | | 1.67 | | 2.52 | | 1.59 | | 2.07 | | 2.04 | | |
| Net Effective Growth | | 16.21 | | -2.92 | | -8.11 | | -13.77 | | 1.59 | | -5.60 | | 5.31 | | 5.89 | | 12.37 | | |
| | | | | | | | | | | | | | Note:-4.75 Fence | | Note:-17.04 Fence | | Note: -7.10 Fence | | | |

| | 2014/2015 | | 20015/2016 | | 2016/2017 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | % Change | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GROSS | NET | GROSS | NET | GROSS | NET | GROSS | NET | GROSS | NET | GROSS | NET | GROSS | NET | GROSS | NET | GROSS | NET | | |
| OCTOBER | 20,010.76 | 19668.54 | 0 | -853 | 0 | -660 | 17,562 | 17,446 | 16117 | 16015 | 14506 | 14020 | 15399.5 | 15391.75 | 16976.1 | 16972.35 | 19384.90 | 19378.64 | 3.23 | |
| NOVEMBER | 14,979.30 | 14586.05 | 0 | -5 | 0 | -2 | 15,029 | 15,022 | 14960 | 14954 | 14493 | 14487 | 14810.5 | 14797.34 | 16631.7 | 15997.23 | 19129.72 | 19126.28 | -21.70 | |
| DECEMBER | 16,408.17 | 16091.87 | 0 | -481 | 0 | -437 | 12,953 | 11,776 | 12367 | 12366 | 11659 | 11658 | 12476 | 11912.03 | 12292.76 | 12088.80 | 13174.71 | 12957.15 | 24.54 | |
| JANUARY | 14,169.11 | 13918.32 | 0 | -9 | 0 | -6 | 11,528 | 11,510 | 11516 | 11510 | 11505 | 11491 | 11416 | 11345.49 | 10922.06 | 10920.73 | 13063.54 | 12452.42 | 8.46 | |
| FEBRUARY | 15,076.18 | 14904.99 | 0 | -139 | 0 | -176 | 11,285 | 10,972 | 11331 | 10443 | 11595 | 10293 | 11469.1 | 11462.85 | 11887.78 | 11707.00 | 12489.65 | 12027.99 | 20.71 | |
| MARCH | 17,990.33 | 17553.89 | 0 | -483 | 0 | -260 | 13,082 | 12,653 | 14812 | 14439 | 13215 | 13214 | 13943.2 | 13940.91 | 14827.06 | 14512.25 | 16288.08 | 16143.14 | 10.45 | |
| APRIL | 0 | 0 | 0 | -21 | 0 | -399 | 15,820 | 15,745 | 16691 | 16176 | 15790 | 15782 | 16390.6 | 16373.38 | 17357.43 | 17348.42 | 19752.70 | 19149.51 | 13.80 | |
| MAY | 0 | 0 | 0 | -1,111 | 0 | -449 | 17,862 | 17,245 | 16766 | 16751 | 16482 | 15648 | 18171.9 | 17051.45 | 20018.71 | 19133.11 | 21435.51 | 20768.89 | 7.08 | |
| JUNE | 0 | 0 | 0 | -6 | 0 | -160 | 16,978 | 16,971 | 18344 | 18213 | 17233 | 17148 | 17290.5 | 17278.33 | 17612.79 | 17264.69 | 18664.17 | 18330.61 | 5.97 | |
| JULY | 0 | 0 | 0 | -459 | 0 | -866 | 15,992 | 14,888 | 16684 | 15953 | 14986 | 14984 | 16055 | 16047.23 | 17851.42 | 17835.48 | 20403.21 | 20003.89 | 14.29 | |
| AUGUST | 0 | 0 | 0 | -622 | 0 | -571 | 16,285 | 16,283 | 16574 | 16558 | 16123 | 15173 | 18028.6 | 17076.93 | 18875.35 | 18326.52 | 22194.69 | 21507.53 | 17.59 | |
| SEPTEMBER | 0 | 0 | 0 | -342 | 0 | -606 | 16,477 | 15,862 | 16060 | 15797 | 15921 | 15239 | 15551.7 | 15445.88 | 17368.97 | 16521.43 | 20394.75 | 20116.31 | 17.42 | 2013 Sum |
| Annual Total | 98,633.85 | 96,723.66 | 0 | -4,530 | 0 | -4,592 | 180,852 | 176,372 | 182,223 | 179,175 | 173,507 | 169,137 | 180,998 | 178,124 | 192,622 | 188,628 | 216,376 | 211,962 | 78.95 | 120,914 |
| Adjusted Tonnage for Re | | 96,719.83 | | -4,530 | | -4,591.92 | | 176,284 | | 179,175 | | 169,137 | | 178,124 | 192,605 | 188,611 | 216,369 | 211,955 | | |
| Tons Recyled | | 1,914 | | 4,530 | | 4,592 | 2.53% | 4,570 | 1.67% | 3,048 | 2.52% | 4,370 | 1.59% | 2,874 | 2.07% | 3,994.08 | 2.04% | 4,413.27 | | |
| Pounds Recycled | | 3,828,040 | | 9,060,300 | | 9,183,840 | | 9,139,260 | | 6,095,900 | | 8,739,040 | | 5,748,180 | | 7,988,160 | | 8,826,540 | | |
| Mega Grams | 89,504 | 87,768 | 0 | -4,111 | 0 | -4,167 | | 159,968 | | 162,591 | | 153,482 | | 161,637 | | 171,169 | | 192,337 | | |
| Gross % incre | -54.42 | | -100.00 | | #DIV/0! | | #DIV/0! | | 0.76 | | -4.78 | | 4.32 | | 6.41 | | 12.33 | | | |
| % Recycled | | 1.94 | | #DIV/0! | | #DIV/0! | | 2.53 | | 1.67 | | 2.52 | | 1.59 | | 2.07 | | 2.04 | | |
| Net Effective Growth | | -54.37 | | -104.68 | | 1.36 | | -3939.01 | | 1.59 | | -5.60 | | 5.31 | | 5.89 | | 12.37 | | |
| | | | | | | | | | | | | | Note:-4.75 Fence | | Note:-17.04 Fence | | Note: -7.10 Fence | | | |

# APPENDIX 1-C
# POPULATION DATA

Thank you for your feedback! The new delivers the following improvements: Search by zip code, improved table display, browse more data feature, download data, and more.

## Canyon County, Idaho

| People QuickFacts | Canyon County | Idaho |
|---|---|---|
| Population, 2014 estimate | 203,143 | 1,634,464 |
| Population, 2010 (April 1) estimates base | 188,923 | 1,567,652 |
| Population, percent change - April 1, 2010 to July 1, 2014 | 7.5% | 4.3% |
| Population, 2010 | 188,923 | 1,567,582 |
| Persons under 5 years, percent, 2014 | 7.9% | 7.0% |
| Persons under 18 years, percent, 2014 | 29.9% | 26.4% |
| Persons 65 years and over, percent, 2014 | 12.5% | 14.3% |
| Female persons, percent, 2014 | 50.6% | 49.9% |
| White alone, percent, 2014 (a) | 93.7% | 93.5% |
| Black or African American alone, percent, 2014 (a) | 0.8% | 0.8% |
| American Indian and Alaska Native alone, percent, 2014 (a) | 1.7% | 1.7% |
| Asian alone, percent, 2014 (a) | 1.0% | 1.4% |
| Native Hawaiian and Other Pacific Islander alone, percent, 2014 (a) | 0.3% | 0.2% |
| Two or More Races, percent, 2014 | 2.5% | 2.3% |
| Hispanic or Latino, percent, 2014 (b) | 24.6% | 12.0% |
| White alone, not Hispanic or Latino, percent, 2014 | 71.3% | 82.8% |
| Living in same house 1 year & over, percent, 2009-2013 | 82.1% | 82.8% |
| Foreign born persons, percent, 2009-2013 | 8.4% | 5.9% |
| Language other than English spoken at home, pct age 5+, 2009-2013 | 18.1% | 10.4% |
| High school graduate or higher, percent of persons age 25+, 2009-2013 | 82.7% | 88.8% |
| Bachelor's degree or higher, percent of persons age 25+, 2009-2013 | 16.8% | 25.1% |
| Veterans, 2009-2013 | 13,416 | 122,955 |
| Mean travel time to work (minutes), workers age 16+, 2009-2013 | 23.6 | 20.0 |
| Housing units, 2014 | 71,326 | 685,099 |
| Homeownership rate, 2009-2013 | 69.3% | 69.8% |
| Housing units in multi-unit structures, percent, 2009-2013 | 11.4% | 14.9% |
| Median value of owner-occupied housing units, 2009-2013 | $122,800 | $162,100 |
| Households, 2009-2013 | 63,442 | 579,797 |
| Persons per household, 2009-2013 | 2.98 | 2.68 |
| Per capita money income in past 12 months (2013 dollars), 2009-2013 | $17,755 | $22,568 |
| Median household income, 2009-2013 | $42,105 | $46,767 |
| Persons below poverty level, percent, 2009-2013 | 20.4% | 15.5% |

| Business QuickFacts | Canyon County | Idaho |
|---|---|---|
| Private nonfarm establishments, 2013 | 3,627 | 43,124[1] |
| Private nonfarm employment, 2013 | 45,609 | 509,986[1] |
| Private nonfarm employment, percent change, 2012-2013 | 5.7% | 3.3%[1] |
| Nonemployer establishments, 2013 | 11,596 | 115,043 |
| Total number of firms, 2007 | 14,561 | 151,671 |
| Black-owned firms, percent, 2007 | 0.2% | 0.2% |
| American Indian- and Alaska Native-owned firms, percent, 2007 | 0.7% | 0.9% |
| Asian-owned firms, percent, 2007 | 0.6% | 0.8% |
| Native Hawaiian and Other Pacific Islander-owned firms, percent, 2007 | F | S |
| Hispanic-owned firms, percent, 2007 | 5.9% | 2.6% |
| Women-owned firms, percent, 2007 | 22.4% | 23.5% |
| Manufacturers shipments, 2007 ($1000) | D | 18,010,976 |

| | | |
|---|---|---|
| Merchant wholesaler sales, 2007 ($1000) | 992,925 | 14,286,715 |
| Retail sales, 2007 ($1000) | 2,176,039 | 20,526,631 |
| Retail sales per capita, 2007 | $12,171 | $13,691 |
| Accommodation and food services sales, 2007 ($1000) | 140,865 | 2,415,951 |
| Building permits, 2014 | 1,130 | 8,797 |
| **Geography QuickFacts** | **Canyon County** | **Idaho** |
| Land area in square miles, 2010 | 587.37 | 82,643.12 |
| Persons per square mile, 2010 | 321.6 | 19.0 |
| FIPS Code | 027 | 16 |
| Metropolitan or Micropolitan Statistical Area | Boise City, ID Metro Area | |

1: Includes data not distributed by county.
(a) Includes persons reporting only one race.
(b) Hispanics may be of any race, so also are included in applicable race categories.
D: Suppressed to avoid disclosure of confidential information
F: Fewer than 25 firms
FN: Footnote on this item for this area in place of data
NA: Not available
S: Suppressed; does not meet publication standards
X: Not applicable
Z: Value greater than zero but less than half unit of measure shown
Source U.S. Census Bureau: State and County QuickFacts. Data derived from Population Estimates, American Community Survey, Census of Population and Housing, State and County Housing Unit Estimates, County Business Patterns, Nonemployer Statistics, Economic Census, Survey of Business Owners, Building Permits
Last Revised: Wednesday, 14-Oct-2015 15:54:46 EDT

Thank you for your feedback! The new delivers the following improvements: Search by zip code, improved table display, browse more data feature, download data, and more.

# Owyhee County, Idaho

| People QuickFacts | Owyhee County | Idaho |
|---|---|---|
| Population, 2014 estimate | 11,353 | 1,634,464 |
| Population, 2010 (April 1) estimates base | 11,526 | 1,567,652 |
| Population, percent change - April 1, 2010 to July 1, 2014 | -1.5% | 4.3% |
| Population, 2010 | 11,526 | 1,567,582 |
| Persons under 5 years, percent, 2014 | 6.4% | 7.0% |
| Persons under 18 years, percent, 2014 | 26.6% | 26.4% |
| Persons 65 years and over, percent, 2014 | 16.3% | 14.3% |
| Female persons, percent, 2014 | 49.1% | 49.9% |
| White alone, percent, 2014 (a) | 91.7% | 93.5% |
| Black or African American alone, percent, 2014 (a) | 0.8% | 0.8% |
| American Indian and Alaska Native alone, percent, 2014 (a) | 4.5% | 1.7% |
| Asian alone, percent, 2014 (a) | 0.7% | 1.4% |
| Native Hawaiian and Other Pacific Islander alone, percent, 2014 (a) | 0.2% | 0.2% |
| Two or More Races, percent, 2014 | 2.0% | 2.3% |
| Hispanic or Latino, percent, 2014 (b) | 26.5% | 12.0% |
| White alone, not Hispanic or Latino, percent, 2014 | 68.2% | 82.8% |
| Living in same house 1 year & over, percent, 2009-2013 | 84.8% | 82.8% |
| Foreign born persons, percent, 2009-2013 | 10.3% | 5.9% |
| Language other than English spoken at home, pct age 5+, 2009-2013 | 21.2% | 10.4% |
| High school graduate or higher, percent of persons age 25+, 2009-2013 | 75.4% | 88.8% |
| Bachelor's degree or higher, percent of persons age 25+, 2009-2013 | 8.2% | 25.1% |
| Veterans, 2009-2013 | 922 | 122,955 |
| Mean travel time to work (minutes), workers age 16+, 2009-2013 | 27.2 | 20.0 |
| Housing units, 2014 | 4,769 | 685,099 |
| Homeownership rate, 2009-2013 | 64.2% | 69.8% |
| Housing units in multi-unit structures, percent, 2009-2013 | 5.4% | 14.9% |
| Median value of owner-occupied housing units, 2009-2013 | $121,200 | $162,100 |
| Households, 2009-2013 | 3,911 | 579,797 |
| Persons per household, 2009-2013 | 2.90 | 2.68 |
| Per capita money income in past 12 months (2013 dollars), 2009-2013 | $15,945 | $22,568 |
| Median household income, 2009-2013 | $32,175 | $46,767 |
| Persons below poverty level, percent, 2009-2013 | 24.2% | 15.5% |

| Business QuickFacts | Owyhee County | Idaho |
|---|---|---|
| Private nonfarm establishments, 2013 | 181 | 43,124[2] |
| Private nonfarm employment, 2013 | 1,612 | 509,986[2] |
| Private nonfarm employment, percent change, 2012-2013 | 5.6% | 3.3%[2] |
| Nonemployer establishments, 2013 | 635 | 115,043 |
| Total number of firms, 2007 | 999 | 151,671 |
| Black-owned firms, percent, 2007 | F | 0.2% |
| American Indian- and Alaska Native-owned firms, percent, 2007 | S | 0.9% |
| Asian-owned firms, percent, 2007 | F | 0.8% |
| Native Hawaiian and Other Pacific Islander-owned firms, percent, 2007 | F | S |
| Hispanic-owned firms, percent, 2007 | 4.0% | 2.6% |
| Women-owned firms, percent, 2007 | 21.6% | 23.5% |

| | | |
|---|---|---|
| Manufacturers shipments, 2007 ($1000) | 0[1] | 18,010,976 |
| Merchant wholesaler sales, 2007 ($1000) | 34,609 | 14,286,715 |
| Retail sales, 2007 ($1000) | 50,935 | 20,526,631 |
| Retail sales per capita, 2007 | $4,653 | $13,691 |
| Accommodation and food services sales, 2007 ($1000) | 4,150 | 2,415,951 |
| Building permits, 2014 | 16 | 8,797 |

| **Geography QuickFacts** | **Owyhee County** | **Idaho** |
|---|---|---|
| Land area in square miles, 2010 | 7,665.51 | 82,643.12 |
| Persons per square mile, 2010 | 1.5 | 19.0 |
| FIPS Code | 073 | 16 |
| Metropolitan or Micropolitan Statistical Area | Boise City, ID Metro Area | |

1: Counties with 500 employees or less are excluded.
2: Includes data not distributed by county.
(a) Includes persons reporting only one race.
(b) Hispanics may be of any race, so also are included in applicable race categories.
D: Suppressed to avoid disclosure of confidential information
F: Fewer than 25 firms
FN: Footnote on this item for this area in place of data
NA: Not available
S: Suppressed; does not meet publication standards
X: Not applicable
Z: Value greater than zero but less than half unit of measure shown
Source U.S. Census Bureau: State and County QuickFacts. Data derived from Population Estimates, American Community Survey, Census of Population and Housing, State and County Housing Unit Estimates, County Business Patterns, Nonemployer Statistics, Economic Census, Survey of Business Owners, Building Permits
Last Revised: Wednesday, 14-Oct-2015 15:54:52 EDT

Thank you for your feedback! The new delivers the following improvements: Search by zip code, improved table display, browse more data feature, download data, and more.

## Nampa (city), Idaho

| People QuickFacts | Nampa | Idaho |
|---|---|---|
| Population, 2014 estimate | 88,211 | 1,634,464 |
| Population, 2010 (April 1) estimates base | 81,748 | 1,567,652 |
| Population, percent change - April 1, 2010 to July 1, 2014 | 7.9% | 4.3% |
| Population, 2010 | 81,557 | 1,567,582 |
| Persons under 5 years, percent, 2010 | 9.8% | 7.8% |
| Persons under 18 years, percent, 2010 | 32.3% | 27.4% |
| Persons 65 years and over, percent, 2010 | 10.3% | 12.4% |
| Female persons, percent, 2010 | 51.0% | 49.9% |
| White alone, percent, 2010 (a) | 82.9% | 89.1% |
| Black or African American alone, percent, 2010 (a) | 0.7% | 0.6% |
| American Indian and Alaska Native alone, percent, 2010 (a) | 1.2% | 1.4% |
| Asian alone, percent, 2010 (a) | 0.9% | 1.2% |
| Native Hawaiian and Other Pacific Islander alone, percent, 2010 (a) | 0.4% | 0.1% |
| Two or More Races, percent, 2010 | 3.2% | 2.5% |
| Hispanic or Latino, percent, 2010 (b) | 22.9% | 11.2% |
| White alone, not Hispanic or Latino, percent, 2010 | 72.7% | 84.0% |
| Living in same house 1 year & over, percent, 2009-2013 | 80.0% | 82.8% |
| Foreign born persons, percent, 2009-2013 | 8.0% | 5.9% |
| Language other than English spoken at home, pct age 5+, 2009-2013 | 17.1% | 10.4% |
| High school graduate or higher, percent of persons age 25+, 2009-2013 | 83.0% | 88.8% |
| Bachelor's degree or higher, percent of persons age 25+, 2009-2013 | 17.0% | 25.1% |
| Veterans, 2009-2013 | 5,656 | 122,955 |
| Mean travel time to work (minutes), workers age 16+, 2009-2013 | 23.5 | 20.0 |
| Housing units, 2010 | 30,507 | 667,796 |
| Homeownership rate, 2009-2013 | 64.7% | 69.8% |
| Housing units in multi-unit structures, percent, 2009-2013 | 14.8% | 14.9% |
| Median value of owner-occupied housing units, 2009-2013 | $113,600 | $162,100 |
| Households, 2009-2013 | 27,227 | 579,797 |
| Persons per household, 2009-2013 | 2.99 | 2.68 |
| Per capita money income in past 12 months (2013 dollars), 2009-2013 | $16,813 | $22,568 |
| Median household income, 2009-2013 | $40,244 | $46,767 |
| Persons below poverty level, percent, 2009-2013 | 23.8% | 15.5% |

| Business QuickFacts | Nampa | Idaho |
|---|---|---|
| Total number of firms, 2007 | 6,775 | 151,671 |
| Black-owned firms, percent, 2007 | 0.4% | 0.2% |
| American Indian- and Alaska Native-owned firms, percent, 2007 | 1.0% | 0.9% |
| Asian-owned firms, percent, 2007 | 0.9% | 0.8% |
| Native Hawaiian and Other Pacific Islander-owned firms, percent, 2007 | F | S |
| Hispanic-owned firms, percent, 2007 | 5.9% | 2.6% |
| Women-owned firms, percent, 2007 | 22.2% | 23.5% |
| Manufacturers shipments, 2007 ($1000) | 1,412,643 | 18,010,976 |
| Merchant wholesaler sales, 2007 ($1000) | 709,659 | 14,286,715 |
| Retail sales, 2007 ($1000) | 1,483,882 | 20,526,631 |
| Retail sales per capita, 2007 | $18,823 | $13,691 |
| Accommodation and food services sales, 2007 ($1000) | 97,015 | 2,415,951 |

| Geography QuickFacts | Nampa | Idaho |
|---|---|---|
| Land area in square miles, 2010 | 31.19 | 82,643.12 |
| Persons per square mile, 2010 | 2,614.7 | 19.0 |
| FIPS Code | 56260 | 16 |
| Counties | | |

(a) Includes persons reporting only one race.
(b) Hispanics may be of any race, so also are included in applicable race categories.
D: Suppressed to avoid disclosure of confidential information
F: Fewer than 25 firms
FN: Footnote on this item for this area in place of data
NA: Not available
S: Suppressed; does not meet publication standards
X: Not applicable
Z: Value greater than zero but less than half unit of measure shown
Source U.S. Census Bureau: State and County QuickFacts. Data derived from Population Estimates, American Community Survey, Census of Population and Housing, County Business Patterns, Economic Census, Survey of Business Owners, Building Permits, Census of Governments
Last Revised: Wednesday, 14-Oct-2015 16:18:39 EDT

Thank you for your feedback! The new delivers the following improvements: Search by zip code, improved table display, browse more data feature, download data, and more.

## Caldwell (city), Idaho

| People QuickFacts | Caldwell | Idaho |
|---|---|---|
| Population, 2014 estimate | 50,224 | 1,634,464 |
| Population, 2010 (April 1) estimates base | 46,301 | 1,567,652 |
| Population, percent change - April 1, 2010 to July 1, 2014 | 8.5% | 4.3% |
| Population, 2010 | 46,237 | 1,567,582 |
| Persons under 5 years, percent, 2010 | 10.7% | 7.8% |
| Persons under 18 years, percent, 2010 | 33.1% | 27.4% |
| Persons 65 years and over, percent, 2010 | 8.9% | 12.4% |
| Female persons, percent, 2010 | 50.6% | 49.9% |
| White alone, percent, 2010 (a) | 77.5% | 89.1% |
| Black or African American alone, percent, 2010 (a) | 0.6% | 0.6% |
| American Indian and Alaska Native alone, percent, 2010 (a) | 1.2% | 1.4% |
| Asian alone, percent, 2010 (a) | 0.9% | 1.2% |
| Native Hawaiian and Other Pacific Islander alone, percent, 2010 (a) | 0.1% | 0.1% |
| Two or More Races, percent, 2010 | 3.6% | 2.5% |
| Hispanic or Latino, percent, 2010 (b) | 35.4% | 11.2% |
| White alone, not Hispanic or Latino, percent, 2010 | 60.8% | 84.0% |
| Living in same house 1 year & over, percent, 2009-2013 | 80.3% | 82.8% |
| Foreign born persons, percent, 2009-2013 | 10.9% | 5.9% |
| Language other than English spoken at home, pct age 5+, 2009-2013 | 24.4% | 10.4% |
| High school graduate or higher, percent of persons age 25+, 2009-2013 | 79.8% | 88.8% |
| Bachelor's degree or higher, percent of persons age 25+, 2009-2013 | 14.2% | 25.1% |
| Veterans, 2009-2013 | 2,755 | 122,955 |
| Mean travel time to work (minutes), workers age 16+, 2009-2013 | 21.9 | 20.0 |
| Housing units, 2010 | 16,323 | 667,796 |
| Homeownership rate, 2009-2013 | 64.8% | 69.8% |
| Housing units in multi-unit structures, percent, 2009-2013 | 15.6% | 14.9% |
| Median value of owner-occupied housing units, 2009-2013 | $99,500 | $162,100 |
| Households, 2009-2013 | 15,563 | 579,797 |
| Persons per household, 2009-2013 | 2.96 | 2.68 |
| Per capita money income in past 12 months (2013 dollars), 2009-2013 | $15,710 | $22,568 |
| Median household income, 2009-2013 | $39,242 | $46,767 |
| Persons below poverty level, percent, 2009-2013 | 21.6% | 15.5% |

| Business QuickFacts | Caldwell | Idaho |
|---|---|---|
| Total number of firms, 2007 | 2,945 | 151,671 |
| Black-owned firms, percent, 2007 | F | 0.2% |
| American Indian- and Alaska Native-owned firms, percent, 2007 | F | 0.9% |
| Asian-owned firms, percent, 2007 | F | 0.8% |
| Native Hawaiian and Other Pacific Islander-owned firms, percent, 2007 | F | S |
| Hispanic-owned firms, percent, 2007 | S | 2.6% |
| Women-owned firms, percent, 2007 | 24.7% | 23.5% |
| Manufacturers shipments, 2007 ($1000) | D | 18,010,976 |
| Merchant wholesaler sales, 2007 ($1000) | 83,384 | 14,286,715 |
| Retail sales, 2007 ($1000) | 611,804 | 20,526,631 |
| Retail sales per capita, 2007 | $15,400 | $13,691 |
| Accommodation and food services sales, 2007 ($1000) | 36,755 | 2,415,951 |

| Geography QuickFacts | Caldwell | Idaho |
|---|---|---|
| Land area in square miles, 2010 | 22.06 | 82,643.12 |
| Persons per square mile, 2010 | 2,095.6 | 19.0 |
| FIPS Code | 12250 | 16 |
| Counties | | |

(a) Includes persons reporting only one race.
(b) Hispanics may be of any race, so also are included in applicable race categories.
D: Suppressed to avoid disclosure of confidential information
F: Fewer than 25 firms
FN: Footnote on this item for this area in place of data
NA: Not available
S: Suppressed; does not meet publication standards
X: Not applicable
Z: Value greater than zero but less than half unit of measure shown
Source U.S. Census Bureau: State and County QuickFacts. Data derived from Population Estimates, American Community Survey, Census of Population and Housing, County Business Patterns, Economic Census, Survey of Business Owners, Building Permits, Census of Governments
Last Revised: Wednesday, 14-Oct-2015 16:18:35 EDT

# APPENDIX 1-D
# ORGANIZATION CHART
# AND JUNE 2015 SCHEDULE

# Canyon County Solid Waste Department

Operator

| June | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2015 | Su | M | T | W | Th | F | S | Su | M | T | W | Th | F | S | Su | M | T | W | Th | F | S | Su | M | T | W | Th | F | S | Su | M | T |
| Mike | | X | X | | | X | X | | | | X | X | X | X | | X | X | X | X | | | | X | X | | | X | X | | | |
| Daniel | | X | X | X | X | | | | X | X | X | X | | | | X | X | X | X | | | | X | X | X | X | | | | X | X |
| Cowboy | | | | X | X | X | X | | X | X | X | X | | | | X | X | | | X | X | | | | X | X | X | X | | X | X |
| Bert | | X | X | X | X | | | | X | X | | | X | X | | | | X | X | X | X | | X | X | X | X | | | | X | X |
| Will | | X | X | | | X | X | | X | X | | | X | X | | X | X | | | X | X | | X | X | | | X | X | | X | X |
| Rick | | | | X | X | X | X | | | | V | V | V | V | | | | X | X | X | X | | | | X | X | X | X | | | |
| Chet | | | | X | X | X | X | | | | X | X | X | X | | | | X | X | X | X | | | | X | X | X | X | | | |
| Michael | | X | X | X | X | | | | X | X | X | X | | | | X | X | X | X | | | | X | X | X | X | | | | | |

Screener

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Su | M | T | W | Th | F | S | Su | M | T | W | Th | F | S | Su | M | T | W | TH | F | S | Su | M | T | W | Th | F | S | Su | M | T |
| Eric | | X | X | | | X | X | | | | X | X | X | X | | X | X | X | X | | | | X | X | | | X | X | | | |
| Brandon | | | | X | X | X | X | | X | X | X | X | | | | X | X | | | X | X | | | | X | X | X | X | | X | X |
| Spencer | | X | X | X | X | | | | X | X | | | X | X | | | | X | X | X | X | | X | X | X | X | | | | X | X |

Code Enforcer

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Su | M | T | W | Th | F | S | Su | M | T | W | Th | F | S | Su | M | T | W | TH | F | S | Su | M | T | W | Th | F | S | Su | M | T |
| Bill | | X | X | | | X | X | | X | X | X | X | | | | | | X | X | X | X | | X | X | | | X | X | | X | X |
| Bags | | | | X | X | X | X | | X | X | | | X | X | | X | X | X | X | | | | | | X | X | X | X | | X | X |
| Todd | | X | X | X | X | | | | | | X | X | X | X | | X | X | | | X | X | | X | X | X | X | | | | | |

Ag day

Pay Days

Vacation

Scalehouse

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Su | M | T | W | Th | F | S | Su | M | T | W | Th | F | S | Su | M | T | W | TH | F | S | Su | M | T | W | Th | F | S | Su | M | T |
| Kim | | X | X | | | X | X | | X | X | X | X | | | | | | X | X | X | X | | X | X | | | X | X | | X | X |
| Kathy | | X | X | X | X | | | | | | X | X | X | X | | X | X | | | X | X | | X | X | X | X | | | | | |
| Kaylyn | | | | X | X | X | X | | X | X | | | X | X | | X | X | X | X | | | | | | X | X | X | X | | X | X |
| Charleen | | | | | | | X | | | | | | | X | | | | | | | X | | | | | | | X | | | |

Shop

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Su | M | T | W | Th | F | S | Su | M | T | W | Th | F | S | Su | M | T | W | TH | F | S | Su | M | T | W | Th | F | S | Su | M | T |
| Kirk | | X | X | X | X | | | | X | X | X | X | | | | X | X | X | X | | | | V | V | V | V | | | | X | X |
| Ken | | | X | X | X | X | | | | X | X | X | X | | | | X | X | X | X | | | | X | X | X | X | | | | |

# APPENDIX 1-E
# LANDFILL FEE SCHEDULE

# Minimum & General Fees

- Covered Load Requirements
- Material Waste Verification
- **Minimum & General Fees**
- Opportunities to Recycle
- Pay Online
- Solid Waste FAQs
- Type of Waste Accepted

## Canyon County Residents

***General Fee:*** $14.50 per ton
***Note:*** *It takes approximately 620lbs to exceed the minimum fee of $5.00*

A limit of ten (10) passenger or light truck tires for $2.00 each in addition to your weight.

Refrigeration units with or without compressors containing Freon or oil an additional fee of $15.00 per unit is charged in addition to your weight.

Clean wood wastes are accepted for a reduced fee of $12.00 per ton.

## Owyhee County Residents

***General Fee:*** $16.00 per ton
***Note:*** *It takes approximately 620lbs to exceed the minimum fee of $4.75.*

A limit of ten (10) passenger or light truck tires for $2.25 each in addition to your weight.

Refrigeration units with or without compressors containing Freon or oil an additional fee of $15.00 per unit is charged in addition to your weight.

Clean wood wastes are accepted for a reduced fee of $12.00 per ton.

# APPENDIX 1-F
# CAT PERFORMANCE MANUAL REFERENCES

## LANDFILLS

The most commonly accepted way to dispose of refuse is to bury it in a sanitary landfill. A sanitary landfill protects the environment by disposing solid waste on land in an engineered cell. Building a cell involves spreading the waste in thin layers, compacting it to the smallest practical volume, covering it with soil by the end of each working day, and compacting the cover material. Proper equipment selection and operating technique can maximize refuse and cover compaction and extend the operational landfill life.

## LANDFILL METHODS

There are three basic landfill methods:

In the *area* method, waste is usually deposited at the toe of the previously compacted cell and then spread and compacted. This method is attractive for landfills receiving over 450 metric tons (500 tons) of refuse per day because it reduces truck unloading congestion. Cover material is normally handled by articulated trucks or wheel tractor-scrapers from nearby borrow sites.

The *trench* method is normally found at smaller landfills where the ground water table is deep. A trench is excavated and refuse is deposited and compacted within it. Excavated material becomes the cover material. Since the trench working face is narrow, truck congestion can occur. This method is usually attractive to landfills receiving under 450 metric tons (500 tons) of refuse per day.

The *ramp* method combines the characteristics of both area and trench designs. Refuse is dumped, spread and compacted on existing slopes and covered with material excavated directly in front of the working face. The excavated area becomes part of the next cell. This is a good way for a landfill to begin operation with a minimum of equipment expenditures.

## EQUIPMENT SELECTION

A landfill's largest single cost for daily operation is purchasing, operating and maintaining the mobile equipment. Undersized, inadequate or unreliable equipment results in breakdowns, higher operating costs and improper landfill operation.

Landfill equipment performs three distinct functions:

1. Waste handling and compaction equipment dispose of the waste. Track-type tractors, track loaders, and landfill compactors are the primary machines.
2. Cover material handling machines provide daily cover requirements. If supplying cover material is a machine's sole function at a landfill, it can be selected on the basis of normal earthmoving considerations, such as material characteristics, distance to borrow areas, volume to be transported, and other basic earthmoving principles, i.e., maximizing earth movement in the least amount of time at the lowest cost per yard.
3. Support equipment includes motor graders, backhoe loaders, hydraulic excavators, water trucks, air compressors, service vehicles, water pumps, generators and any other necessary equipment.

### Track-Type Tractors

The track-type tractor is the most popular and versatile machine on a sanitary landfill. They not only spread and compact refuse and cover material, they also prepare the site, rip cover material, build haul roads, knock down trees, remove stumps, and work in virtually all weather conditions. They are well-suited for all three landfill methods (area, ramp, and trench).

The crawler tractor can achieve compaction densities of 475 to 590 kg/m³ (800-1000 lb/yd³). Maximum compaction is achieved when it works on a 3:1 slope, permitting the grousers to rip and tear while pushing and compacting waste up-slope. Economic limit of cover or waste movement by a track-type tractor is normally under 90 m (300 ft).

**ack Loaders**

Track loaders are highly versatile allowing them perform many applications. Small landfills under 5 metric tons (150 tons) per day generally utilize minimum amount of equipment. Track loaders can rve both the waste handling and cover material nctions.

The track loader is an ideal machine for the trench ethod. Since the bucket does not extend outside e tracks, it can obtain full compaction to the trench lls. Rippers can be attached to handle frozen cover aterial. Compaction densities are similar to or ghtly higher than the track-type tractor — 475 to 0 kg/m³ (800-1000 lb/yd³). Many people believe ck loaders equipped with single grouser shoes ovide maximum demolition and compaction denies. Loading the bucket during compaction passes creases weight helping achieve higher densities.

Equipping track loaders with multi-purpose buck- increases their versatility in single machine plications, allowing the operator to selectively pple items out of the working face.

**ndfill Compactors**

Landfill compactors are specialized pieces of equip- nt effective in spreading and compacting large umes of waste. Compactors offer higher opera- nal speeds than track machines. This is the rec- mended machine if more than one spreading and paction machine is needed and waste does not ve to be pushed more than 90 m (300 ft).

andfill compactors over 20 410 kg (45,000 lb) oper- ng weight achieve the highest compaction levels from 710 to 950 kg/m³ (1200-1600 lb/yd³).

andfill compactors normally operate on slopes no eper than 4:1 due to reduced compaction and oper- onal safety. Compactors should not be used to vate cover material.

**Wheel Loaders**

Although not recommended as a waste handling and compaction machine, wheel loaders are used by those communities sharing a single machine which travels from landfill to landfill. Versatility and mobility are the primary wheel loader advantages. In landfills over 272 metric tons (300 tons) per day, wheel loaders will sometimes be used to perform general clean-up tasks.

Wheel loaders can achieve compaction densities of 530 to 650 kg/m³ (900-1100 lb/yd³). A disadvantage of wheel loaders is that they can leave ruts in the refuse, requiring extra cover material.

**Wheel Tractor-Scrapers**

A scraper can be used to excavate trenches for site preparation, but usually performs a cover operation at a landfill and is most economical at distances over 185 m (600 ft). A scraper should be selected as if it were performing a typical earthmoving job.

Preferably, the scraper unloads the cover material close to the working face, either at the base or top. The cover material is then spread by the machine(s) working on the refuse. This reduces the possibility of tire damage from driving over the refuse. Foam filled tires are not recommended for scrapers due to the high travel speeds. Since excavating and transporting cover material is a major expense at a landfill, scrapers with work alone capability have been the most popular.

**Articulated Trucks**

Articulated trucks are versatile, highly maneuverable, all-weather haulers that can negotiate poor underfoot conditions and tight spaces normally found in landfills. In combination with a variety of loading tools, articulated trucks typically work in site preparation, cell construction, hauling cover material, and are economically effective at haul distances ranging from 0.1 km-5 km (600 ft-3 miles). In dump configuration, cover material can be dumped close to the face and spread by other machines. In ejector configuration, articulated trucks provide on-the-go dumping and can operate in soft material and on side-slopes that would not be suitable for machines in dump configuration. In addition, Cat articulated trucks are available in a range of container handler and refuse body configurations for specialized landfill applications.

### Machine Selection Factors

Selecting the type, size, quantity, and combination of machines required to spread, compact, and cover varying daily refuse volumes is determined by the following parameters:

1. Amount and type of waste to be handled (daily tonnage)
2. Amount and type of soil cover to be handled
3. Distance cover material to be transported
4. Weather conditions
5. Compaction requirements
6. Landfill method utilized
7. Supplemental tasks
8. Budget
9. Growth

A. *Daily tonnage and type of waste* — Amount of waste produced by a community is the major variable in selecting the appropriate size machine. The chart serves as a guideline in sizing a landfill machine. For example, if a community generates approximately 180 metric tons (200 tons) of refuse per day, a D6 or 963 and a 816 Landfill Compactor should be considered.

**WASTE EQUIPMENT SELECTION BASED UPON POPULATION AND DAILY REFUSE TONNAGE**

| Population | Metric Tons/ Day | U.S. Tons/ Day | Machine(s) Required |
|---|---|---|---|
| 0-20,000 | 0-45 | 0-50 | D3 or 939 |
| 20,000-60,000 | 45-136 | 50-150 | D4 or 939 and an 816 |
| 60,000-100,000 | 136-226 | 150-250 | D5 or D6 or 953 and 816 |
| 100,000-140,000 | 226-317 | 250-350 | D6 or D7 or 963 and 816 |
| 140,000-200,000 | 317-453 | 350-500 | D7 or D8 or 973 and 816 |
| 200,000-300,000 | 453-680 | 500-750 | D8 or D9 and 836 |
| 300,000-more | 680-more | 750-more | D9, D10 and 836/variety of support equipment |

NOTE: Daily tonnage figures are based on 2.25 kg (5 lb) of residential refuse per person per day. The amount of waste/person/day can vary depending on the community and should be adjusted to the individual community.

Type of waste to be handled will strongly influence machine selection. The major solid waste components for a community should be identified and the proper machine chosen based on the type of waste and the compaction desired. For example, if the site receives a high proportion of noncompactible heavy industrial waste (rocks, bricks, concrete, reinforcing rod, etc.) a compactor might not achieve normal compaction densities and the pushing and tractive ability of a track-type tractor may be needed. However, a small track-type tractor has more difficulty compacting bulk waste such as washing machines and telephone poles than a landfill compactor.

Waste varies from location to location, even within a community; however, the following figures are representative in the U.S.:

**Characterization of Domestic — Household Waste**

| Component | Percent by Weight |
|---|---|
| Paper | 42 |
| Food | 18 |
| Glass | 14 |
| Metal | 12 |
| Plastics | 5 |
| Wood | 5 |
| Rubber and Leather | 4 |
| Textiles | 2 |

NOTE: Moisture content can have a significant effect on waste characteristics. Field tests have indicated moisture content can vary from 10-30% during dry and wet seasons.

...mount and type of cover material to be handled —Although landfill size and type will vary, a rule of thumb for estimating needed cover material is one cubic meter (cubic yard) of cover material for every four cubic meters (or cubic yards) of in-place compacted waste. That is, about 20-25% of a sanitary landfill's volume consists of soil used for cover (including daily and final covering). On smaller landfills, the percentage of soil could be as high as 50% to meet reasonable cover requirements.

It is important to remember that cover material also occupies landfill space reducing the volume available for refuse. For example a landfill with 1 900 000 m³ (2,500,000 yd³) of *total volume* would provide for disposing of 1 520 000 m³ (2,000,000 yd³) of refuse and allow 380 000 m³ (500,000 yd³) of cover material. This example considers one cubic yard of cover for every 4 cubic yards of in place compacted waste.

The type of cover material can also be important. If the material is sandy or highly abrasive, a rubber tired wheel loader or scraper might be considered rather than a track-type unit.

C. *Distance cover material is to be transported* will have a large effect on cover equipment selection. The following economic limits or guidelines are recommended for cover material movement. The quantity of material to be moved and the time available must be considered when using these guidelines.

| | | |
|---|---|---|
| Track-type tractor | 0-90 m | (0-300 ft) |
| Track loader | 0-152 m | (0-500 ft) |
| Wheel loader | 0-185 m | (0-600 ft) |
| Wheel tractor-scraper | over 185 m | (over 600 ft) |
| Articulated trucks | over 185 m | (over 600 ft) |

D. *Weather conditions* — when working in inclement weather, the tractive capability of a track-type machine may be necessary for poor underfoot conditions or to *rip* frozen cover material.

E. *Compaction requirements* — are becoming critical as extended landfill life is sought. If high density is desired, then a compactor may be necessary.

The following pages contain features, specifications and work tools for Caterpillar's Waste Handling machines. Additional information regarding drawbar pull/rimpull Vs groundspeed, controls, ground pressures, production estimating for these machines as well as specifications and performance information for Wheel Tractor Scrapers and Articulated Trucks can be found in their respective Performance Handbook sections.

## REFUSE DENSITIES

Generally, loose residential and commercial refuse weighs 150-180 kg/m³ (250-300 lb/yd³). A refuse collection vehicle will increase this density to 237-415 kg/m³ (400-700 lb/yd³). In-place landfill density can vary from 355-890 kg/m³ (600-1500 lb/yd³), depending on the compactive effort applied to the refuse. Landfill sites that accept a high percentage of demolition waste can have densities up to 1485 kg/m³ (2500 lb/yd³). Cover material will generally raise fill densities 60-120 kg/m³ (100-200 lb/yd³) over the figures given above.

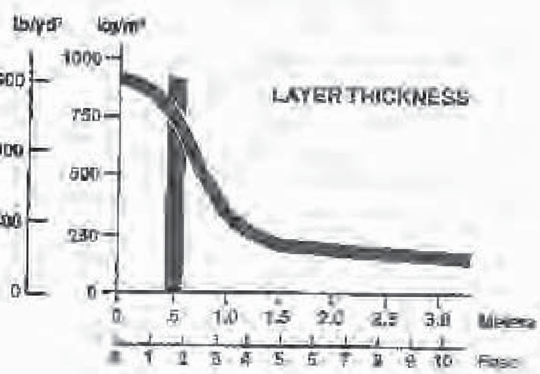
Weight of Refuse

| | kg/m³ | lb/yd³ |
|---|---|---|
| Loose Refuse: | 150-180 | 250-300 |
| Packer Truck: | 237-415 | 400-700 |
| Fill Density: | 355-890 | 600-1500 |
| Refuse and Cover: | 415-1009 | 700-1700 |

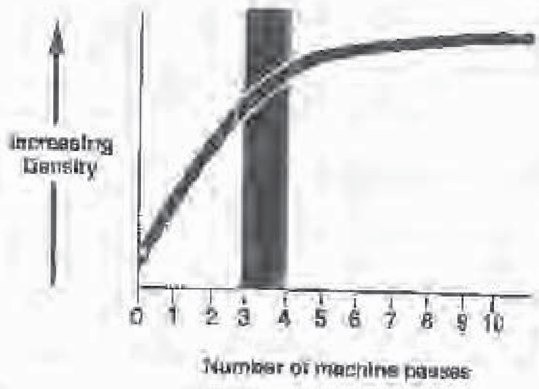
## FACTORS GOVERNING COMPACTION

Assuming equal machine weight, regardless of the type of machine, the following factors (1-4) affect compaction:

1. Refuse Layer Thickness — The depth of each compacted layer is perhaps the single most important controllable factor influencing density. To obtain maximum density, waste should be spread and compacted in layers **not exceeding a depth of 610 mm (2 ft)**. Thicker layers will reduce the density that a machine can develop in a given number of passes. (Density figures shown do not include cover material.)




2. Number of passes made over the refuse also affects density. Regardless of the type of machine used, the unit should make 3-4 passes to achieve optimum density. The following graph illustrates that more than four passes result in little additional compactive effort. The added expense of additional passes is not justified by the incremental increase in density.




3. Slope — Maximum compactive effort by a track-type unit is achieved by working the waste on a slope of 3:1. Track-type machines achieve higher densities by grinding and shredding the refuse into smaller pieces as they climb a slope.

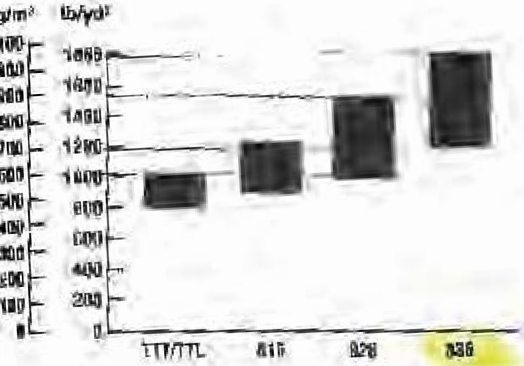
   Just the opposite is true for landfill compactors, the flatter the slope the better. This is because the weight of the landfill compactor is more efficiently utilized and concentrated when working on a flat surface. Landfill compactors that are used on slight slopes achieve a higher compaction density due to shearing stress that aids shredding and better blending of material.

4. Moisture Content — has been shown to have a significant effect on compacted density. It is believed that water tends to weaken the bridging characteristics of refuse, particularly paper such as large pieces of cardboard, etc., thereby allowing tighter consolidation. The water may also act as a lubricant — much as it does for soils. A minimum amount of moisture can increase refuse compaction density by 10%.

   The optimum moisture content for maximum compaction of household refuse appears to be around 50% by weight. Field tests show actual moisture contents varying from 10-60% during dry and wet seasons. Although higher moisture [illegible]

## MPACTION COMPARISON ESTIMATE

he following graph may be used as a rule of mb for the compactive ranges of various types andfill machines if proper operating technique mployed.




**EXAMPLE OF INCREASED COMPACTION ON POTENTIAL LANDFILL LIFE**

| | |
|---|---|
| ndfill refuse capacity | 1 530 000 m³ (2,000,000 yd³) |
| erating days | 260 |
| ily volume | 365 metric tons (400 tons) |
| ally volume | 94 320 metric tons (104,000 tons) |

| Compaction | | Landfill Life | Gain |
|---|---|---|---|
| 90 kg/m³ | 1000 lb/yd³ | 9.6 years | 0 |
| 10 kg/m³ | 1200 lb/yd³ | 11.5 years | 1.9 years |
| 30 kg/m³ | 1400 lb/yd³ | 13.4 years | 3.8 years |
| 60 kg/m³ | 1600 lb/yd³ | 15.3 years | 5.7 years |
| 70 kg/m³ | 1800 lb/yd³ | 17.2 years | 7.6 years |

In this example, each 120 kg (200 lb) increase in refuse density results in an additional 1.9 years of landfill life. Also this example is exclusive of cover requirements.

**COMPACTOR PRODUCTION GUIDELINES**

| | Tons/Day | | Tons/Hr | |
|---|---|---|---|---|
| Model | Metric | U.S. | Metric | U.S. |
| 836 | 1016 | 1000 | 127 | 125 |
| 826G | 813 | 800 | 102 | 100 |
| 816F | 508 | 500 | 63.5 | 62.5 |

All models are pushing refuse 61 m (200 ft) spreading and making 3 to 4 passes to compact. A pass is defined as: A machine traveling over the refuse one time in one direction on flat level ground. Adverse (uphill) or favorable (downhill) grades will affect the above production figures.

F. *Landfill method utilized* — impacts the equipment needed. The area method, which is generally suited for flat or gradual sloping surfaces will get maximum compaction effort with a compactor. The trench method may require a track loader due to its excavating and tractive capabilities.

G. *Supplemental tasks* — should be reviewed before selecting a landfill machine. Will the machine be required for site clearing, maintaining access roads, excavating, etc.? Auxiliary duties may require additional machine capability and/or attachments. If versatility is the key consideration, a track-type machine again becomes the logical choice.

H. *Budget* — Smaller landfill operations with limited budgets may have to consider single machine versatility ahead of specialized machines or multiple units.

I. *Growth* — Future increases in refuse volume must be considered to properly size machines.

# APPENDIX 1-G
# EQUIPMENT INFORMATION

# FEMA's SCHEDULE OF EQUIPMENT RATES

**DEPARTMENT OF HOMELAND SECURITY**
**FEDERAL EMERGENCY MANAGEMENT AGENCY**
RECOVERY DIRECTORATE
PUBLIC ASSISTANCE DIVISION
WASHINGTON, D.C. 20472

The rates on this Schedule of Equipment Rates are for applicant-owned equipment in good mechanical condition, complete with all required attachments. Each rate covers all costs eligible under the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C. § 5121, et seq., for ownership and operation of equipment, including depreciation, overhead, all maintenance, field repairs, fuel, lubricants, tires, OSHA equipment and other costs incidental to operation. Standby equipment costs are not eligible.

Equipment must be in actual operation performing eligible work in order for reimbursement to be eligible. LABOR COSTS OF OPERATOR ARE NOT INCLUDED in the rates and should be approved separately from equipment costs.

Information regarding the use of the Schedule is contained in 44 CFR § 206.228 *Allowable Costs.* Rates for equipment not listed will be furnished by FEMA upon request. Any appeals shall be in accordance with 44 CFR § 206.206 *Appeals.*

THESE RATES ARE APPLICABLE TO MAJOR DISASTERS AND EMERGENCIES DECLARED BY THE PRESIDENT ON OR AFTER SEPTEMBER 15, 2010.

| Cost Code | Equipment | Specification | Capacity/Size | HP | Notes | Unit | Rate |
|---|---|---|---|---|---|---|---|
| 8490 | Aerial Lift, Self-Propelled | Max. Platform Height | 37 ft | to 15 | Articulated, Telescoping, Scissor. | hour | $8.25 |
| 8491 | Aerial Lift, Self-Propelled | Max. Platform Height | 60 ft | to 30 | Articulated, Telescoping, Scissor. | hour | $12.25 |
| 8492 | Aerial Lift, Self-Propelled | Max. Platform Height | 70 ft | to 50 | Articulated, Telescoping, Scissor. | hour | $21.00 |
| 8493 | Aerial Lift, Self-Propelled | Max. Platform Height | 125 ft | to 85 | Articulated and Telescoping. | hour | $55.00 |
| 8494 | Aerial Lift, Self-Propelled | Max. Platform Height | 150 ft | to 130 | Articulated and Telescoping. | hour | $67.00 |
| 8486 | Aerial Lift, Truck Mntd | Max. Platform Height | 40 ft | | Articulated and Telescoping. Add to Truck rate for total rate. | hour | $6.75 |
| 8487 | Aerial Lift, Truck Mntd | Max. Platform Height | 61 ft | | Articulated and Telescoping. Add to Truck rate for total rate. | hour | $12.25 |
| 8488 | Aerial Lift, Truck Mntd | Max. Platform Height | 80 ft | | Articulated and Telescoping. Add to Truck rate for total rate. | hour | $23.50 |
| 8489 | Aerial Lift, Truck Mntd | Max. Platform Height | 100 ft | | Articulated and Telescoping. Add to Truck rate for total rate. | hour | $34.00 |
| 8010 | Air Compressor | Air Delivery | 41 cfm | to 10 | Hoses included. | hour | $1.50 |
| 8011 | Air Compressor | Air Delivery | 103 cfm | to 30 | Hoses included. | hour | $7.00 |
| 8012 | Air Compressor | Air Delivery | 130 cfm | to 50 | Hoses included. | hour | $9.25 |
| 8013 | Air Compressor | Air Delivery | 175 cfm | to 90 | Hoses included. | hour | $20.00 |
| 8014 | Air Compressor | Air Delivery | 400 cfm | to 145 | Hoses included. | hour | $27.50 |
| 8015 | Air Compressor | Air Delivery | 575 cfm | to 230 | Hoses included. | hour | $45.50 |
| 8016 | Air Compressor | Air Delivery | 1100 cfm | to 355 | Hoses included. | hour | $51.00 |
| 8017 | Air Compressor | Air Delivery | 1600 cfm | to 500 | Hoses included. | hour | $80.00 |
| 8040 | Ambulance | | | to 150 | | hour | $25.50 |
| 8041 | Ambulance | | | to 210 | | hour | $32.50 |
| 8060 | Auger, Portable | Hole Diameter | 16 in | to 6 | | hour | $1.30 |
| 8061 | Auger, Portable | Hole Diameter | 18 in | to 13 | | hour | $3.50 |
| 8062 | Auger, Tractor Mntd | Max. Auger Diameter | 36 in | to 13 | Includes digger, boom and mounting hardware. Add to Tractor rate for total rate. | hour | $1.30 |
| 8063 | Auger, Truck Mntd | Max. Auger Size | 24 in | to 100 | Includes digger, boom and mounting hardware. Add to Truck rate for total rate. | hour | $29.00 |
| 8070 | Automobile | | | to 130 | Transporting people. | mile | $0.50 |
| 8071 | Automobile | | | to 130 | Transporting cargo. | hour | $13.00 |
| 8072 | Automobile, Police | | | to 250 | Patrolling. | mile | $0.60 |
| 8073 | Automobile, Police | | | to 250 | Stationary with engine running. | hour | $16.25 |
| 8110 | Barge, Deck | Size | 50'x35'x7.25' | | | hour | $34.00 |
| 8111 | Barge, Deck | Size | 50'x35'x9' | | | hour | $49.00 |
| 8112 | Barge, Deck | Size | 120'x45'x10' | | | hour | $60.00 |
| 8113 | Barge, Deck | Size | 160'x45'x11' | | | hour | $75.00 |
| 8050 | Board, Arrow | | | to 8 | Trailer Mounted. | hour | $3.15 |
| 8051 | Board, Message | | | to 5 | Trailer Mounted. | hour | $8.50 |
| 8133 | Boat, Push | Size | 45'x21'x6' | to 435 | Flat hull. | hour | $150.00 |
| 8134 | Boat, Push | Size | 54'x21'x6' | to 525 | Flat hull. | hour | $200.00 |
| 8135 | Boat, Push | Size | 58'x24'x7.5' | to 705 | Flat hull. | hour | $250.00 |
| 8136 | Boat, Push | Size | 64'x25'x8' | to 870 | Flat hull. | hour | $300.00 |

| Cost Code | Equipment | Specification | Capacity/Size | HP | Notes | Unit | Rate |
|---|---|---|---|---|---|---|---|
| 8130 | Boat, Row | | | | Heavy duty. | hour | $0.85 |
| 8131 | Boat, Runabout | Size | 13'x5' | to 50 | Outboard. | hour | $14.00 |
| 8132 | Boat, Tender | Size | 14'x7' | to 100 | Inboard with 360 degree drive. | hour | $26.00 |
| 8120 | Boat, Tow | Size | 55'x20'x5' | to 870 | Steel. | hour | $250.00 |
| 8121 | Boat, Tow | Size | 60'x21'x5' | to 1050 | Steel. | hour | $300.00 |
| 8122 | Boat, Tow | Size | 70'x30'x7.5' | to 1350 | Steel. | hour | $450.00 |
| 8123 | Boat, Tow | Size | 120'x34'x8' | to 2000 | Steel. | hour | $830.00 |
| 8140 | Boat, Tug | Length | 16 ft | to 100 | | hour | $33.50 |
| 8141 | Boat, Tug | Length | 18 ft | to 175 | | hour | $53.00 |
| 8142 | Boat, Tug | Length | 26 ft | to 250 | | hour | $65.00 |
| 8143 | Boat, Tug | Length | 40 ft | to 380 | | hour | $150.00 |
| 8144 | Boat, Tug | Length | 51 ft | to 700 | | hour | $225.00 |
| 8419 | Breaker, Pavement, Hand-Held | Weight | 25-90 lb | | | hour | $0.65 |
| 8420 | Breaker, Pavement | | | to 70 | | hour | $31.25 |
| 8150 | Broom, Pavement | Broom Length | 72 in | to 35 | | hour | $12.30 |
| 8151 | Broom, Pavement | Broom Length | 96 in | to 100 | | hour | $19.75 |
| 8153 | Broom, Pavement, Mntd | Broom Length | 72 in | to 18 | Add to Prime Mover rate for total rate. | hour | $6.00 |
| 8154 | Broom, Pavement, Pull | Broom Length | 84 in | to 20 | Add to Prime Mover rate for total rate. | hour | $10.25 |
| 8270 | Bucket, Clamshell | Capacity | 1.0 cy | | Includes teeth. Does not include Clamshell & Dragline. | hour | $3.60 |
| 8271 | Bucket, Clamshell | Capacity | 2.5 cy | | Includes teeth. Does not include Clamshell & Dragline. | hour | $6.75 |
| 8272 | Bucket, Clamshell | Capacity | 5.0 cy | | Includes teeth. Does not include Clamshell & Dragline. | hour | $11.25 |
| 8273 | Bucket, Clamshell | Capacity | 7.5 cy | | Includes teeth. Does not include Clamshell & Dragline. | hour | $14.50 |
| 8275 | Bucket, Dragline | Capacity | 2.0 cy | | Does not include Clamshell & Dragline. | hour | $2.90 |
| 8276 | Bucket, Dragline | Capacity | 5.0 cy | | Does not include Clamshell & Dragline. | hour | $6.50 |
| 8277 | Bucket, Dragline | Capacity | 10 cy | | Does not include Clamshell & Dragline. | hour | $10.50 |
| 8278 | Bucket, Dragline | Capacity | 14 cy | | Does not include Clamshell & Dragline. | hour | $13.50 |
| 8180 | Bus | | | to 150 | | hour | $20.00 |
| 8181 | Bus | | | to 210 | | hour | $23.00 |
| 8182 | Bus | | | to 300 | | hour | $27.00 |
| 8190 | Chain Saw | Bar Length | 16 in | | | hour | $1.75 |
| 8191 | Chain Saw | Bar Length | 25 in | | | hour | $3.20 |
| 8192 | Chain Saw, Pole | Bar Size | 18 in | | | hour | $1.60 |
| 8200 | Chipper, Brush | Chipping Capacity | 6 in | to 35 | Trailer Mounted. | hour | $7.50 |
| 8201 | Chipper, Brush | Chipping Capacity | 9 in | to 65 | Trailer Mounted. | hour | $16.00 |
| 8202 | Chipper, Brush | Chipping Capacity | 12 in | to 100 | Trailer Mounted. | hour | $21.75 |
| 8203 | Chipper, Brush | Chipping Capacity | 15 in | to 125 | Trailer Mounted. | hour | $30.75 |
| 8204 | Chipper, Brush | Chipping Capacity | 18 in | to 200 | Trailer Mounted. | hour | $45.50 |
| 8210 | Clamshell & Dragline, Crawler | | 149,999 lb | to 235 | Bucket not included in rate. | hour | $86.00 |
| 8211 | Clamshell & Dragline, Crawler | | 250,000 lb | to 520 | Bucket not included in rate. | hour | $121.00 |
| 8212 | Clamshell & Dragline, Truck | | | to 240 | Bucket not included in rate. | hour | $130.00 |
| 8712 | Cleaner, Sewer/Catch Basin | Hopper Capacity | 5 cy | | Truck Mounted. Add to Truck rate for total rate. | hour | $16.00 |
| 8713 | Cleaner, Sewer/Catch Basin | Hopper Capacity | 14 cy | | Truck Mounted. Add to Truck rate for total rate. | hour | $21.50 |
| 8220 | Compactor | | | to 10 | | hour | $11.00 |
| 8221 | Compactor, Towed, Vibratory Drum | | | to 45 | | hour | $17.50 |
| 8222 | Compactor, Vibratory, Drum | | | to 75 | | hour | $25.00 |
| 8223 | Compactor, Pneumatic, Wheel | | | to 100 | | hour | $29.00 |
| 8225 | Compactor, Sanitation | | | to 300 | | hour | $96.00 |
| 8226 | Compactor, Sanitation | | | to 400 | | hour | $163.00 |
| 8227 | Compactor, Sanitation | | | to 535 | | hour | $225.00 |
| 8228 | Compactor, Towed, Pneumatic, Wheel | | 10000 lb | | Add to Prime Mover rate for total rate. | hour | $7.50 |

# FEMA's SCHEDULE OF EQUIPMENT RATES

| Cost Code | Equipment | Specification | Capacity/Size | HP | Notes | Unit | Rate |
|---|---|---|---|---|---|---|---|
| 8229 | Compactor, Towed, Drum Static | | 20000 lb | | Add to Prime Mover rate for total rate. | hour | $12.25 |
| 8500 | Crane | Max. Lift Capacity | 8 MT | to 80 | | hour | $27.00 |
| 8501 | Crane | Max. Lift Capacity | 15 MT | to 150 | | hour | $55.00 |
| 8502 | Crane | Max. Lift Capacity | 50 MT | to 200 | | hour | $95.00 |
| 8503 | Crane | Max. Lift Capacity | 70 MT | to 300 | | hour | $155.00 |
| 8504 | Crane | Max. Lift Capacity | 110 MT | to 350 | | hour | $220.00 |
| 8496 | Crane, Truck Mntd | Max. Lift Capacity | 24000 lb | | Add to Truck rate for total rate. | hour | $10.00 |
| 8497 | Crane, Truck Mntd | Max. Lift Capacity | 36000 lb | | Add to Truck rate for total rate. | hour | $16.00 |
| 8498 | Crane, Truck Mntd | Max. Lift Capacity | 60000 lb | | Add to Truck rate for total rate. | hour | $30.00 |
| 8195 | Cutter, Brush | Cutter Size | 8 ft | to 150 | | hour | $90.00 |
| 8196 | Cutter, Brush | Cutter Size | 8 ft | to 190 | | hour | $100.00 |
| 8197 | Cutter, Brush | Cutter Size | 10 ft | to 245 | | hour | $120.00 |
| 8670 | Derrick, Hydraulic Digger | Max. Boom Length | 60 ft | | Includes hydraulic pole alignment attachment. Add to Truck rate. | hour | $21.00 |
| 8671 | Derrick, Hydraulic Digger | Max. Boom Length | 90 ft | | Includes hydraulic pole alignment attachment. Add to Truck rate. | hour | $39.00 |
| 8580 | Distributor, Asphalt | Tank Capacity | 500 gal | | insulated tank, and circulating spray bar. | hour | $12.00 |
| 8581 | Distributor, Asphalt | Tank Capacity | 1000 gal | | Truck Mounted. Includes burners, insulated tank, and circulating spray bar. Add to Truck rate. | hour | $13.00 |
| 8582 | Distributor, Asphalt | Tank Capacity | 4000 gal | | Truck Mounted. Includes burners, insulated tank, and circulating spray bar. Add to Truck rate. | hour | $25.00 |
| 8250 | Dozer, Crawler | | | to 75 | | hour | $31.00 |
| 8251 | Dozer, Crawler | | | to 105 | | hour | $40.00 |
| 8252 | Dozer, Crawler | | | to 160 | | hour | $65.00 |
| 8253 | Dozer, Crawler | | | to 250 | | hour | $80.00 |
| 8254 | Dozer, Crawler | | | to 360 | | hour | $135.00 |
| 8255 | Dozer, Crawler | | | to 565 | | hour | $250.00 |
| 8256 | Dozer, Crawler | | | to 850 | | hour | $340.00 |
| 8260 | Dozer, Wheel | | | to 300 | | hour | $55.00 |
| 8261 | Dozer, Wheel | | | to 400 | | hour | $110.00 |
| 8262 | Dozer, Wheel | | | to 500 | | hour | $150.00 |
| 8263 | Dozer, Wheel | | | to 625 | | hour | $200.00 |
| 8280 | Excavator, Hydraulic | Bucket Capacity | 0.5 cy | to 45 | Crawler, Truck & Wheel. Includes bucket. | hour | $18.00 |
| 8281 | Excavator, Hydraulic | Bucket Capacity | 1.0 cy | to 90 | Crawler, Truck & Wheel. Includes bucket. | hour | $39.00 |
| 8282 | Excavator, Hydraulic | Bucket Capacity | 1.5 cy | to 160 | Crawler, Truck & Wheel. Includes bucket. | hour | $65.00 |
| 8283 | Excavator, Hydraulic | Bucket Capacity | 2.5 cy | to 265 | Crawler, Truck & Wheel. Includes bucket. | hour | $120.00 |
| 8284 | Excavator, Hydraulic | Bucket Capacity | 4.5 cy | to 420 | Crawler, Truck & Wheel. Includes bucket. | hour | $200.00 |
| 8285 | Excavator, Hydraulic | Bucket Capacity | 7.5 cy | to 650 | Crawler, Truck & Wheel. Includes bucket. | hour | $240.00 |
| 8286 | Excavator, Hydraulic | Bucket Capacity | 12 cy | to 1000 | Crawler, Truck & Wheel. Includes bucket. | hour | $400.00 |
| 8240 | Feeder, Grizzly | | | to 35 | | hour | $17.00 |
| 8241 | Feeder, Grizzly | | | to 55 | | hour | $30.00 |
| 8242 | Feeder, Grizzly | | | to 75 | | hour | $44.00 |
| 8300 | Fork Lift | Capacity | 6000 lb | to 60 | | hour | 11,75 |
| 8301 | Fork Lift | Capacity | 12000 lb | to 90 | | hour | $17.00 |
| 8302 | Fork Lift | Capacity | 18000 lb | to 140 | | hour | $23.00 |
| 8303 | Fork Lift | Capacity | 50000 lb | to 215 | | hour | $50.00 |
| 8310 | Generator | Prime Output | 5.5 kW | to 10 | | hour | $3.25 |
| 8311 | Generator | Prime Output | 16 kW | to 25 | | hour | $8.00 |
| 8312 | Generator | Prime Output | 43 kW | to 65 | | hour | $17.00 |
| 8313 | Generator | Prime Output | 100 kW | to 125 | | hour | $34.00 |
| 8314 | Generator | Prime Output | 150 kW | to 240 | | hour | $50.00 |
| 8315 | Generator | Prime Output | 210 kW | to 300 | | hour | $60.00 |
| 8316 | Generator | Prime Output | 280 kW | to 400 | | hour | $85.00 |

# FEMA's SCHEDULE OF EQUIPMENT RATES

| Cost Code | Equipment | Specification | Capacity/Size | HP | Notes | Unit | Rate |
|---|---|---|---|---|---|---|---|
| 8317 | Generator | Prime Output | 350 kW | to 500 | | hour | $95.00 |
| 8318 | Generator | Prime Output | 530 kW | to 750 | | hour | $150.00 |
| 8319 | Generator | Prime Output | 710 kW | to 1000 | | hour | $200.00 |
| 8320 | Generator | Prime Output | 1100 kW | to 1500 | | hour | $375.00 |
| 8321 | Generator | Prime Output | 2500 kW | to 3000 | | hour | $500.00 |
| 8755 | Golf Cart | Capacity | 2 person | | | hour | $3.20 |
| 8330 | Graders | Moldboard Size | 10 ft | to 110 | Includes Rigid and Articulate | hour | $34.50 |
| 8331 | Graders | Moldboard Size | 12 ft | to 150 | Includes Rigid and Articulate | hour | $58.00 |
| 8332 | Graders | Moldboard Size | 14 ft | to 225 | Includes Rigid and Articulate | hour | $70.00 |
| 8350 | Hose, Discharge | Diameter | 3 in | | Per 25 foot length. Includes couplings. | hour | $0.13 |
| 8351 | Hose, Discharge | Diameter | 4 in | | Per 25 foot length. Includes couplings. | hour | $0.19 |
| 8352 | Hose, Discharge | Diameter | 6 in | | Per 25 foot length. Includes couplings. | hour | $0.50 |
| 8353 | Hose, Discharge | Diameter | 8 in | | Per 25 foot length. Includes couplings. | hour | $0.75 |
| 8354 | Hose, Discharge | Diameter | 12 in | | Per 25 foot length. Includes couplings. | hour | $1.35 |
| 8355 | Hose, Discharge | Diameter | 16 in | | Per 25 foot length. Includes couplings. | hour | $2.20 |
| 8356 | Hose, Suction | Diameter | 3 in | | Per 25 foot length. Includes couplings. | hour | $0.23 |
| 8357 | Hose, Suction | Diameter | 4 in | | Per 25 foot length. Includes couplings. | hour | $0.43 |
| 8358 | Hose, Suction | Diameter | 6 in | | Per 25 foot length. Includes couplings. | hour | $0.90 |
| 8359 | Hose, Suction | Diameter | 8 in | | Per 25 foot length. Includes couplings. | hour | $1.35 |
| 8360 | Hose, Suction | Diameter | 12 in | | Per 25 foot length. Includes couplings. | hour | $2.45 |
| 8361 | Hose, Suction | Diameter | 16 in | | Per 25 foot length. Includes couplings. | hour | $3.90 |
| 8517 | Jackhammer (Dry) | Weight Class | 25-45 lb | | | hour | $1.00 |
| 8518 | Jackhammer (Wet) | Weight Class | 30-55 lb | | | hour | $1.15 |
| 8380 | Loader, Crawler | Bucket Capacity | 0.5 cy | to 32 | Includes bucket. | hour | $11.50 |
| 8381 | Loader, Crawler | Bucket Capacity | 1 cy | to 60 | Includes bucket. | hour | $19.00 |
| 8382 | Loader, Crawler | Bucket Capacity | 2 cy | to 118 | Includes bucket. | hour | $42.00 |
| 8383 | Loader, Crawler | Bucket Capacity | 3 cy | to 178 | Includes bucket. | hour | $76.00 |
| 8384 | Loader, Crawler | Bucket Capacity | 4 cy | to 238 | Includes bucket. | hour | $115.00 |
| 8540 | Loader, Skid-Steer | Operating Capacity | 1000 lb | to 35 | | hour | $11.00 |
| 8541 | Loader, Skid-Steer | Operating Capacity | 2000 lb | to 65 | | hour | $18.00 |
| 8542 | Loader, Skid-Steer | Operating Capacity | 3000 lb | to 85 | | hour | $22.00 |
| 8401 | Loader, Tractor, Wheel | | | to 81 | | hour | $25.00 |
| 8390 | Loader, Wheel | Bucket Capacity | 0.5 cy | to 38 | | hour | $15.50 |
| 8391 | Loader, Wheel | Bucket Capacity | 1 cy | to 60 | | hour | $21.50 |
| 8392 | Loader, Wheel | Bucket Capacity | 2 cy | to 105 | | hour | $28.75 |
| 8393 | Loader, Wheel | Bucket Capacity | 3 cy | to 152 | | hour | $40.00 |
| 8394 | Loader, Wheel | Bucket Capacity | 4 cy | to 200 | | hour | $52.00 |
| 8395 | Loader, Wheel | Bucket Capacity | 5 cy | to 250 | | hour | $66.00 |
| 8396 | Loader, Wheel | Bucket Capacity | 6 cy | to 305 | | hour | $82.00 |
| 8397 | Loader, Wheel | Bucket Capacity | 7 cy | to 360 | | hour | $95.00 |
| 8398 | Loader, Wheel | Bucket Capacity | 8 cy | to 530 | | hour | $140.00 |
| 8570 | Loader-Backhoe, Wheel | Loader Bucket Capacity | 0.5 cy | to 40 | Loader and Backhoe Buckets included. | hour | $14.75 |
| 8571 | Loader-Backhoe, Wheel | Loader Bucket Capacity | 1 cy | to 70 | Loader and Backhoe Buckets included. | hour | $23.50 |
| 8572 | Loader-Backhoe, Wheel | Loader Bucket Capacity | 1.5 cy | to 95 | Loader and Backhoe Buckets included. | hour | $33.00 |
| 8573 | Loader-Backhoe, Wheel | Loader Bucket Capacity | 1.75 cy | to 115 | Loader and Backhoe Buckets included. | hour | $38.00 |
| 8410 | Mixer, Concrete Portable | Batching Capacity | 10 cft | | | hour | $3.25 |
| 8411 | Mixer, Concrete Portable | Batching Capacity | 12 cft | | | hour | $4.25 |
| 8412 | Mixer, Concrete, Trailer Mntd | Batching Capacity | 11 cft | to 10 | | hour | $8.75 |
| 8413 | Mixer, Concrete, Trailer Mntd | Batching Capacity | 16 cft | to 25 | | hour | $15.25 |
| 8075 | Motorcycle, Police | | | | | mile | $0.35 |
| 8633 | Mulcher, Trailer Mntd | Working Capacity | 7 tph | to 35 | | hour | $10.25 |
| 8634 | Mulcher, Trailer Mntd | Working Capacity | 10 tph | to 55 | | hour | $15.75 |
| 8635 | Mulcher, Trailer Mntd | Working Capacity | 20 tph | to 120 | | hour | $24.75 |
| 8430 | Paver, Asphalt, Towed | | | | Does not include Prime Mover. | hour | $7.00 |
| 8431 | Paver, Asphalt | | | to 50 | Includes wheel and crawler equipment. | hour | $65.00 |
| 8432 | Paver, Asphalt | | | to 125 | Includes wheel and crawler equipment. | hour | $115.00 |
| 8433 | Paver, Asphalt | | | to 175 | Includes wheel and crawler equipment. | hour | $125.00 |
| 8434 | Paver, Asphalt | | | to 250 | Includes wheel and crawler equipment. | hour | $140.00 |
| 8436 | Pick-up, Asphalt | | | to 110 | | hour | $55.00 |
| 8437 | Pick-up, Asphalt | | | to 150 | | hour | $83.00 |
| 8438 | Pick-up, Asphalt | | | to 200 | | hour | $110.00 |
| 8439 | Pick-up, Asphalt | | | to 275 | | hour | $140.00 |
| 8660 | Plow, Cable | Plow Depth | 24 in | to 30 | | hour | $10.25 |

## FEMA's SCHEDULE OF EQUIPMENT RATES

| Cost Code | Equipment | Specification | Capacity/Size | HP | Notes | Unit | Rate |
|---|---|---|---|---|---|---|---|
| 8661 | Plow, Cable | Plow Depth | 36 in | to 65 | | hour | $27.75 |
| 8662 | Plow, Cable | Plow Depth | 48 in | to 110 | | hour | $31.75 |
| 8450 | Plow, Snow, Grader Mntd | Width | to 10 ft | | Add to Grader for total rate. | hour | $16.00 |
| 8451 | Plow, Snow, Grader Mntd | Width | to 14 ft | | Add to Grader for total rate. | hour | $24.00 |
| 8452 | Plow, Snow, Truck Mntd | Width | to 15 ft | | Add to Truck rate for total rate. | hour | $10.75 |
| 8453 | Plow, Snow, Truck Mntd | Width | to 15 ft | | With leveling wing. Add to Truck rate for total rate. | hour | $18.50 |
| 8470 | Pump | | | to 4 | Does not include Hoses. | hour | $2.15 |
| 8471 | Pump | | | to 6 | Does not include Hoses. | hour | $3.20 |
| 8472 | Pump | | | to 10 | Does not include Hoses. | hour | $4.10 |
| 8473 | Pump | | | to 15 | Does not include Hoses. | hour | $7.75 |
| 8474 | Pump | | | to 25 | Does not include Hoses. | hour | $9.25 |
| 8475 | Pump | | | to 40 | Does not include Hoses. | hour | $16.00 |
| 8476 | Pump | | | to 60 | Does not include Hoses. | hour | $18.75 |
| 8477 | Pump | | | to 95 | Does not include Hoses. | hour | $26.50 |
| 8478 | Pump | | | to 140 | Does not include Hoses. | hour | $31.00 |
| 8479 | Pump | | | to 200 | Does not include Hoses. | hour | $36.00 |
| 8480 | Pump | | | to 275 | Does not include Hoses. | hour | $80.00 |
| 8481 | Pump | | | to 350 | Does not include Hoses. | hour | $95.00 |
| 8482 | Pump | | | to 425 | Does not include Hoses. | hour | $120.00 |
| 8483 | Pump | | | to 500 | Does not include Hoses. | hour | $135.00 |
| 8484 | Pump | | | to 575 | Does not include Hoses. | hour | $155.00 |
| 8485 | Pump | | | to 650 | Does not include Hoses. | hour | $180.00 |
| 8510 | Saw, Concrete | Blade Diameter | 14 in | to 14 | | hour | $6.00 |
| 8511 | Saw, Concrete | Blade Diameter | 26 in | to 35 | | hour | $13.50 |
| 8512 | Saw, Concrete | Blade Diameter | 48 in | to 65 | | hour | $23.00 |
| 8513 | Saw, Rock | | | to 100 | | hour | $30.00 |
| 8514 | Saw, Rock | | | to 200 | | hour | $60.00 |
| 8521 | Scraper | Scraper Capacity | 16 cy | to 250 | | hour | $90.00 |
| 8522 | Scraper | Scraper Capacity | 23 cy | to 365 | | hour | $130.00 |
| 8523 | Scraper | Scraper Capacity | 34 cy | to 475 | | hour | $200.00 |
| 8524 | Scraper | Scraper Capacity | 44 cy | to 600 | | hour | $240.00 |
| 8560 | Snow Blower | Capacity | 2,000 tph | to 400 | | hour | $140.00 |
| 8561 | Snow Blower | Capacity | 2,500 tph | to 500 | | hour | $160.00 |
| 8562 | Snow Blower | Capacity | 3,500 tph | to 600 | | hour | $180.00 |
| 8550 | Snow Blower, Truck Mntd | Capacity | 600 tph | to 75 | Does not include Truck. | hour | $37.50 |
| 8551 | Snow Blower, Truck Mntd | Capacity | 1400 tph | to 200 | Does not include Truck. | hour | $70.00 |
| 8552 | Snow Blower, Truck Mntd | Capacity | 2000 tph | to 340 | Does not include Truck. | hour | $110.00 |
| 8553 | Snow Blower, Truck Mntd | Capacity | 2500 tph | to 400 | Does not include Truck. | hour | $120.00 |
| 8558 | Snow Thrower, Walk Behind | Cutting Width | 25 in | to 5 | | hour | $3.25 |
| 8559 | Snow Thrower, Walk Behind | Cutting Width | 60 in | to 15 | | hour | $7.00 |
| 8630 | Sprayer, Seed | Working Capacity | 750 gal | to 30 | Trailer & Truck mounted. Does not include Prime Mover. | hour | $9.75 |
| 8631 | Sprayer, Seed | Working Capacity | 1250 gal | to 50 | Trailer & Truck mounted. Does not include Prime Mover. | hour | $15.00 |
| 8632 | Sprayer, Seed | Working Capacity | 3500 gal | to 115 | Trailer & Truck mounted. Does not include Prime Mover. | hour | $25.75 |
| 8458 | Spreader, Chemical | Capacity | 5 cy | to 4 | Trailer & Truck mounted. Does not | hour | $4.00 |
| 8423 | Spreader, Chip | Spread Hopper Width | 12.5 ft | to 152 | | hour | $50.00 |
| 8424 | Spreader, Chip | Spread Hopper Width | 16.5 ft | to 215 | | hour | $80.00 |
| 8425 | Spreader, Chip, Mntd | Hopper Size | 8 ft | to 8 | Trailer & Truck mounted. | hour | $3.30 |
| 8455 | Spreader, Sand | Mounting | Tailgate, Chassis | | | hour | $3.30 |
| 8456 | Spreader, Sand | Mounting | Dump Body | | | hour | $5.50 |
| 8457 | Spreader, Sand | Mounting | Truck (10 yd) | | | hour | $7.50 |
| 8440 | Striper | Paint Capacity | 40 gal | to 22 | | hour | $8.75 |
| 8441 | Striper | Paint Capacity | 90 gal | to 60 | | hour | $19.00 |
| 8442 | Striper | Paint Capacity | 120 gal | to 122 | | hour | $37.00 |
| 8445 | Striper, Truck Mntd | Paint Capacity | 120 gal | to 460 | | hour | $70.00 |
| 8446 | Striper, Walk-behind | Paint Capacity | 12 gal | | | hour | $3.35 |
| 8157 | Sweeper, Pavement | | | to 110 | | hour | $59.00 |
| 8158 | Sweeper, Pavement | | | to 230 | | hour | $74.00 |
| 8590 | Trailer, Dump | Capacity | 20 cy | | Does not include Prime Mover. | hour | $8.00 |

# FEMA's SCHEDULE OF EQUIPMENT RATES

| Cost Code | Equipment | Specification | Capacity/Size | HP | Notes | Unit | Rate |
|---|---|---|---|---|---|---|---|
| 8591 | Trailer, Dump | Capacity | 30 cy | | Does not include Prime Mover. | hour | $14.00 |
| 8600 | Trailer, Equipment | Capacity | 30 ton | | | hour | $10.25 |
| 8601 | Trailer, Equipment | Capacity | 40 ton | | | hour | $12.50 |
| 8602 | Trailer, Equipment | Capacity | 60 ton | | | hour | $15.00 |
| 8603 | Trailer, Equipment | Capacity | 120 ton | | | hour | $25.00 |
| 8640 | Trailer, Office | Trailer Size | 8' x 24' | | | hour | $1.70 |
| 8641 | Trailer, Office | Trailer Size | 8' x 32' | | | hour | $1.75 |
| 8642 | Trailer, Office | Trailer Size | 10' x 32' | | | hour | $2.60 |
| 8610 | Trailer, Water | Tank Capacity | 4000 gal | | Includes a centrifugal pump with sump and a rear spraybar. | hour | $11.00 |
| 8611 | Trailer, Water | Tank Capacity | 6000 gal | | Includes a centrifugal pump with sump and a rear spraybar. | hour | $14.00 |
| 8612 | Trailer, Water | Tank Capacity | 10000 gal | | Includes a centrifugal pump with sump and a rear spraybar. | hour | $16.50 |
| 8613 | Trailer, Water | Tank Capacity | 14000 gal | | Includes a centrifugal pump with sump and a rear spraybar. | hour | $20.50 |
| 8650 | Trencher | | | to 40 | Walk-behind, Crawler & Wheel Mounted. Chain and Wheel. | hour | $11.75 |
| 8651 | Trencher | | | to 85 | Walk-behind, Crawler & Wheel Mounted. Chain and Wheel. | hour | $25.00 |
| 8290 | Trowel, Concrete | Diameter | 48 in | to 12 | | hour | $4.50 |
| 8680 | Truck, Concrete Mixer | Mixer Capacity | 13 cy | to 300 | | hour | $75.00 |
| 8720 | Truck, Dump | Struck Capacity | 8 cy | to 220 | | hour | $35.00 |
| 8721 | Truck, Dump | Struck Capacity | 10 cy | to 320 | | hour | $45.00 |
| 8722 | Truck, Dump | Struck Capacity | 12 cy | to 400 | | hour | $60.00 |
| 8723 | Truck, Dump | Struck Capacity | 18 cy | to 400 | | hour | $65.00 |
| 8724 | Truck, Dump, Off | Struck Capacity | 28 cy | to 450 | | hour | $105.00 |
| 8690 | Truck, Fire | Pump Capacity | 1000 gpm | | | hour | $70.00 |
| 8691 | Truck, Fire | Pump Capacity | 1250 gpm | | | hour | $80.00 |
| 8692 | Truck, Fire | Pump Capacity | 1500 gpm | | | hour | $85.00 |
| 8693 | Truck, Fire | Pump Capacity | 2000 gpm | | | hour | $90.00 |
| 8694 | Truck, Fire Ladder | Ladder length | 75 ft | | | hour | $125.00 |
| 8695 | Truck, Fire Ladder | Ladder length | 150 ft | | | hour | $150.00 |
| 8700 | Truck, Flatbed | Maximum Gvw | 15000 lb | to 200 | | hour | $20.00 |
| 8701 | Truck, Flatbed | Maximum Gvw | 25000 lb | to 275 | | hour | $22.00 |
| 8702 | Truck, Flatbed | Maximum Gvw | 30000 lb | to 300 | | hour | $25.00 |
| 8703 | Truck, Flatbed | Maximum Gvw | 45000 lb | to 380 | | hour | $43.00 |
| 8730 | Truck, Garbage | Capacity | 25 cy | to 255 | | hour | $47.00 |
| 8731 | Truck, Garbage | Capacity | 32 cy | to 325 | | hour | $55.00 |
| 8800 | Truck, Pickup | | | | Transporting people. | mile | $0.50 |
| 8801 | Truck, Pickup | | ½ ton | | | hour | $14.00 |
| 8802 | Truck, Pickup | | 1 ton | | | hour | $20.00 |
| 8803 | Truck, Pickup | | 1¼ ton | | | hour | $22.00 |
| 8804 | Truck, Pickup | | 1½ ton | | | hour | $25.00 |
| 8805 | Truck, Pickup | | 1¾ ton | | | hour | $30.00 |
| 8790 | Truck, Tractor | 4 x 2 | 30000 lb | to 220 | | hour | $32.00 |
| 8791 | Truck, Tractor | 4 x 2 | 45000 lb | to 310 | | hour | $45.00 |
| 8792 | Truck, Tractor | 6 x 4 | 50000 lb | to 400 | | hour | $55.00 |
| 8780 | Truck, Water | Tank Capacity | 2500 gal | to 175 | Include pump and rear spray system. | hour | $31.00 |
| 8781 | Truck, Water | Tank Capacity | 4000 gal | to 250 | Include pump and rear spray system. | hour | $42.00 |
| 8620 | Tub Grinder | | | to 440 | | hour | $85.00 |
| 8621 | Tub Grinder | | | to 630 | | hour | $120.00 |
| 8622 | Tub Grinder | | | to 760 | | hour | $150.00 |
| 8623 | Tub Grinder | | | to 1000 | | hour | $270.00 |
| 8753 | Vehicle, Recreational | | | to 10 | | hour | $3.00 |
| 8750 | Vehicle, Small | | | to 30 | | hour | $7.00 |
| 8761 | Vibrator, Concrete | | | to 4 | | hour | $1.15 |
| 8770 | Welder, Portable | | | to 16 | Includes ground cable and lead cable. | hour | $5.00 |
| 8771 | Welder, Portable | | | to 34 | Includes ground cable and lead cable. | hour | $11.50 |
| 8772 | Welder, Portable | | | to 50 | Includes ground cable and lead cable. | hour | $16.00 |
| 8773 | Welder, Portable | | | to 80 | Includes ground cable and lead cable. | hour | $22.00 |

| UNIT # | DESCRIPTION | DRIVER | SERIAL # | LIC. # | CO SHOP |
|---|---|---|---|---|---|
| SW01 | 2013 Ford Escape | Office | 1FMCU9H97DUD88489 | C18900 | X |
| SW08 | 2000 FORD F350 DIESEL W/DUMPER | Shop | 1FDWF37F8YED59238 | C7612 | X |
| #26 | Goertzen Tag Dump Trailer | Work Crew | 2WXTH12231000671O legal shows 8710 | A5083 | |
| #27 | 2002 Kenworth T800 Water Truck | | 1NKDLU0X82R887695 | C12055 | |
| SW29 | 2014 Ford 150 Pickup | Shop | 1FTNF1EF8EKF24516 | C6886 | X |
| #39 | 2007 White Bus | Safety | 4DRBUAFM17B412824 | C14421 | |
| #40 | C&B Trailer- vacuum | Safety | 4JUBU14266N023043 | A11717 | |
| #20 | 2000 MADVAC - trailer | | 11091 | | |
| #41 | 2006 John Deere 1050C Crawler Dozer W | | LU1050C008488 | | |
| #42 | 2006 Thule Trailer | Freon/Shop | 5FGN4071663024730 | | |
| #43 | 2007 Water/Dump Kenworth Truck state shows 2007 not 2006 | Shop | 1NKDL40X27R196024 | C14798 | |
| #44 | 2007 Backhoe Loader 410J | Shop | TO410JX145083 | | |
| #45 | Water Tank for 2007 Kenworth | Shop | | | |
| SW46 | 2005 Toyota Tundra Truck | Screener | 5TBDT48105S496766 | C14121 | X |
| #47 | 2007 Hull Fuel Tank | Shop | D08657 | | |
| SW48 | 2007 Dodge Ram Truck | Shop | 3D6WH48D67G755252 | C11315 | X |
| SW49 | 2005 Toyota Tundra Truck | Shop | 5TBDT44115S475947 | C14063 | X |
| #52 | 2010 623G Scraper W | Shop | DBC00514 | | |
| SW55 | 2007 Chevy K2500 Crew Cab Pickup | Code | 1GCHK23D87F180584 | C11863 | X |
| #56 | 2010 John Deer Motor Grader | Shop | 1DW772GPCA0629951 | | |
| #57 | 2010 Advantage 525J4 Al-jon W | Shop | 14821 | | |
| #58 | Car Tire DeRimmer - CHS13 | Shop | 61232710 | | |
| #59 | 2012 Husqvarna lawn mower | Shop | YTH24K48/022812A002113 | | |
| SW60 | 2014 Ford 150 Pickup | Office | 1FTFW1EF4EKE90966 | C18129 | X |
| [redacted] | TCX575 Tire changer & 3W00 Balancer | Shop | 11G739021-Changer KWC913-Balancer | | |
| [redacted] | 2013 John Deer 624K loader W | Shop | 1DW624KHCDE653048 | | |
| [redacted] | 2013 Dodge Ram 1500 ST Cab 4x4 | Ken | 3C6JR7DG7DG592872 | C11333 | X |
| SW64 | 2013 F150 Ford | Bags | 1FTFW1EF0DFB45859 | C14234 | X |
| SW65 | 2013 Dodge Ram 1500 | Screener | 3C6JR7AG6DG585299 | C18393 | X |
| #66 | 2014 Advantage 525 Compactor W | Shop | 15085/0W05556 | | |
| #67 | 2004 Sterling Model LT7500 Rolloff Truck W | Shop | VIN#2FZHATDCX4ANW8641 | C18694 | |
| #68 | Tow Behind Magnetic Sweeper | Shop | n/a model #mks5000 | | |
| #69 | 2014 Caterpillar 623K Scrapper W | Shop | 623K OWTB00136 | | |

| Unit # | Description | Hours | Miles | Monthly Average |
|---|---|---|---|---|
| 27 | 2000 Water Truck | | 73449 | |
| 41 | 2006 Bull Dozer | 2671 | | |
| 43 | 2006 Dump Truck | | 12006 | |
| 44 | 2007 Backhoe | 2350 | | |
| 52 | 2009 Scraper | 6212 | | |
| 56 | 2010 Motor Grader | 3047 | | |
| 57 | 2010 Compactor | 8336 | | |
| 62 | 2013 Loader | 6194 | | 240 |
| 66 | 2014 Compactor | 2841 | | 240 |
| 67 | 2005 Transfer Truck | 10787 | 224493 | |
| 69 | 2014 Scraper | 1349 | | 180 |

Oct 2014

2010 Compactor March 2014

2010 Compactor 7670hrs March 2014
2014 Scraper 5539hrs Oct 2014

# 624K

WHEEL LOADER


## FEATURES & SPECS

- Final Tier 4 emission-certified engine
- Multi-function color LCD monitor
- Unsurpassed 360-degree visibility
- SmartShift™ ensures gear changes are smooth

See All Features

| | |
|---|---|
| Net Power | 139 kW (186 hp) @ 1,800 rpm |
| Bucket Capacity | 2.3–2.7 m³ (3.0–3.5 cu. yd.) |
| Bucket Width | 2.69 m (8 ft. 10 in.) |
| Breakout Force | 10 983–12 821 kg (24,214–28,266 lb.) |

BUILD YOUR OWN

Overview | Features | Specifications | Compare | Support

### A whole lot of new thinKing.

What operator wouldn't be more productive in the high-back air-ride seat of a 624K Loader? Up-front and enhanced multifunction monitor displays operation, diagnostic, and maintenance info on a color LCD screen with easy-on-the-eyes clarity. Ten-percent more tinted glass and a lower-profile console allow a commanding view of the work ahead. The quieter cab boasts more legroom and improved ergonomics, too, including fatigue-beating features like seat-mounted loader controls. And an expanded sealed-switch module with keyless start and easy push-button operation of even more functions. For more productivity without extra effort.


624K Wheel Loader

## PRODUCT BROCHURES:

- Brochure - English
- Brochure - Français
- Product Guide

## YOU MAY ALSO BE INTERESTED IN ...

- Attachment Guide
- Non-Current Wheel Loaders
- Used Equipment
- Product News and Jobsite Stories
- Ultimate Uptime


# 624K

| Engine | 624K Z-BAR / HIGH-LIFT / POWERLLEL™ / TOOL CARRIER | | |
|---|---|---|---|
| Manufacturer and Model | John Deere PowerTech™ PVX 6068 | John Deere PowerTech™ Plus 6068H | John Deere PowerTech™ 6068H |
| Non-Road Emission Standard | EPA Final Tier 4/EU Stage IV | EPA Tier 3/EU Stage IIIA | EPA Tier 2/EU Stage II |
| Cylinders | 6 | 6 | 6 |
| Valves Per Cylinder | 4 | 4 | 4 |
| Displacement | 6.8 L (414 cu. in.) | 6.8 L (414 cu. in.) | 6.8 L (414 cu. in.) |
| Net Peak Power (ISO 9249) | 139 kW (186 hp) at 1,800 rpm | 147 kW (198 hp) at 1,800 rpm | 147 kW (198 hp) at 1,800 rpm |
| Net Peak Torque (ISO 9249) | 826 Nm (609 lb.-ft.) at 1,300 rpm | 836 Nm (617 lb.-ft.) at 1,600 rpm | 836 Nm (617 lb.-ft.) at 1,600 rpm |
| Net Torque Rise | 57% | 65% | 65% |
| Fuel System (electronically controlled) | High-pressure common rail | High-pressure common rail | High-pressure common rail |
| Lubrication | Full-flow spin-on filter and integral cooler | Full-flow spin-on filter and integral cooler | Full-flow spin-on filter and integral cooler |
| Aspiration | Turbocharged, charge air cooled | Turbocharged, charge air cooled | Turbocharged, charge air cooled |
| Air Cleaner | Under-hood, dual-element dry type, restriction indicator in cab monitor for service | | |
| Fan Drive | Hydraulically driven, proportionally controlled, fan aft of coolers | Hydraulically driven, proportionally controlled, fan aft of coolers | Hydraulically driven, proportionally controlled, fan aft of coolers |
| Electrical System | 24 volt with 130-amp alternator | 24 volt with 80-amp (100-amp optional) alternator | 24 volt with 80-amp (100-amp optional) alternator |
| Batteries (2 – 12 volt) | 950 CCA (each) | 950 CCA (each) | 950 CCA (each) |

| Transmission System | | | | |
|---|---|---|---|---|
| Type | Countershaft-type PowerShift™ | | | |
| Torque Converter | Single stage, single phase | | | |
| Shift Control | Electronically modulated, adaptive, load and speed dependent | | | |
| Operator Interface | Steering-column or joystick-mounted F-N-R and gear-select lever; quick-shift button on hydraulic lever | | | |
| Shift Modes | Manual/auto (1st–D or 2nd–D); Quick-Shift button with 2 selectable modes: kick-down or kick-up/down; and 3 adjustable clutch-cutoff settings | | | |
| | *Standard 5-Speed with Lockup Torque Converter* | | *Optional 4-Speed* | |
| Maximum Travel Speeds (with 20.5 R 25 tires) | *Forward* | *Reverse* | *Forward* | *Reverse* |
| Range 1 | 5.9 km/h (3.7 mph) | 6.3 km/h (3.9 mph) | 7.6 km/h (4.7 mph) | 7.6 km/h (4.7 mph) |
| Range 2 | 10.5 km/h (6.5 mph) | 10.5 km/h (6.5 mph) | 12.5 km/h (7.8 mph) | 13.0 km/h (8.1 mph) |
| Range 3 | 16.1 km/h (10.0 mph) | 26.2 km/h (16.3 mph) | 25.0 km/h (15.5 mph) | 25.7 km/h (16.0 mph) |
| Range 4 | 25.0 km/h (15.5 mph) | N/A | 39.5 km/h (24.5 mph) | N/A |
| Range 5 | 40.0 km/h (24.9 mph) | N/A | N/A | N/A |

| Axles/Brakes | |
|---|---|
| Final Drives | Heavy-duty inboard-mounted planetary |
| Differentials | Hydraulic locking front with conventional rear – standard; dual locking front and rear – optional |
| Rear Axle Oscillation, Stop to Stop (with 20.5 R 25 tires) | 24 deg. (12 deg. each direction) |
| Service Brakes (conform to ISO 3450) | Hydraulically actuated, spring-retracted, self-adjusting, inboard sun-shaft mounted, oil-cooled, single disc |
| Parking Brakes (conform to ISO 3450) | Automatic spring-applied, hydraulically released, driveline-mounted, oil-cooled, multi disc |

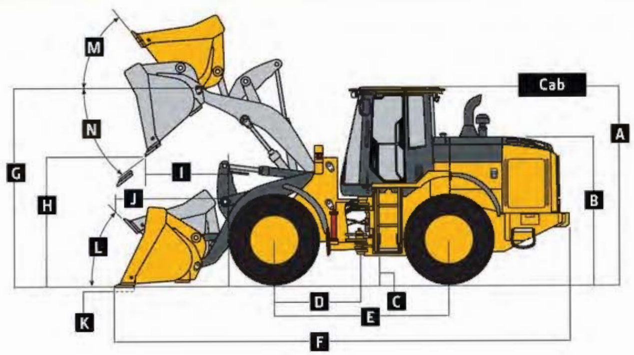
| Tires/Wheels *(see page 23 for complete tire adjustments)* | | |
|---|---|---|
| | *Tread Width* | *Width Over Tires* |
| Michelin 20.5 R 25, 1 Star L-3 | 2050 mm (80.7 in.) | 2657 mm (104.6 in.) |

| Serviceability | | | |
|---|---|---|---|
| Refill Capacities | EPA FT4/EU Stage IV | EPA Tier 3/EU Stage IIIA | EPA Tier 2/EU Stage II |
| Fuel Tank with Lockable Cap | 299 L (79 gal.) | 352 L (93 gal.) | 352 L (93 gal.) |
| Diesel Exhaust Fluid (DEF) | 19 L (20 qt.) | N/A | N/A |
| Cooling System | 33.8 L (35.7 qt.) | 27 L (29 qt.) | 27 L (29 qt.) |
| Engine Oil with Vertical Spin-On Filter | 19.5 L (20.6 qt.) | 19 L (20 qt.) | 19 L (20 qt.) |
| Transmission Reservoir with Vertical Filter | 22 L (23 qt.) | 22 L (23 qt.) | 22 L (23 qt.) |
| Axle Oil | | | |
| Front | 22 L (23 qt.) | 22 L (23 qt.) | 22 L (23 qt.) |
| Rear | 17 L (18 qt.) | 17 L (18 qt.) | 17 L (18 qt.) |
| Hydraulic Reservoir and Filter | 105.2 L (27.8 gal.) | 110 L (29 gal.) | 110 L (29 gal.) |
| Park Brake Oil (wet disc) | 0.3 L (10 oz.) | 0.3 L (10 oz.) | 0.3 L (10 oz.) |

| Hydraulic System/Steering | |
|---|---|
| Pump (loader and steering) | Variable-displacement, axial-piston pump; closed-center, pressure-compensating system |
| Maximum Rated Flow at 6895 kPa (1,000 psi) and 2,350 rpm | 223 L/m (59 gpm) |
| System Relief Pressure (loader and steering) | 24 821 kPa (3,675 psi) |
| Loader Controls | 2-function valve; joystick control or fingertip controls; hydraulic-function enable/disable; optional 3rd- and 4th-function valve with auxiliary lever |
| Steering (conforms to ISO 5010) | |
| Type | Power, fully hydraulic |
| Articulation Angle | 80-deg. arc (40 deg. each direction) |


| Hydraulic System/Steering *(continued)* | 624K Z-BAR / HIGH-LIFT / POWERLLEL / TOOL CARRIER | | | |
|---|---|---|---|---|
| Turning Radius (measured to centerline of outside tire) | 5.27 m (17 ft. 4 in.) | | | |
| Hydraulic Cycle Times | *Z-Bar* | *High-Lift* | *Powerllel* | *Tool Carrier* |
| Raise | 5.9 sec. | 5.9 sec. | 5.9 sec. | 5.6 sec. |
| Dump | 1.3 sec. | 1.3 sec. | 1.4 sec. | 3.0 sec. |
| Lower (float down) | 2.7 sec. | 2.7 sec. | 2.8 sec. | 2.7 sec. |
| Total | 9.9 sec. | 9.9 sec. | 10.1 sec. | 11.3 sec. |

**Dimensions and Specifications with Pin-On Bucket**

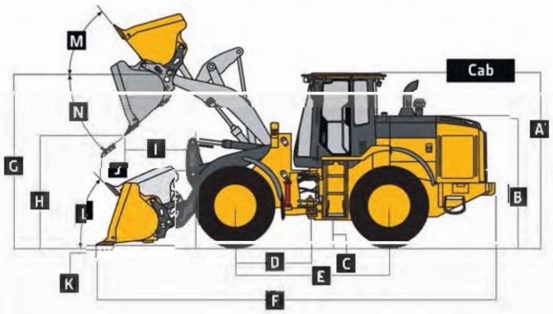



**624K Z-BAR AND HIGH-LIFT LOADERS WITH PIN-ON BUCKET**

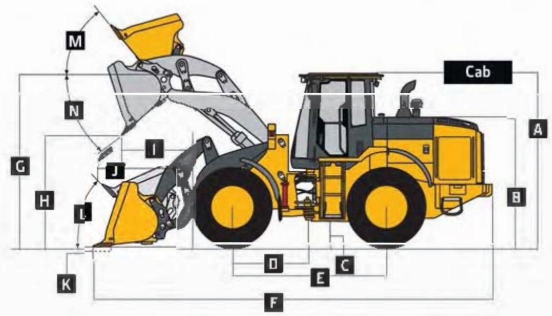
| | *Z-Bar* | *High-Lift* |
|---|---|---|
| **Dimensions with Bucket** | *2.7-m³ (3.5 cu. yd.) general-purpose with bolt-on edge* | *2.7-m³ (3.5 cu. yd.) general-purpose with bolt-on edge* |
| **A** Height to Top of Cab | 3.32 m (10 ft. 11 in.) | 3.32 m (10 ft. 11 in.) |
| **B** Hood Height | 2.46 m (8 ft. 1 in.) | 2.46 m (8 ft. 1 in.) |
| **C** Ground Clearance | 384 mm (15.1 in.) | 384 mm (15.1 in.) |
| **D** Length from Centerline to Front Axle | 1.52 m (5 ft. 0 in.) | 1.52 m (5 ft. 0 in.) |
| **E** Wheelbase | 3.09 m (10 ft. 1 in.) | 3.09 m (10 ft. 1 in.) |
| **F** Overall Length, Bucket on Ground | 7.76 m (25 ft. 5 in.) | 8.17 m (26 ft. 9 in.) |
| **G** Height to Hinge Pin, Fully Raised | 3.95 m (13 ft. 0 in.) | 4.30 m (14 ft. 2 in.) |
| **H** Dump Clearance, 45 deg., Full Height | 2.86 m (9 ft. 5 in.) | 3.23 m (10 ft. 7 in.) |
| **I** Reach, 45-deg. Dump, Full Height | 1.02 m (3 ft. 4 in.) | 1.11 m (3 ft. 8 in.) |
| **J** Reach, 45-deg. Dump, 2.13-m (7 ft. 0 in.) Clearance | 1.57 m (5 ft. 2 in.) | 1.93 m (6 ft. 4 in.) |
| **K** Maximum Digging Depth | 95 mm (3.8 in.) | 203 mm (8.0 in.) |
| **L** Maximum Rollback at Ground Level | 37 deg. | 36 deg. |
| **M** Maximum Rollback, Boom Fully Raised | 50 deg. | 49 deg. |
| **N** Maximum Bucket Dump Angle, Fully Raised | 45 deg. | 46 deg. |
| Loader Clearance Circle, Bucket Carry Position | 12.24 m (40 ft. 2 in.) | 12.61 m (41 ft. 4 in.) |
| **Specifications with Bucket** | | |
| Capacity, Heaped | 2.7 m³ (3.5 cu. yd.) | 2.7 m³ (3.5 cu. yd.) |
| Capacity, Struck | 2.3 m³ (3.0 cu. yd.) | 2.3 m³ (3.0 cu. yd.) |
| Bucket Weight with Bolt-On Cutting Edge | 1148 kg (2,532 lb.) | 1148 kg (2,532 lb.) |
| Bucket Width | 2.69 m (8 ft. 10 in.) | 2.69 m (8 ft. 10 in.) |
| Breakout Force | 12 821 kg (28,266 lb.) | 11 662 kg (25,709 lb.) |
| Tipping Load, Straight, No Tire Deflection | 13 804 kg (30,433 lb.) | 11 590 kg (25,552 lb.) |
| Tipping Load, Straight, With Tire Deflection | 13 005 kg (28,671 lb.) | 11 007 kg (24,266 lb.) |
| Tipping Load, 40-deg. Full Turn, No Tire Deflection | 12 006 kg (26,469 lb.) | 10 044 kg (22,143 lb.) |
| Tipping Load, 40-deg. Full Turn, With Tire Deflection | 10 956 kg (24,154 lb.) | 9255 kg (20,404 lb.) |
| Rated Operating Load, 50% Full-Turn Tipping Load, No Tire Deflection (conforms to ISO 14397-1)* | 6003 kg (13,234 lb.) | 5022 kg (11,072 lb.) |
| Rated Operating Load, 50% Full-Turn Tipping Load, With Tire Deflection (conforms to ISO 14397-1)* | 5478 kg (12,077 lb.) | 4627 kg (10,201 lb.) |
| Operating Weight | 15 747 kg (34,717 lb.) | 15 948 kg (35,159 lb.) |

*Loader operating information is based on machine with identified linkage and standard equipment, PowerTech PVX 6068 (EPA Final Tier 4/EU Stage IV) engine, ROPS cab, rear cast bumper/counterweight, transmission side-frame guards, bottom guards, standard tires, full fuel tank, and 79-kg (175 lb.) operator. This information is affected by changes in tires, ballast, and different attachments.*

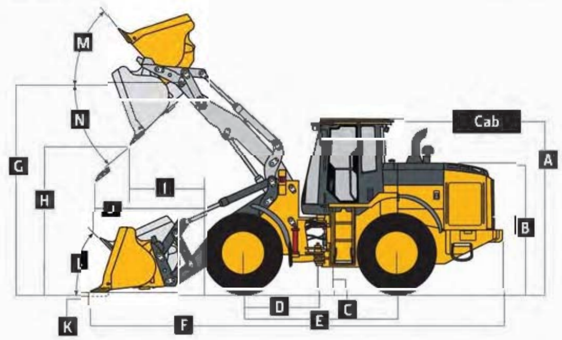
**Rated operating capacity based on Deere attachments only.*




624K Z-BAR AND HIGH-LIFT LOADERS WITH QUICK-COUPLER AND HOOK-ON BUCKET




624K POWERLLEL LOADER WITH QUICK-COUPLER AND HOOK-ON BUCKET




624K TOOL CARRIER LOADER WITH QUICK-COUPLER AND HOOK-ON BUCKET

| | *Z-Bar* | *Z-Bar* | *High-Lift* | *High-Lift* | *Powerllel* | *Powerllel* | *Tool Carrier* | *Tool Carrier* |
|---|---|---|---|---|---|---|---|---|
| **Dimensions with Bucket** | *2.7-m³ (3.5 cu. yd.) general-purpose with bolt-on edge* | *4.01-m³ (5.25 cu. yd.) light-material with bolt-on edge* | *2.7-m³ (3.5 cu. yd.) general-purpose with bolt-on edge* | *4.01-m³ (5.25 cu. yd.) light-material with bolt-on edge* | *2.7-m³ (3.5 cu. yd.) general-purpose with bolt-on edge* | *4.01-m³ (5.25 cu. yd.) light-material with bolt-on edge* | *2.7-m³ (3.5 cu. yd.) general-purpose with bolt-on edge* | *4.01-m³ (5.25 cu. yd.) light-material with bolt-on edge* |
| A Height to Top of Cab | 3.32 m (10 ft. 11 in.) | | 3.32 m (10 ft. 11 in.) | | 3.32 m (10 ft. 11 in.) | | 3.32 m (10 ft. 11 in.) | |
| B Hood Height | 2.46 m (8 ft. 1 in.) | | 2.46 m (8 ft. 1 in.) | | 2.46 m (8 ft. 1 in.) | | 2.46 m (8 ft. 1 in.) | |
| C Ground Clearance | 384 mm (15.1 in.) | | 384 mm (15.1 in.) | | 384 mm (15.1 in.) | | 384 mm (15.1 in.) | |
| D Length from Centerline to Front Axle | 1.52 m (5 ft. 0 in.) | | 1.52 m (5 ft. 0 in.) | | 1.52 m (5 ft. 0 in.) | | 1.52 m (5 ft. 0 in.) | |
| E Wheelbase | 3.09 m (10 ft. 1 in.) | | 3.09 m (10 ft. 1 in.) | | 3.09 m (10 ft. 1 in.) | | 3.09 m (10 ft. 1 in.) | |
| F Overall Length, Bucket on Ground | 7.98 m (26 ft. 2 in.) | 8.09 m (26 ft. 6 in.) | 8.39 m (27 ft. 6 in.) | 8.50 m (27 ft. 11 in.) | 8.13 m (26 ft. 8 in.) | 8.42 m (27 ft. 7.5 in.) | 7.95 m (26 ft. 1 in.) | 8.19 m (26 ft. 10 in.) |
| G Height to Hinge Pin, Fully Raised | 3.96 m (13 ft. 0 in.) | | 4.32 m (14 ft. 2 in.) | | 3.99 m (13 ft. 1 in.) | | 3.99 m (13 ft. 1 in.) | |
| H Dump Clearance, 45 deg., Full Height | 2.69 m (8 ft. 10 in.) | 2.56 m (8 ft. 5 in.) | 3.06 m (10 ft. 1 in.) | 2.90 m (9 ft. 6 in.) | 2.70 m (8 ft. 10 in.) | 2.55 m (8 ft. 4 in.) | 2.81 m (9 ft. 3 in.) | 2.60 m (8 ft. 6 in.) |
| I Reach, 45-deg. Dump, Full Height | 1.11 m (3 ft. 8 in.) | 1.15 m (3 ft. 9 in.) | 1.20 m (3 ft. 11 in.) | 1.23 m (4 ft. 0 in.) | 1.28 m (4 ft. 2 in.) | 1.31 m (4 ft. 4 in.) | 1.45 m (4 ft. 9 in.) | 1.42 m (4 ft. 8 in.) |
| J Reach, 45-deg. Dump, 2.13-m (7 ft. 0 in.) Clearance | 1.56 m (5 ft. 2 in.) | 1.50 m (4 ft. 11 in.) | 1.94 m (6 ft. 4 in.) | 1.90 m (6 ft. 3 in.) | 1.75 m (5 ft. 9 in.) | 1.70 m (5 ft. 7 in.) | 1.85 m (6 ft. 1 in.) | 1.77 m (5 ft. 10 in.) |
| K Maximum Digging Depth | 165 mm (6.5 in.) | 257 mm (10.12 in.) | 262 mm (10.3 in.) | 358 mm (14.0 in.) | 119 mm (4.7 in.) | 228 mm (9.0 in.) | 102 mm (4.0 in.) | 225 mm (8.9 in.) |
| L Maximum Rollback at Ground Level | 39 deg. | 40 deg. | 39 deg. | 41 deg. | 42 deg. | 45 deg. | 49 deg. | 56 deg. |
| M Maximum Rollback, Boom Fully Raised | 55 deg. | 56 deg. | 48 deg. | 50 deg. | 52 deg. | 53 deg. | 64 deg. | 58.5 deg. |
| N Maximum Bucket Dump Angle, Fully Raised | 45 deg. | 49 deg. | 42 deg. | 45 deg. | 46 deg. | 48 deg. | 43 deg. | 48 deg. |
| Loader Clearance Circle, Bucket Carry Position | 12.38 m (40 ft. 7 in.) | 13.00 m (42 ft. 8 in.) | 12.77 m (41 ft. 11 in.) | 13.36 m (43 ft. 10 in.) | 12.60 m (41 ft. 4 in.) | 12.90 m (42 ft. 4 in.) | 12.26 m (40 ft. 3 in.) | 12.55 m (41 ft. 2 in.) |

## Dimensions and Specifications with Hi-Vis Coupler and Hook-On Bucket *(continued)*

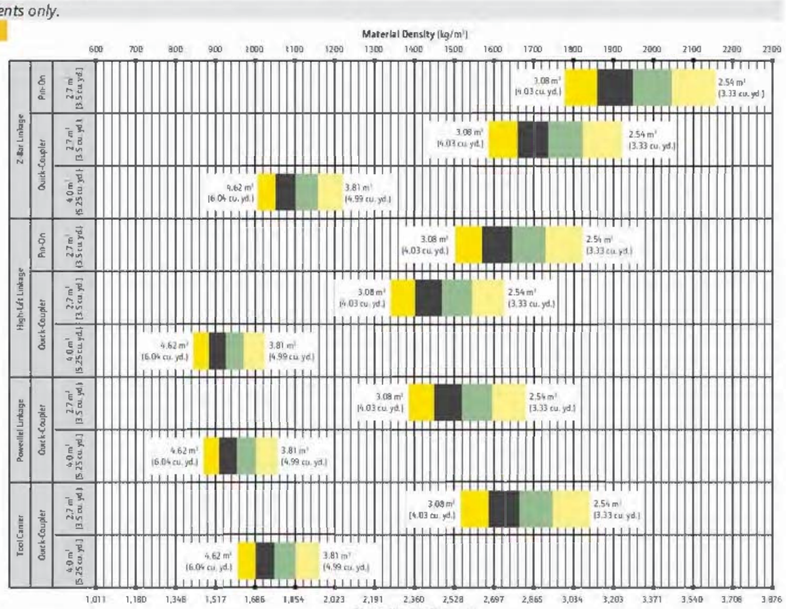
**624K Z-BAR / HIGH-LIFT / POWERLLEL / TOOL CARRIER**

| Specifications with Bucket | *Z-Bar* *2.7-m³ (3.5 cu. yd.) general-purpose with bolt-on edge* | *Z-Bar* *4.01-m³ (5.25 cu. yd.) light-material with bolt-on edge* | *High-Lift* *2.7-m³ (3.5 cu. yd.) general-purpose with bolt-on edge* | *High-Lift* *4.01-m³ (5.25 cu. yd.) light-material with bolt-on edge* | *Powerllel* *2.7-m³ (3.5 cu. yd.) general-purpose with bolt-on edge* | *Powerllel* *4.01-m³ (5.25 cu. yd.) light-material with bolt-on edge* | *Tool Carrier* *2.7-m³ (3.5 cu. yd.) general-purpose with bolt-on edge* | *Tool Carrier* *4.01-m³ (5.25 cu. yd.) light-material with bolt-on edge* |
|---|---|---|---|---|---|---|---|---|
| Capacity, Heaped | 2.7 m³ (3.5 cu. yd.) | 4.0 m³ (5.25 cu. yd.) | 2.7 m³ (3.5 cu. yd.) | 4.0 m³ (5.25 cu. yd.) | 2.7 m³ (3.5 cu. yd.) | 4.0 m³ (5.25 cu. yd.) | 2.7 m³ (3.5 cu. yd.) | 4.0 m³ (5.25 cu. yd.) |
| Capacity, Struck | 2.3 m³ (3.0 cu. yd.) | 3.5 m³ (4.6 cu. yd.) | 2.3 m³ (3.0 cu. yd.) | 3.5 m³ (4.6 cu. yd.) | 2.3 m³ (3.0 cu. yd.) | 3.5 m³ (4.6 cu. yd.) | 2.3 m³ (3.0 cu. yd.) | 3.5 m³ (4.6 cu. yd.) |
| Bucket Weight with Bolt-On Cutting Edge | 1532 kg (3,378 lb.) | 1890 kg (4,167 lb.) | 1532 kg (3,378 lb.) | 1890 kg (4,167 lb.) | 1562 kg (3,444 lb.) | 1913 kg (4,217 lb.) | 1077 kg (2,375 lb.) | 1724 kg (3,801 lb.) |
| Bucket Width | 2.69 m (8 ft. 10 in.) | 3.05 m (10 ft. 0 in.) | 2.69 m (8 ft. 10 in.) | 3.05 m (10 ft. 0 in.) | 2.69 m (8 ft. 10 in.) | 3.05 m (10 ft. 0 in.) | 2.69 m (8 ft. 10 in.) | 3.05 m (10 ft. 0 in.) |
| Breakout Force | 10 983 kg (24,214 lb.) | 9849 kg (21,713 lb.) | 9998 kg (22,042 lb.) | 9035 kg (19,919 lb.) | 10 759 kg (23,719 lb.) | 10 638 kg (23,453 lb.) | 10 978 kg (24,202 lb.) | 9826 kg (21,663 lb.) |
| Tipping Load, Straight, No Tire Deflection | 12 357 kg (27,242 lb.) | 11 924 kg (26,288 lb.) | 10 419 kg (22,969 lb.) | 10 001 kg (22,048 lb.) | 10 803 kg (23,816 lb.) | 10 299 kg (22,705 lb.) | 11 837 kg (26,097 lb.) | 11 337 kg (24,994 lb.) |
| Tipping Load, Straight, With Tire Deflection | 11 661 kg (25,708 lb.) | 11 199 kg (24,689 lb.) | 9900 kg (21,826 lb.) | 9540 kg (21,032 lb.) | 10 251 kg (22,600 lb.) | 9729 kg (21,449 lb.) | 11 169 kg (24,623 lb.) | 10 659 kg (23,499 lb.) |
| Tipping Load, 40-deg. Full Turn, No Tire Deflection | 10 694 kg (23,577 lb.) | 10 278 kg (22,659 lb.) | 8975 kg (19,786 lb.) | 8573 kg (18,900 lb.) | 9312 kg (20,530 lb.) | 8835 kg (19,478 lb) | 10 253 kg (22,605 lb.) | 9774 kg (21,548 lb.) |
| Tipping Load, 40-deg. Full Turn, With Tire Deflection | 9768 kg (21,535 lb.) | 9318 kg (20,542 lb.) | 8268 kg (18,228 lb.) | 7827 kg (17,255 lb.) | 8547 kg (18,843 lb.) | 8064 kg (17,778 lb.) | 9354 kg (20,622 lb.) | 8862 kg (19,537 lb.) |
| Rated Operating Load, 50% Full-Turn Tipping Load, No Tire Deflection (conforms to ISO 14397-1)* | 5347 kg (11,788 lb.) | 5139 kg (11,329 lb.) | 4487 kg (9,893 lb.) | 4286 kg (9,449 lb.) | 4656 kg (10,265 lb.) | 4417 kg (9,738 lb.) | 5127 kg (11,302 lb.) | 4887 kg (10,774 lb.) |
| Rated Operating Load, 50% Full-Turn Tipping Load, With Tire Deflection (conforms to ISO 14397-1)* | 4884 kg (10,767 lb.) | 4659 kg (10,271 lb.) | 4134 kg (9,114 lb.) | 3913 kg (8,627 lb.) | 4273 kg (9,420 lb.) | 4032 kg (8,889 lb.) | 4677 kg (10,311 lb.) | 4431 kg (9,769 lb.) |
| Operating Weight | 16 152 kg (35,608 lb.) | 16 477 kg (36,325 lb.) | 16 352 kg (36,050 lb.) | 16,678 kg (36,769 lb.) | 17 167 kg (37,847 lb.) | 17 472 kg (38,519 lb.) | 16 166 kg (35,640 lb.) | 16 482 kg (36,336 lb.) |

*Loader operating information is based on machine with identified linkage and standard equipment, PowerTech PVX 6068 (EPA Final Tier 4/EU Stage IV) engine, ROPS cab, rear cast bumper/counterweight, transmission side-frame guards, bottom guards, standard tires, full fuel tank, and 79-kg (175 lb.) operator. This information is affected by changes in tires, ballast, and different attachments.*

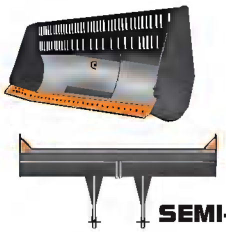
**Rated operating capacity based on Deere attachments only.*

### Bucket Selection Guides

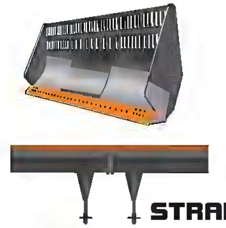



| LOOSE MATERIALS | kg/m³ | lb./cu. yd. | LOOSE MATERIALS | kg/m³ | lb./cu. yd. |
|---|---|---|---|---|---|
| Chips, pulpwood | 288 | 486 | Limestone, coarse, sized | 1570 | 2,646 |
| Cinders (coal, ashes, clinkers) | 673 | 1,134 | Limestone, mixed sizes | 1682 | 2,835 |
| Clay and gravel, dry | 1602 | 2,700 | Limestone, pulverized or crushed | 1362 | 2,295 |
| Clay, compact, solid | 1746 | 2,943 | Sand, damp | 2083 | 3,510 |
| Clay, dry in lump loose | 1009 | 1,701 | Sand, dry | 1762 | 2,970 |
| Clay, excavated in water | 1282 | 2,160 | Sand, voids, full of water | 2083 | 3,510 |
| Coal, anthracite, broken, loose | 865 | 1,458 | Sandstone, quarried | 1314 | 2,214 |
| Coal, bituminous, moderately wet | 801 | 1,350 | Shale, broken crushed | 1362 | 2,295 |
| Earth, common loam, dry | 1218 | 2,052 | Slag, furnace granulated | 1955 | 3,294 |
| Earth, mud, packed | 1843 | 3,105 | Stone or gravel, 37.5 to 87.5-mm (1.5 to 3.5") size | 1442 | 2,430 |
| Granite, broken | 1538 | 2,592 | Stone or gravel, 18.75-mm (3/4") size | 1602 | 2,700 |
| Gypsum | 2275 | 3,834 | | | |

FULL-U



SEMI-U

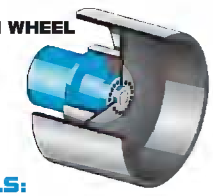


STRAIGHT

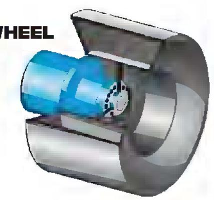
## BLADE:

Your choice of Full-U, Semi-U or Straight Blade. Standard blade minimum of 184 inches (4673mm) wide, 76 inches (1930mm) high including full width trash screens. Bolt-on reversible cutting edges and replaceable end bits.

I-BEAM WHEEL



CONE WHEEL



## WHEELS:

Standard wheels are 48 inches (1219mm) wide I-beam style with 2 inch (50mm) thick outer drums and 8 inch (203mm) tall MacPactor M-Trax Diamond 1-piece, weld-on style cleats. Drum diameter is 58 inch (1473mm) overall diameter is 74 inch (1879mm). Cleats are arranged to provide effective traction and demolition and to prevent material plugging without the use of cleaner bars. Contact Al-jon for other available wheel options.

### 8 INCH TALL CLEAT OPTIONS (203mm)

M-TRAX DIAMOND TRACTION

M-TRAX DIAMOND LATERAL

## AL-JON INC. SOLID WASTE DIVISION WIRE OR CABLE WRAP STRUCTURE WARRANTY

Al-jon MFG.LLC, Solid Waste Division, will warranty the following for a period of Five (5) Years or 10,000 Hours, whichever occurs first:

| | |
|---|---|
| Wheel Inner Drum | Wheel Side Wall (Inner Cone) |
| Welds Attaching Cones to Drums | Planetary or Planetary Shaft Seals |
| Axle Structure | |

This warranty guarantees repair or entire replacement of any listed component damaged by wire, cable or other foreign debris trapped between the wheels and the frame of the compactor. Exercise of this warranty and its extent by Al-jon MFG. LLC. or its representative shall be at the discretion of Al-jon MFG. LLC, Solid Waste Division. All expenditures made to exercise this warranty are the responsibility of Al-jon MFG. LLC excluding consequential damages, lost production, etc.

This warranty shall remain in effect for the time period indicated above, and shall apply to the original purchaser only.

AL-JON, MFG. LLC SOLID WASTE DIVISION

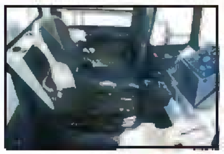
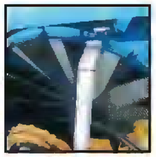
OTTUMWA, IOWA ▶ 888-255-6681 ▶ www.aljon.com

# ADVANTAGE 525 SERIES
LANDFILL COMPACTOR

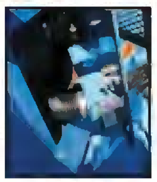
## OPERATING WEIGHT:
**MIN. - 107,000 lbs.**

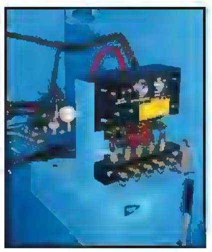
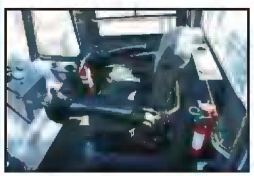

## FILTRATION and COOLING:
Hydraulic system features 100 mesh screened inlet filtration, 5 micron return line filtration and independent 10 micron filtration for each individual wheel circuit.
Cooling components are oversized all aluminum construction and feature in-line tubes with 6.5 cooling fins per inch for superior performance in dusty landfill conditions. Corrugated and perforated pre-screens pull out for easy maintenance.

## DRIVE:
Hydrostatic drive, with each wheel driven by its own independent system, consisting of PC-controlled variable displacement pump, motor and planetary reduction final drive.


## SPEED:
4 Speeds Forward,
4 Speeds Reverse.
0 to 5.2 mph
(0 to 8.4 km/hr)



## GAUGES:
Illuminated, analog style gauges display engine oil pressure, engine coolant temperature, fuel level, and tachometer.

## MC400 ELECTRONIC CONTROL SYSTEM:
Continuously calibrates all four wheels with the angle of the center joint to improve steering, reduce component wear and increase operator comfort. The MC400 monitors all critical components and alerts the operator via digital display and/or alarm and shuts down the machine when potentially damaging conditions exist.

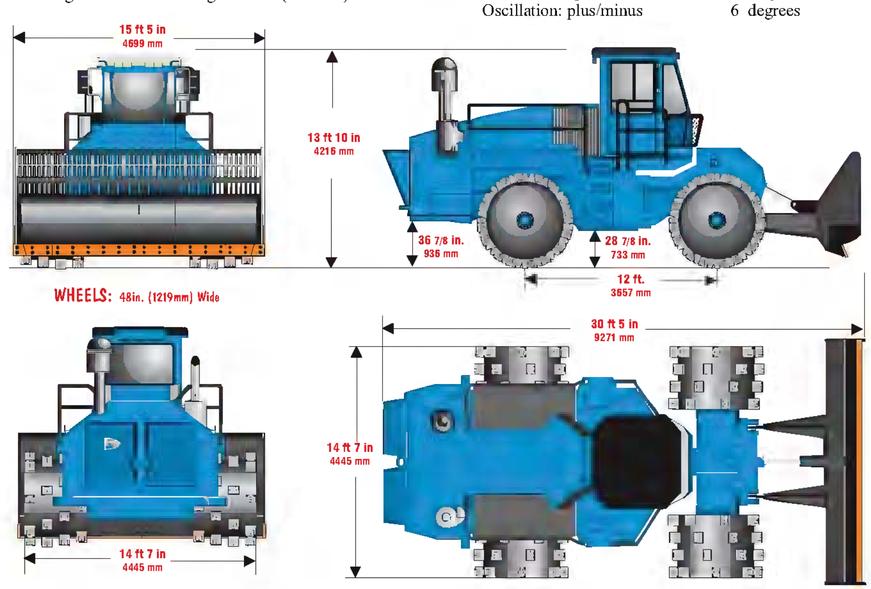
## CAB:
Ergonomically-designed, insulated and sound suppressed.
ROPS/FOPS certified.
Six-way adjustable air ride seat, adjustable head rest and 3 inch wide seat belt.
Joystick steering with horn button.
Joystick blade control with blade (raise, lower, float), speed selector, and directional controls.
Illuminated analog style gauges, MC400 digital display screen and warning indicators.
40,000 BTU front and rear A/C system with directional vents.
30,000 BTU front and rear Heat/Defrost system.
Filtered fresh air intake.
AM/FM radio/CD, MP3 port, four speaker stereo.
Integrated CB antenna.
Rear vision camera with full color display.
Four exterior West Coast Mirrors.
Four front and rear, two side Halogen exterior lights.
Front and rear wiper/washer (intermittent front wiper).
Two 12V DC accessory.
4 cup holders, 2 coat hooks and Dome light.

## CAPACITIES:

| | | |
|---|---|---|
| Fuel: | 205 gallons | (776 liters) |
| Hydraulic oil, main tank: | 70 gallons | (264 liters) |
| Hydraulic oil, reserve tank: | 70 gallons | (264 liters) |
| Engine coolant: | 19 gallons | (71 liters) |
| Engine lube oil system: | | |
| Cat Engine | 9.0 gallons | (34 liters) |
| John Deer Engine | 10.5gallons | (39 liters) |

## DIMENSIONS:

| | | |
|---|---|---|
| Overall length: | 30ft 5in | (9271mm) |
| Overall width at wheels: | 14ft 7in | (4445mm) |
| Overall height at ROPS: | 13ft 10in | (4216mm) |
| Wheelbase: | 12ft | (3657mm) |
| Turning radius (inside): | 10ft 6in | (3200mm) |
| Ground clearance: | 28 7/8in. | (733mm) |
| Articulation: plus/minus | 35 degrees | |
| Oscillation: plus/minus | 6 degrees | |




## BRAKES:
OSHA-approved, all-wheel hydrodynamic braking.
Independent spring-applied, hydraulic-realease fail-safe parking/emergency brakes on front wheels.

## FRAME:
Extra heavy box beam construction with 1 ½ inch (38mm) flanges and 1 inch (25mm) thick webs. Center joint with 4 inch (101mm) thick rear tangs and one 2 inch (50mm) and three 1 ½ inch (38mm) thick front tangs.

## ELECTRICAL SYSTEM:
24 volt electrical system with four maintenance free, heavy duty 925CCA batteries. Cat engine has a 95 AMP and John Deere engine has a 140 AMP Alternator.

## ENGINE:
**Caterpillar® C15 ACERT™: 15.2 liter/540 gross horsepower - OR - John Deere® 6135H PowerTech Plus™: 13.5 liter/550 gross horsepower**
These turbo-charged and after-cooled six cylinder diesel engines meet current Tier 3/Stage IIIA emissions regulations. Direct injection fuel system with adjustment-free injection pumps and valves. 1500 watt engine block heater. 24 volt direct electric starting with ether starting aid. Dual, dry-type, two-stage air cleaner. Pressure lubrication with full-flow filtered oil and heat exchange oil cooler. Al-jon hydraulic, auto-reverse cooling fan ("ARC") is standard.

## OPTIONS:
Contact Al-jon for a list of available options.

# Cat®

# 623K

## Wheel Tractor-Scraper

**Main Features and Benefits:**

- **Tractor Serviceability Improvement** – The filter bank located at the rear of the engine compartment has undergone improvements for serviceability by raising the filter bank up for easier access.
- **Engine Over Speed Protection** – In the event of an engine over speed situation, the compression brake or brakes will automatically engage with no operator input. The machine determines the over speed condition based on rate of acceleration and applies compression brakes automatically.
- **Advanced Cushion Hitch** – With similar technology as the Cat® Advanced Ride Management seat suspension, this software allows the cushion hitch to prevent end stroke by having the ability to predict end stroke events and manage the rate of dampening. The desired result is improved hitch repair, reduced maintenance and improved operator ride in rough conditions.
- **High Pressure Steering** – 620K Series steering system design requires significantly less steering effort. The reduced steering effort will allow for decreased operator fatigue and a more efficient operator resulting in possible higher rates of production late in the work cycle.
- **Load Assist Option** – The 623K now is offered with the Load Assist option like the 621K and 627K.
- **Draft Arm Overflow Guards** – The open bowls now come standard with bowl side overflow guards to help prevent material from flowing over the bowl sides and falling onto the draft arms where material becomes lodged between the bowl side and draft arm resulting in decreased work cycle times.
- **Auto Stall** – In cold weather conditions the machine will use the Auto Stall feature to help warm up the transmission oil faster resulting in the machine shifting out of torque converter drive (2nd gear) faster than on previous models.
- **Differential Lock Engagement Protection (Standard)** – This standard feature allows the machine to prevent the operator from engaging the differential lock when damage could occur.
- **Cab Improved** – The interior of the K Series cabs has improved the operator comfort and visibility by redesigning the dash area and key pad placement.
- **Machine Speed Limit** – This feature is designed to take the place of top gear selection. If the machine top speed needs to be limited the operator can select the top speed through the display or the top speed can be set in ET. This will allow the machine to find the correct gear that works best for the engine and transmission. Allowing the engine and transmission to select the correct gear to pull the load in most cases resulting in a lower engine load factor and lower fuel burn verses using top gear selection that required the machine to run at engine speeds at or close high idle.
- **Ground Speed Control** – Ground Speed Control sets the desired top speed by the operator if job site conditions or segment speed limits require a speed less than full run out. Machine Speed Limit is intended for use when top speed needs to be limited for longer durations and Ground Speed Control is intended for use when the top speed needs to be reduced for shorter segments or intermediate periods of time. The operator can set the desired top speed and the machine will find the correct gear that works best for the engine and transmission. Allowing the engine and transmission to select the correct gear to pull the load in most cases will result in a lower engine load factor and lower fuel burn verses top gear selection.

# Specifications

## General Data

| | | |
|---|---|---|
| Fuel Tank Refill Capacity: Scraper | 763 L | 201 U.S. gal |
| Overall Width | 3.57 m | 11'7" |
| Overall Shipping Height | 3.77 m | 12'3" |
| Scraper Capacity: | | |
| Struck | 14.4 $m^3$ | 18.8 $yd^3$ |
| Heaped | 17.6 $m^3$ | 23 $yd^3$ |
| Rated Load | 25 038 kg<br>25.1 tonnes | 55,200 lb<br>27.6 tons |
| Width of Cut | 3.14 m | 10'4" |
| Maximum Depth of Cut | 262 mm | 10.3" |
| Maximum Depth of Spread | 465 mm | 18.3" |

| | | |
|---|---|---|
| Top Speed (Loaded) | 53.9 km/h | 33.5 mph |
| 180° Curb-to-Curb Turning Width | 11.8 m | 38'7" |
| Tires: | | |
| Tractor Drive | 33.25R29**E3 | |
| Scraper | 33.25R29**E3 | |
| Operating Weight (Empty) | 39 937 kg | 88,061 lb |
| Overall Length | 13.77 m | 45'2" |
| Elevator Flight Spacing | 520 mm | 20" |
| Number of Flights | 15 | |
| Maximum Floor Opening | 1.34 mm | 4'4" |

# 623K Wheel Tractor-Scraper

## Engine

| | | |
|---|---|---|
| Engine Model | Cat C13 ACERT™ | |
| Rated Engine RPM | 2,000 rpm | |
| Flywheel Power: Tractor | 304 kW | 407 hp |

- Cat C13 ACERT engine meets U.S. Environmental Protection Agency (EPA) Tier 4 Final/EU Stage IV engine emission standards.

## Cab

| | |
|---|---|
| ROPS/FOPS | Meets SAE and ISO standards |

- The exterior sound power level for the standard machine (ISO 6393) is 111.5 dB(A).

## Safety Criteria Compliance Standards

| | |
|---|---|
| Rollover Protection Structure (ROPS) | ISO 3471:2008 for up to 17 084 kg (37,664 lb) |
| Falling Object Protective Structure (FOPS) | ISO 3449:2005 Level II |
| Brakes | ISO 3450:1996 |
| Steering System | ISO 5010:2007 |
| Seat Belt | SAE J386:JUN1985 |
| Reverse Alarm | ISO 9533:2010 |

## Travel Speeds (Runout)

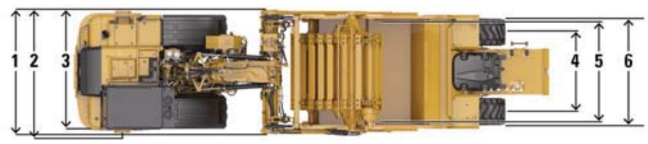
| Transmission Gear: | | |
|---|---|---|
| First | 5.0 km/h | 3.1 mph |
| Second | 8.9 km/h | 5.5 mph |
| Third | 12.1 km/h | 7.5 mph |
| Fourth | 16.3 km/h | 10.1 mph |
| Fifth | 21.9 km/h | 13.6 mph |
| Sixth | 29.6 km/h | 18.4 mph |
| Seventh | 39.9 km/h | 24.8 mph |
| Eighth | 53.9 km/h | 33.5 mph |
| Reverse | 9.2 km/h | 5.7 mph |

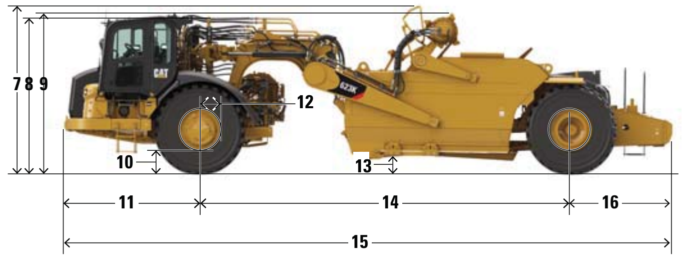
## Implement Cycle Times

| | |
|---|---|
| Bowl Raise | 3.0 seconds |
| Bowl Lower | 3.5 seconds |
| Ejector Extend | 6.45 seconds |
| Ejector Retract | 9.7 seconds |

## Service Refill Capacities

| | | |
|---|---|---|
| Crankcase | 30.58 L | 8.08 gal |
| Transmission System | 93 L | 24.76 gal |
| Cooling System | 45 L | 11.89 gal |
| Fuel Tank | 818 L | 216.09 gal |
| Hydraulic System | 83 L | 21.926 gal |
| Diesel Exhaust Fluid | 30.5 L | 8.0572 gal |




## Dimensions

| | | 623K | |
|---|---|---|---|
| | | mm | in |
| 1 | Width – Overall Machine | 3585 | 141.1 |
| 2 | Width – Overall Machine – Ladder Down | 3790 | 149.2 |
| 3 | Width – Tractor | 3381 | 133.1 |
| 4 | Width – Rear Tire Centers | 2290 | 90.2 |
| 5 | Width – Inside of Bowl | 3048 | 120.0 |
| 6 | Width – Outside Rear Tires | 3275 | 128.9 |
| 7 | Height – Overall Shipping | 4037 | 158.9 |
| 8 | Height – Top of Cab | 3621 | 142.6 |
| 9 | Height of Top of Elevator | 3768 | 148.3 |
| 10 | Ground Clearance – Tractor | 557 | 21.9 |
| 11 | Front of Tractor to Front Axle | 3119 | 122.8 |
| 12 | Axle to Vertical Hitch Pin | 432 | 17.0 |
| 13 | Height – Scraper Blade Maximum | 520 | 20.5 |
| 14 | Wheelbase | 8370 | 329.5 |
| 15 | Length – Overall Machine | 13 767 | 542.0 |
| 16 | Rear Axle to Rear of Machine | 2278 | 89.7 |

# APPENDIX 1-H
# WELL PB-1 ABANDONMENT DOCUMENTATION

David M. Loper

**From:** Jones, Chad <ChadJones@idwr.idaho.gov>
**Sent:** Thursday, July 09, 2015 12:29 PM
**To:** ccsw@speedyquick.net
**Subject:** Well Info

There are many wells around that area, but I seem to have only located one that was abandoned. The only document scanned into the system relating to its abandonment is included below.
Permit # 731904
Well ID # 296507

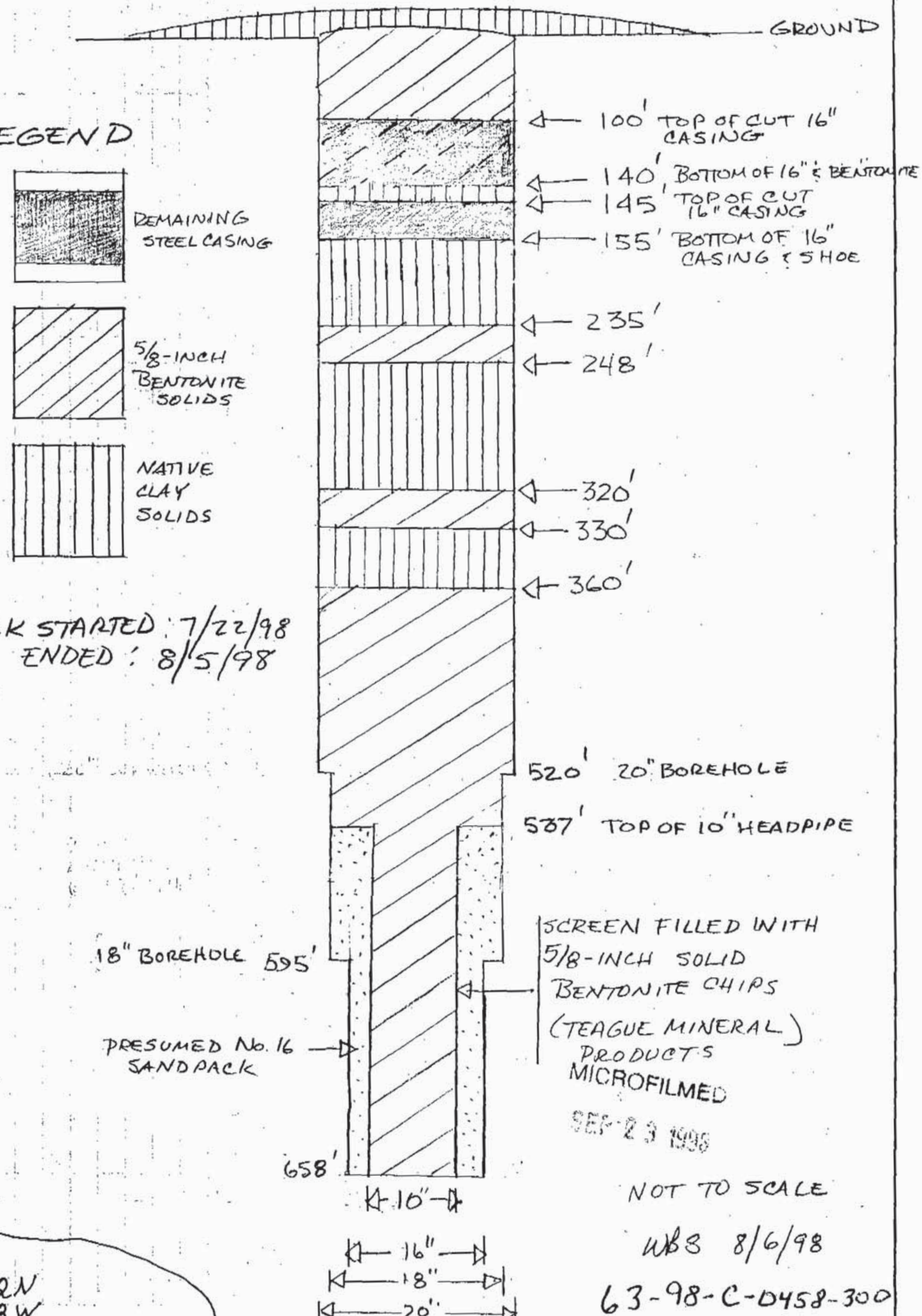
http://www.idwr.idaho.gov/apps/appsWell/.%5CDocsImages%5C3p2701_.PDF


**Chad Jones**
**Office Specialist II**
**Idaho Dept. of Water Resources - Western Region**
**chad.jones@idwr.idaho.gov**
**(208)334-2190**

63-98-C-0458-300
SHOPWELL ABANDONMENT, CANYON COUNTY

15500 Missouri Ave
Pickles Butte LANDFILL

065438 Job No. CC 021/98




TS 2N
R 3W
Sec 21 SE SWNW

# PHASE I HYDROGEOLOGIC CHARACTERIZATION REPORT

## 1992 SITE INVESTIGATION
## PICKLES BUTTE SANITARY LANDFILL
## CANYON COUNTY, IDAHO

REGISTERED PROFESSIONAL GEOLOGIST
WILLIAM B. STROWD
541
STATE OF IDAHO

JUNE 1993

HOLLADAY ENGINEERING COMPANY
Payette, Idaho

Project Number T1120491

# IV. SITE HYDROGEOLOGY

## A. PB-1 DESCRIPTION

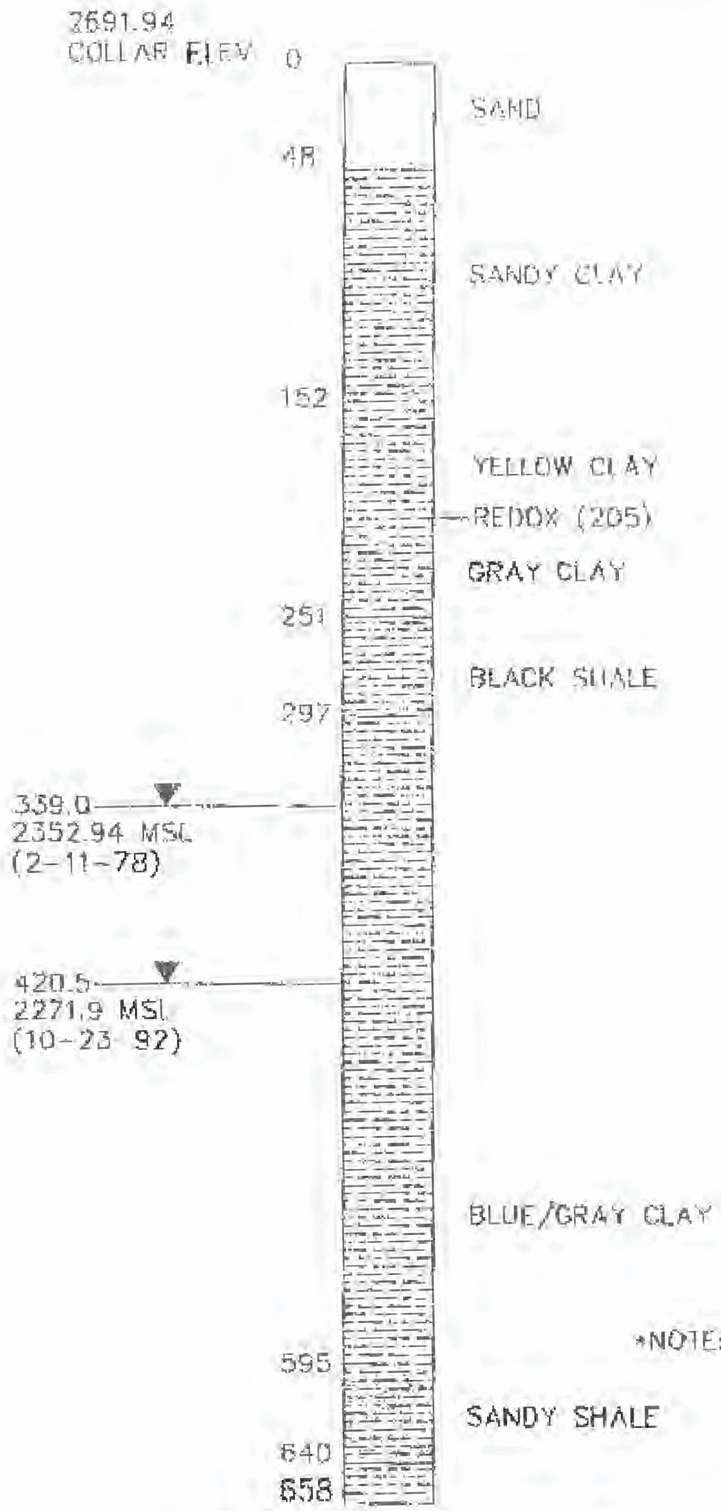
The PB-1 well is located approximately 100 feet southeast of the landfill shop with a collar elevation of 2692 MSL and was completed on 2-11-78 by Witt Drilling using a cable tool drill. The following lithologic description for PB-1 is based on the well driller's log (see Appendix B) which was found to be generally consistent with results of the Phase I drilling. The uppermost 48 feet is described as clayey sand, sandy clay from 48 to 152 feet, yellow clay from 152 to 205, gray sticky clay from 205 to 251, blue or gray clay and shale from 251 to 595, sandy shale from 595 to 640, and blue clay from 640 to the hole bottom at 658 feet. The driller's log reported ground-water production from the sandy shale unit of 595 to 640 feet and placed the well screen from 577 to 637 feet. The resulting static water level after completion was recorded as 339 feet below land surface (2353 feet MSL).

The low consumptive use of the well for the landfill's equipment cleaner and for its two restrooms appears to have resulted in substantial drawdown. This use has required the pump to be lowered twice in the well to date. Knowledge of the well's performance history is unclear since water levels were not taken in the intervening years. However, a check on the water level on 10-23-92 indicated a depth of 420 feet (2272 feet MSL) or 81 feet lower than recorded at the time of well construction in 1978. The water level found on 10-23 may be lower than normally encountered due to heavy use the day prior since personnel at the facility knew they would be without water the following day. In any case the well recovers slowly and has possibly sustained a reduction in confined head from routine use over the intervening 14 years. A videocamera survey of the well on 10-24-92 indicated no problems with the casing liner or screen.

The water temperature in the bottom of the well's water column as determined by a downhole thermometer is 27.8° C (82° F). The water is described by the facility's personnel as unfit to drink due to sulfide odor and high iron and mineral taste (they use bottled water). Analysis for the Appendix I 40 CFR Part 258 suite on a sample taken from this well on 4-8-92 resulted in nondetect for all constituents (certificate of analysis in Appendix F). Tested field parameters of water at the wellhead indicate a temperature of 21.1° C (70° F), a pH of 8.4 and a conductivity of 1.10 mS/cm. The fact that the productive zone occurs 256 feet below the static level at the time of drilling (175 feet below its measured level on 10-23-92) and the aquifer is at elevated temperatures indicates both a confined and geothermally heated aquifer condition. This condition is implicit of the resource possessing positive pressure at the confining layer boundary and the water's origin is either remote or, at least in part, ascending from depth from an environment of higher heat flow.

## B. PB-2 DESCRIPTION

Corehole PB-2 was located immediately east of the landfill as shown on the well location map (Figure 1). The lithology encountered in this hole consist of a varied sequence of weak to moderately consolidated tan to light brown silty sand, clayey silt, and sandy silt from the surface down to 294 feet. This assemblage constitutes the coarser material of which an analog was identified in the upper levels of all three holes drilled at the landfill. The same package also appears to be reflected in the driller's log of the domestic well PB-1 which may correspond to its sand (0 - 48 feet) and sandy clay (48 - 152 feet). A moderately consolidated silty claystone occurs from 294 to 396 feet depth; this unit contains a redox boundary at 353 feet, below which occasional plant carbon and fine pyrite occurs. A well indurated, dark gray, mostly massive claystone was found in the interval below 396 feet to the hole bottom at 557 feet. This unit corresponds to the lithology found in the lower reaches of the subsequent holes PB-3 and PB-4 and almost




*NOTE: LITHOLOGY BASED ON WELL DRILLER'S LOG

1" = 80 VERT. FEET

| | | |
|---|---|---|
| HOLLADAY ENGINEERING CO. ENGINEERS & CONSULTANTS | 1431 HWY. 95, BUS. ALT. P. O. BOX 235 PAYETTE, IDAHO 83661 208-642-3304 FAX: 208-642-2159 | GEOLOGIC SCHEMATIC OF BOREHOLE* PB-1 |

JOB NO. 120491 DATE: 2-93 TIME DR SLG CK WBS

USE TYPEWRITER OR BALL POINT PEN

State of Idaho
Department of Water Resources

# WELL DRILLER'S REPORT

State law requires that this report be filed with the Director, **Department of Water Resources within 30** days after the completion or abandonment of the well.

## 1. WELL OWNER

Name CANYON COUNTY

Address Caldwell, Idaho

Owner's Permit No. ____

## 2. NATURE OF WORK

☑ New well ☐ Deepened ☐ Replacement

☐ Abandoned (describe method of abandoning)

## 3. PROPOSED USE

☑ Domestic ☐ Irrigation ☐ Test ☐ Other (specify type)

☐ Municipal ☐ Industrial ☐ Stock ☐ Waste Disposal or Injection

## 4. METHOD DRILLED

☑ Cable ☐ Rotory ☐ Dug ☐ Other

## 5. WELL CONSTRUCTION

Diameter of hole 20 inches Total depth 658 feet

Casing schedule: ☑ Steel ☐ Concrete

| Thickness | Diameter | From | To |
|---|---|---|---|
| .375 inches | 16 inches | +2 feet | 575 feet |
| .250 inches | 10 inches | 537 feet | 577 feet |
| .250 inches | 10 inches | 637 feet | 658 feet |
| inches | inches | feet | feet |
| inches | inches | feet | feet |

Was casing drive shoe used? ☑ Yes ☐ No

Was a packer or seal used? ☑ Yes ☐ No

Perforated? ☐ Yes ☐ No

How perforated? ☐ Factory ☐ Knife ☐ Torch

Size of perforation ____ inches by ____ inches

| Number | | From | To |
|---|---|---|---|
| | perforations | feet | feet |
| | perforations | feet | feet |
| | perforations | feet | feet |

Well screen installed? ☑ Yes ☐ No

Manufacturer's name JOHNSON

Type STAINLESS Model No.

PS Diameter 10 Slot size 25 Set from 577 feet to 637 feet

Diameter ___ Slot size ___ Set from ____ feet to ____ feet

Gravel packed? ☑ Yes ☐ No Size of gravel NO 16 Del Monte

Placed from 537 feet to 658 feet

**Surface seal depth** 20 **Material used in seal** ☑ **Cement grout** ☐ **Puddling clay** ☐ **Well cuttings**

**Sealing procedure used** ☐ **Slurry pit** ☑ **Temporary surface casing** ☐ **Overbore to seal depth**

## 6. LOCATION OF WELL

63

Sketch map location must agree with written location.

N / W / E / S

Subdivision Name ____

Lot No. ____ Block No. ____

County CANYON

SW ¼ NW ¼ Sec. 21, T. 2 N/S, R. 3 E/W

## 7. WATER LEVEL

Static water level 339 feet below land surface

Flowing? ☐ Yes ☐ No G.P.M. flow ____

Temperature ____ °F. Quality ____

Artesian closed-in pressure ____ p.s.i.

Controlled by ☐ Valve ☐ Cap ☐ Plug

## 8. WELL TEST DATA

☑ Pump ☐ Bailer ☐ Other

| Discharge G.P.M. | Draw Down | Hours Pumped |
|---|---|---|
| 8 GPM | 161 | 3 |

## 9. LITHOLOGIC LOG

106783

| Hole Diam. | Depth From | Depth To | Material | Water Yes | Water No |
|---|---|---|---|---|---|
| 20" | 0 | 3 | Top Soil | | |
| " | 3 | 48 | SAND 20% CLAY | | |
| " | 48 | 152 | SANDY CLAY | | |
| " | 152 | 205 | Yellow CLAY | | |
| " | 205 | 251 | GRAY CLAY STICKY | | |
| 20 | 251 | 297 | Blue SHALE | | |
| 20 | 297 | 327 | Blue CLAY 10% SAND | | |
| 20 | 327 | 520 | Blue CLAY (SHALE) | | |
| 18 | 520 | 595 | GREY SHALE | | |
| 16 | 595 | 640 | SHALE, SANDY | ✓ | |
| 16 | 640 | 658 | Blue CLAY | | |

RECEIVED

FEB 23 1978

Department of Water Resources
Western Regional Office

## 10.

Work started 10/4/77 finished 2/10/78

## 11. DRILLERS CERTIFICATION

Firm Name WITT Drilling Firm No. 55

Address Caldwell, Ida Date 2/10/78

Signed by (Firm Official) Kenneth Witt

and

(Operator) Claude DuFoe

USE ADDITIONAL SHEETS IF NECESSARY FORWARD THE WHITE COPY TO THE DEPARTMENT

# APPENDIX 2-A
# LOW FLOW EQUIPMENT COST

QED Environmental Systems

**Quote No:** W-10043, Aug 12, 2015

**Site Reference:** Pickle Butte Landfill

**Prepared For:**
Maureen McGraw
(406) 543-3045
maureen.mcgraw@tetratech.com

TETRA TECH
2525 PALMER ST
SUITE 2
MISSOULA, MT 59808
USA

**Represented By:**
Rose Riedel, Olympic Envr Equipment
360-297-5409
rose@olympicenv.com

Prepared By:
Carl Ellison
800-624-2026
cellison@qedenv.com

| QTY | PART NO. | DESCRIPTION | UM | UNIT PRICE | EXTENSION |
|---|---|---|---|---|---|
| 13 | ST1102M | Bladder pump, stainless steel construction with Dura-Flex Teflon bladder. Flow tested, lab certified with inlet screen and support cable hardware (for 34324 cable). 3/8" discharge. | EA | 1,045.00 | 13,585.00 |
| 8 | C46UH | 4" well cap, designed for 1/4" air supply and 3/8" discharge tubing. Cap is constructed of anodized aluminum. Includes Ultra High Pressure Fitting and dust cover. | EA | 115.00 | 920.00 |
| 5 | WW-CUSTOM | WELL WIZARD CUSTOM PRODUCT<br>*C46UH - 4" well cap, designed for 1/4" air supply and 3/8" discharge tubing. Cap is constructed of anodized aluminum. Includes Ultra High Pressure Fitting, dust cover and adapter plate for use with a 4.5" SS well casing.*<br>*SPN: 909511*<br>*LEAD TIME: 3-4 weeks ARO* | EA | 175.00 | 875.00 |
| 13 | 38458UH | Freeze protection kit for 3/8" or 1/4" tubing, for Ultra High Pressure applications. | EA | 46.00 | 598.00 |
| 13 | 37740 | 3/8" Dura-Flex discharge adapter, 3' length, with reusable tubing lock ring. | EA | 31.00 | 403.00 |
| 7158 | PT5000 | Teflon-lined polyethylene tubing, twin bonded design. 3/8" OD sample tube with 1/4" OD air line. | FT | 4.10 | 29,347.80 |
| 5 | 37757 | Drop tube kit for 1200 series or portable stainless pump (ST1102PM). For 3/8" tube, includes stainless steel pump inlet fitting and stainless steel weight. | EA | 150.00 | 750.00 |
| 363 | 34115 | Polyethylene tubing, 3/8" OD. | FT | 1.05 | 381.15 |

| | | | | | |
|---|---|---|---|---|---|
| 5 | 39365EP | Drop Tube Screen Adapter. (Connects ST1102M inlet screen to SS drop tube weight.) | EA | 12.00 | 60.00 |
| 5 | 35415 | Additional stainless steel drop tube weight, 2' long. | EA | 70.00 | 350.00 |
| 7171 | 34324 | Poly covered 3/32" stainless steel cable. | FT | 1.35 | 9,680.85 |
| 1 | MP10UH | Ultra High Pressure MicroPurge Basics Controller. Advanced electronic controller for applications to 500 PSI, 1000 maximum lift. Microprocessor-based logic simplies MicroPurge sampling. Eliminate excessive drawdown by linking with optional MP30 Drawdown Meter. Controls allow for easy flow rate adjustment and include manual mode for sample collection. Powered by 3 "AA" batteries (provides up to 400 hours use). Includes Nitrogen regulator (CGA-580) and (2) air hoses. | EA | 5,495.00 | 5,495.00 |
| | | | | **TOTAL** | **62,445.80** |

**OPTIONAL ITEMS:**

| | | | | | |
|---|---|---|---|---|---|
| 1 | WW-CUSTOM | WELL WIZARD CUSTOM PRODUCT<br>*MP30-1000: MicroPurge Basics Drawdown / Level Meter. 1000' model connects to the MP10 / MP15 controls to prevent excessive drawdown during low-flow purging (based on limits you set). If drawdown reaches the limit, system alerts the user visually and audibly and signals the controller to standby until the well recovers. Meter also functions as a standard water level meter with visual and audible signals.*<br>*SPN:909512*<br>*LEAD TIME:4-5 Weels ARO* | EA | 2,600.00 | 2,600.00 |

**TERMS & CONDITIONS:** Payment Terms: NET 30

Estimated shipping time 5-10 working days after receipt of Purchase Order, transit time not included. Pricing valid for 30 days. Final delivery date will be determined at time of order. All prices are in U. S. dollars, FOB SHIPPING POINT, USA. A copy of your purchase order, or signed quote, is required at time of order. Payment terms (shown above) are calculated from invoice date, subject to credit approval. A service charge of 1% per month will be applied to all past due invoices.

Unless shown as separate line item(s), total price shown DOES NOT include applicable sales tax or shipping & handling charges. Applicable sales taxes, shipping and handling charges will be added to the invoice. Estimates available upon request.

After acceptance of an order, no order can be returned without QED approval. Standard equipment, not custom in nature, can generally be returned for credit within 30 days of purchase. The equipment must be unused and in its original packaging and is subject to a 15% restocking fee. Custom equipment or tubing cut to a requested length cannot be returned for credit. All products will be returned freight prepaid to sellers facility.

Invoice To: ________________________________ Ship To: ________________________________

________________________________ ________________________________

________________________________ ________________________________

________________________________ Attn: ________________________________

REQUESTED DELIVERY DATE: ____ / ____ / 2015 Amount Approved: $ ______________________

Accepted by: ______________________________ PO Number: ____________________________

Print Name: ______________________________ Company: ____________________________

Title: ______________________________ Date: ____________________________

[__] Check box if this order is necessary to your (or another contractors) contract with the federal government.

To place your order, complete the above section and email to: info@qedenv.com (or fax to: 734-995-1170).
(Please note that a hard copy of your PO may be required before shipment.)

When placing orders, please make paperwork out to: QED Environmental Systems, Inc.

| Mailing Address: | Remit To Address: |
|---|---|
| PO Box 3726 | PO Box 935668 |
| Ann Arbor, MI, 48106 | Atlanta, GA 31193-5668 |

TOTAL BEING APPROVED $62,445.80

## Well Wizard (R) Specification Sheet

**Rev Date:** 8/13/2015

**Customer:** Tetra Tech
**Site/Location:** Pickle Butte Landfill
**Date:** 8/12/15
**Salesperson:** RES/cfe

*Note: All dimensions from top of casing, unless specified.*

| **Well ID No.** | **PB-3** | **PB-4** | **PB-5** | **PB-6** | **PB-7** | **PB-8** |
|---|---|---|---|---|---|---|
| Well System Type | L | A | A | A | A | A |
| Casing Material & Schedule | SS | SS | SS | SS | SS | SS |
| Well Diameter (Inches) | 4 | 4 | 4 | 4 | 4 | 4 |
| Well Depth | 542 | 645 | 527.5 | 507.5 | 565 | 417.5 |
| Static Water Level | 400 | 545 | 517 | 492 | 537 | 289 |
| Water Column Height | 142 | 100 | 10.5 | 15.5 | 28 | 128.5 |
| Screen Length | 10 | 15 | 10 | 10 | 20 | 30 |
| Casing Length to Screen | 520 | 605 | 512.5 | 487.5 | 535 | 377.5 |
| Recovery Rate (gpm) | ________ | ________ | ________ | ________ | ________ | ________ |
| **Sample Collection Point** | **525** | **612** | **521** | **496** | **545** | **392.5** |
| Cold Weather Protection | 38458UH | 38458UH | 38458UH | 38458UH | 38458UH | 38458UH |
| Cap Model | C46UH | C46UH | C46UH | C46UH | C46UH | C46UH |
| Elbow/Flex Flow Model | 37740 | 37740 | 37740 | 37740 | 37740 | 37740 |
| Tubing Stick-up Above Cap (included in total tube length) | 0 | 0 | 0 | 0 | 0 | 0 |
| Bladder Pump Model | ST1102M | ST1102M | ST1102M | ST1102M | ST1102M | ST1102M |
| Bladder Pump Inlet Screen | w/pump | w/pump | w/pump | w/pump | w/pump | w/pump |
| Pump Submergence | 75.0 | 63.5 | **0.5** | **0.5** | **4.5** | 100.0 |
| Bladder PumpTubing Model | PT5000 | PT5000 | PT5000 | PT5000 | PT5000 | PT5000 |
| Bladder Pump Tubing Length | 475.0 | 608.5 | 517.5 | 492.5 | 541.5 | 389.0 |
| Drop Tube Kit | 37757 | ________ | ________ | ________ | ________ | ________ |
| Drop Tubing Model | 34115 | ________ | ________ | ________ | ________ | ________ |
| Drop Tubing Length | 42.5 | ________ | ________ | ________ | ________ | ________ |
| Drop Tube Inlet Screen Adapter | 39365EP | ________ | ________ | ________ | ________ | ________ |
| Drop Tube Weight Model | 35415 | ________ | ________ | ________ | ________ | ________ |
| Drop Tube Extra Weights | 1 | ________ | ________ | ________ | ________ | ________ |
| SS Support Cable | 34324 | 34324 | 34324 | 34324 | 34324 | 34324 |
| SS Support Cable Length | 476.0 | 609.5 | 518.5 | 493.5 | 542.5 | 390.0 |
| SS Support Cable Hardware | w/pump | w/pump | w/pump | w/pump | w/pump | w/pump |
| Cable Support Bracket (pump) | w/pump | w/pump | w/pump | w/pump | w/pump | w/pump |
| Cable Support Bracket (cap) | w/pump | w/pump | w/pump | w/pump | w/pump | w/pump |
| Initial Purge Volume (ml) (pump & tubing) | 5,850 | 6,480 | 5,570 | 5,320 | 5,810 | 4,285 |
| **Calculated Throttle Pressure** | | | | | | |
| **Initial Install** | 57.5 | 51.75 | 20.25 | 20.25 | 22.25 | 70 |
| **Operational Pressures** | 257.5 | 324.25 | 278.75 | 266.25 | 290.75 | 214.5 |
| **VOA Sampling Pressures** | 224.25 | 281.655 | 242.525 | 231.775 | 252.845 | 187.27 |

Signature: ____________________

Date: ____________________

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8/13/2015
print date
3:26 PM

**Well Wizard (R) Specification Sheet**

**Rev Date:** 8/13/2015

**Customer:** Tetra Tech
**Site/Location:** Pickle Butte Landfill
**Date:** 8/12/15
**Salesperson:** RES/cfe

*Note: All dimensions from top of casing, unless specified.*

| **Well ID No.** | **PB-9** | **PB-10** | **PB-11** | **PB-12** | **PB-13** | **PB-14** |
|---|---|---|---|---|---|---|
| Well System Type | A | A | A | L | L | L |
| Casing Material & Schedule | SS | SS | SS | SS | SS | SS |
| Well Diameter (Inches) | 4 | 4 | 4.5 | 4.5 | 4.5 | 4.5 |
| Well Depth | 543.25 | 546.35 | 420 | 555 | 923 | 923 |
| Static Water Level | 509 | 512 | 294 | 311 | 735 | 719 |
| Water Column Height | 34.25 | 34.35 | 126 | 244 | 188 | 204 |
| Screen Length | 30 | 30 | 60 | 60 | 60 | 60 |
| Casing Length to Screen | 508.25 | 511.35 | 340 | 480 | 840 | 845 |
| Recovery Rate (gpm) | ________ | ________ | ________ | ________ | ________ | ________ |
| **Sample Collection Point** | **523** | **526** | **370** | **510** | **870** | **875** |
| Cold Weather Protection | 38458UH | 38458UH | 38458UH | 38458UH | 38458UH | 38458UH |
| Cap Model | C46UH | C46UH | WW-CUSTOM | WW-CUSTOM | WW-CUSTOM | WW-CUSTOM |
| Elbow/Flex Flow Model | 37740 | 37740 | 37740 | 37740 | 37740 | 37740 |
| Tubing Stick-up Above Cap (included in total tube length) | 0 | 0 | 0 | 0 | 0 | 0 |
| Bladder Pump Model | ST1102M | ST1102M | ST1102M | ST1102M | ST1102M | ST1102M |
| Bladder Pump Inlet Screen | w/pump | w/pump | w/pump | w/pump | w/pump | w/pump |
| Pump Submergence | 10.5 | 10.5 | 72.5 | 75.0 | 75.0 | 75.0 |
| Bladder PumpTubing Model | PT5000 | PT5000 | PT5000 | PT5000 | PT5000 | PT5000 |
| Bladder Pump Tubing Length | 519.5 | 522.5 | 366.5 | 386.0 | 810.0 | 794.0 |
| Drop Tube Kit | ________ | ________ | ________ | 37757 | 37757 | 37757 |
| Drop Tubing Model | ________ | ________ | ________ | 34115 | 34115 | 34115 |
| Drop Tubing Length | ________ | ________ | ________ | 116.5 | 52.5 | 73.5 |
| Drop Tube Inlet Screen Adapter | ________ | ________ | ________ | 39365EP | 39365EP | 39365EP |
| Drop Tube Weight Model | ________ | ________ | ________ | 35415 | 35415 | 35415 |
| Drop Tube Extra Weights | ________ | ________ | ________ | 1 | 1 | 1 |
| SS Support Cable | 34324 | 34324 | 34324 | 34324 | 34324 | 34324 |
| SS Support Cable Length | 520.5 | 523.5 | 367.5 | 387.0 | 811.0 | 795.0 |
| SS Support Cable Hardware | w/pump | w/pump | w/pump | w/pump | w/pump | w/pump |
| Cable Support Bracket (pump) | w/pump | w/pump | w/pump | w/pump | w/pump | w/pump |
| Cable Support Bracket (cap) | w/pump | w/pump | w/pump | w/pump | w/pump | w/pump |
| Initial Purge Volume (ml) (pump & tubing) | 5,590 | 5,620 | 4,060 | 5,700 | 9,300 | 9,350 |
| **Calculated Throttle Pressure** | | | | | | |
| **Initial Install** | 25.25 | 25.25 | 56.25 | 57.5 | 57.5 | 57.5 |
| **Operational Pressures** | 279.75 | 281.25 | 203.25 | 213 | 425 | 417 |
| **VOA Sampling Pressures** | 243.385 | 244.675 | 177.595 | 185.98 | 368.3 | 361.42 |

Signature: ____________________

Date: ____________________

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## Well Wizard (R) Specification Sheet

**Rev Date:** 8/13/2015

**Customer:** Tetra Tech
**Site/Location:** Pickle Butte Landfill
**Date:** 8/12/15
**Salesperson:** RES/cfe

*Note: All dimensions from top of casing, unless specified.*

| | | | | | | |
|---|---|---|---|---|---|---|
| **Well ID No.** | **PB-15** | | | | | |
| Well System Type | L | | | | | |
| Casing Material & Schedule | SS | | | | | |
| Well Diameter (Inches) | 4.5 | | | | | |
| Well Depth | 870 | | | | | |
| Static Water Level | 660 | | | | | |
| Water Column Height | 210 | | | | | |
| Screen Length | 60 | | | | | |
| Casing Length to Screen | 790 | | | | | |
| Recovery Rate (gpm) | | | | | | |
| **Sample Collection Point** | **820** | | | | | |
| Cold Weather Protection | 38458UH | | | | | |
| Cap Model | WW-CUSTOM | | | | | |
| Elbow/Flex Flow Model | 37740 | | | | | |
| Tubing Stick-up Above Cap (included in total tube length) | 0 | | | | | |
| Bladder Pump Model | ST1102M | | | | | |
| Bladder Pump Inlet Screen | w/pump | | | | | |
| Pump Submergence | 75.0 | | | | | |
| Bladder PumpTubing Model | PT5000 | | | | | |
| Bladder Pump Tubing Length | 735.0 | | | | | |
| Drop Tube Kit | 37757 | | | | | |
| Drop Tubing Model | 34115 | | | | | |
| Drop Tubing Length | 77.5 | | | | | |
| Drop Tube Inlet Screen Adapter | 39365EP | | | | | |
| Drop Tube Weight Model | 35415 | | | | | |
| Drop Tube Extra Weights | 1 | | | | | |
| SS Support Cable | 34324 | | | | | |
| SS Support Cable Length | 736.0 | | | | | |
| SS Support Cable Hardware | w/pump | | | | | |
| Cable Support Bracket (pump) | w/pump | | | | | |
| Cable Support Bracket (cap) | w/pump | | | | | |

Initial Purge Volume (ml) (pump & tubing) 8,800

**Calculated Throttle Pressure**

| | |
|---|---|
| **Initial Install** | 57.5 |
| **Operational Pressures** | 387.5 |
| **VOA Sampling Pressures** | 336.05 |

Signature: ____________
Date: ____________

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# APPENDIX 4-A
# PROJECTED WASTE FLOW DATA

## Canyon County Pickles Butte Sanitary Landfill Waste Acceptance

| Year | Waste Landfilled | | Cumulative Waste Landfilled | Daily Rate |
|---|---|---|---|---|
| | [Mg/yr.] | [short tons/yr.] | [short tons/yr.] | [short tons/yr.] |
| | 2015 - 2040 tonnage estimated based on 1.5% annual increase | | | (312 DPY) |
| 1983 | 16,763 | 18,478 | 18,478 | 59 |
| 1984 | 35,837 | 39,503 | 57,981 | 127 |
| 1985 | 38,289 | 42,206 | 100,187 | 135 |
| 1986 | 40,890 | 45,074 | 145,261 | 144 |
| 1987 | 43,651 | 48,117 | 193,378 | 154 |
| 1988 | 46,579 | 51,345 | 244,723 | 165 |
| 1989 | 49,687 | 54,770 | 299,493 | 176 |
| 1990 | 62,117 | 68,472 | 367,965 | 219 |
| 1991 | 65,906 | 72,649 | 440,614 | 233 |
| 1992 | 69,927 | 77,081 | 517,695 | 247 |
| 1993 | 74,371 | 81,980 | 599,675 | 263 |
| 1994 | 98,035 | 108,065 | 707,740 | 346 |
| 1995 | 102,897 | 113,424 | 821,164 | 364 |
| 1996 | 108,596 | 119,707 | 940,871 | 384 |
| 1997 | 113,751 | 125,389 | 1,066,260 | 402 |
| 1998 | 115,511 | 127,329 | 1,193,589 | 408 |
| 1999 | 119,497 | 131,723 | 1,325,312 | 422 |
| 2000 | 127,385 | 140,418 | 1,465,730 | 450 |
| 2001 | 135,886 | 149,789 | 1,615,519 | 480 |
| 2002 | 141,407 | 155,874 | 1,771,393 | 500 |
| 2003 | 154,321 | 170,110 | 1,941,503 | 545 |
| 2004 | 162,007 | 178,582 | 2,120,085 | 572 |
| 2005 | 177,420 | 195,572 | 2,315,657 | 627 |
| 2006 | 207,128 | 228,320 | 2,543,977 | 732 |
| 2007 | 201,826 | 222,475 | 2,766,452 | 713 |
| 2008 | 185,458 | 204,433 | 2,970,885 | 655 |
| 2009 | 159,922 | 176,284 | 3,147,169 | 565 |
| 2010 | 162,545 | 179,175 | 3,326,344 | 574 |
| 2011 | 153,438 | 169,137 | 3,495,481 | 542 |
| 2012 | 161,591 | 178,124 | 3,673,605 | 571 |
| 2013 | 171,105 | 188,611 | 3,862,216 | 605 |
| 2014 | 192,282 | 211,955 | 4,074,171 | 679 |
| 2015 | 195,167 | 215,134 | 4,289,305 | 690 |
| 2016 | 198,094 | 218,361 | 4,507,667 | 700 |
| 2017 | 201,065 | 221,637 | 4,729,303 | 710 |
| 2018 | 204,081 | 224,961 | 4,954,265 | 721 |
| 2019 | 207,143 | 228,336 | 5,182,600 | 732 |
| 2020 | 210,250 | 231,761 | 5,414,361 | 743 |
| 2021 | 213,404 | 235,237 | 5,649,598 | 754 |

## Canyon County Pickles Butte Sanitary Landfill Waste Acceptance

| Year | Waste Landfilled | | Cumulative Waste Landfilled | Daily Rate |
|---|---|---|---|---|
| | [Mg/yr.] | [short tons/yr.] | [short tons/yr.] | [short tons/yr.] |
| | 2015 - 2040 tonnage estimated based on 1.5% annual increase | | | (312 DPY) |
| 2022 | 216,605 | 238,766 | 5,888,364 | 765 |
| 2023 | 219,854 | 242,347 | 6,130,711 | 777 |
| 2024 | 223,151 | 245,982 | 6,376,694 | 788 |
| 2025 | 226,499 | 249,672 | 6,626,366 | 800 |
| 2026 | 229,896 | 253,417 | 6,879,783 | 812 |
| 2027 | 233,345 | 257,219 | 7,137,002 | 824 |
| 2028 | 236,845 | 261,077 | 7,398,079 | 837 |
| 2029 | 240,398 | 264,993 | 7,663,071 | 849 |
| 2030 | 244,004 | 268,968 | 7,932,039 | 862 |
| 2031 | 247,664 | 273,002 | 8,205,042 | 875 |
| 2032 | 251,379 | 277,097 | 8,482,139 | 888 |
| 2033 | 255,149 | 281,254 | 8,763,393 | 901 |
| 2034 | 258,976 | 285,473 | 9,048,866 | 915 |
| 2035 | 262,861 | 289,755 | 9,338,620 | 929 |
| 2036 | 266,804 | 294,101 | 9,632,721 | 943 |
| 2037 | 270,806 | 298,513 | 9,931,234 | 957 |
| 2038 | 274,868 | 302,990 | 10,234,224 | 971 |
| 2039 | 278,991 | 307,535 | 10,541,759 | 986 |
| 2040 | 283,176 | 312,148 | 10,853,907 | 1,000 |
| Total | 9,846,499 | 10,853,907 | | |

*Based on a 6 day per week operation (312 days per year) and an annual growth rate of 1.5%

# APPENDIX 4-B
# COPIES OF FEDERAL REGULATIONS

6560-50-P

**ENVIRONMENTAL PROTECTION AGENCY**

**40 CFR Part 60**

**[EPA-HQ-OAR-2014-0451; FRL-9930-64-OAR]**

**RIN 2060-AS23**

# Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills

**AGENCY**: Environmental Protection Agency.

**ACTION**: Proposed rule.

**SUMMARY:** The Environmental Protection Agency (EPA) is proposing a new subpart, 40 CFR part 60, subpart Cf that updates the Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills (40 CFR part 60, subpart Cc) (Emission Guidelines). The EPA determined that it was appropriate to review the landfills Emission Guidelines based on changes in the landfills industry since the Emission Guidelines were promulgated in 1996. The EPA's review of the Emission Guidelines for municipal solid waste (MSW) landfills applies to landfills that accepted waste after November 8, 1987, and commenced construction, reconstruction, or modification on or before July 17, 2014. Based on its initial review, the EPA has determined that it is appropriate to propose revisions to the Emission

Guidelines that reflect changes to the population of landfills and the results of an analysis of the timing and methods for reducing emissions. This action proposes to achieve additional reductions of landfill gas (LFG) and its components, including methane, by lowering the emissions threshold at which a landfill must install controls. This action also incorporates new data and information received in response to an advanced notice of proposed rulemaking and addresses other regulatory issues including surface emissions monitoring, wellhead monitoring, and the definition of landfill gas treatment system.

In addition to considering information received in response to this proposed rule in evaluating potential changes to the Emission Guidelines, the EPA intends to consider the information in evaluating whether changes to the requirements for new sources beyond those in the July 17, 2014, proposed rule (79 FR 41796) for new sources are warranted.

The proposed revisions to the Emission Guidelines, once implemented through revised state plans or a revised federal plan, would reduce emissions of LFG, which contains both nonmethane organic compounds and methane. Landfills are a significant source of methane which is a potent greenhouse gas (GHG) pollutant. These avoided emissions will improve air quality and reduce public health and welfare effects associated with exposure to landfill gas emissions.

protection of human health and the environment.

### 3.4.3 Technical Considerations

Disease vectors such as rodents, birds, flies, and mosquitoes typically are attracted by putrescent waste and standing water, which act as a food source and breeding ground. Putrescent waste is solid waste that contains organic matter (such as food waste) capable of being decomposed by micro-organisms. A MSWLF facility typically accepts putrescent wastes.

Application of cover at the end of each operating day generally is sufficient to control disease vectors; however, other vector control alternatives may be required. These alternatives could include: reducing the size of the working face; other operational modifications (e.g., increasing cover thickness, changing cover type, density, placement frequency, and grading); repellents, insecticides or rodenticides; composting or processing of organic wastes prior to disposal; and predatory or reproductive control of insect, bird, and animal populations. Additional methods to control birds are discussed in Chapter 2 (Airport Safety).

Mosquitoes, for example, are attracted by standing water found at MSWLFs, which can provide a potential breeding ground after only three days. Water generally collects in surface depressions, open containers, exposed tires, ponds resulting from soil excavation, leachate storage ponds, and siltation basins. Landfill operations that minimize standing water and that use an insecticide spraying program ordinarily are effective in controlling mosquitoes.

Vectors may reach the landfill facility not only from areas adjacent to the landfill, but through other modes conducive to harborage and breeding of disease vectors. Such modes may include residential and commercial route collection vehicles and transfer stations. These transport modes and areas also should be included in the disease vector control program if disease vectors at the landfill facility become a problem. Keeping the collection vehicles and transfer stations covered; emptying and cleaning the collection vehicles and transfer stations; using repellents, insecticides, or rodenticides; and reproductive control are all measures available to reduce disease vectors in these areas.

## 3.5 EXPLOSIVE GASES CONTROL 40 CFR §258.23

### 3.5.1 Statement of Regulation

**(a) Owners or operators of all MSWLF units must ensure that:**

**(1) The concentration of methane gas generated by the facility does not exceed 25 percent of the lower explosive limit for methane in facility structures (excluding gas control or recovery system components); and**

**(2) The concentration of methane gas does not exceed the LEL for methane at the facility property boundary.**

**(b) Owners or operators of all MSWLF units must implement a routine methane monitoring program to ensure that the standards of paragraph (a) of this section are met.**

**(1) The type and frequency of monitoring must be determined based on the following factors:**

**(i) Soil conditions;**

**(ii) The hydrogeologic conditions surrounding the facility;**

**(iii) The hydraulic conditions surrounding the facility; and**

**(iv) The location of facility structures and property boundaries.**

**(2) The minimum frequency of monitoring shall be quarterly.**

**(c) If methane gas levels exceeding the limits specified in paragraph (a) of this section are detected, the owner or operator must:**

**(1) Immediately take all necessary steps to ensure protection of human health and notify the State Director;**

**(2) Within seven days of detection, place in the operating record the methane gas levels detected and a description of the steps taken to protect human health; and**

**(3) Within 60 days of detection, implement a remediation plan for the methane gas releases, place a copy of the plan in the operating record, and notify the State Director that the plan has been implemented. The plan shall describe the nature and extent of the problem and the proposed remedy.**

**(4) The Director of an approved State may establish alternative schedules for demonstrating compliance with paragraphs (2) and (3).**

**(d) For purposes of this section, lower explosive limit (LEL) means the lowest percent by volume of a mixture of explosive gases in air that will propagate a flame at 25°C and atmospheric pressure.**

### 3.5.2 Applicability

The regulation applies to existing MSWLF units, lateral expansions, and new MSWLF units. The accumulation of methane in MSWLF structures can potentially result in fire and explosions that can endanger employees, users of the disposal site, and occupants of nearby structures, or cause damage to landfill containment structures. These hazards are preventable through monitoring and through corrective action should methane gas levels exceed specified limits in the facility structures (excluding gas control or recovery system components), or at the facility property boundary. MSWLF facility owners and operators must comply with the following requirements:

- Monitor at least quarterly;
- Take immediate steps to protect human health in the event of methane gas levels exceeding 25% of the lower explosive limit (LEL) in facility structures, such as evacuating the building;
- Notify the State/Tribal Director if methane levels exceed 25% of the LEL in facility structures or exceed the LEL at the facility property boundary;

- Within 7 days of detection, place in the operating record documentation that methane gas concentrations exceeded the criteria, along with a description of immediate actions taken to protect human health; and

- Within 60 days of detection, implement a remediation plan for the methane gas releases, notify the State/Tribal Director, and place a copy of the remediation plan in the operating record.

The compliance schedule for monitoring and responding to methane levels that exceed the criteria of this regulation can be changed by the Director of an approved State/Tribe.

### 3.5.3 Technical Considerations

To implement an appropriate routine methane monitoring program to demonstrate compliance with allowable methane concentrations, the characteristics of landfill gas production and migration at a site should be understood. Landfill gases are the result of microbial decomposition of solid waste. Gases produced include methane ($CH_4$), carbon dioxide ($CO_2$), and lesser amounts of other gases (e.g., hydrogen, volatile organic compounds, and hydrogen sulfide). Methane gas, the principal component of natural gas, is generally the primary concern in evaluating landfill gas generation because it is odorless and highly combustible. Typically, hydrogen gas is present at much lower concentra-tions. Hydrogen forms as decomposition progresses from the acid production phase to the methanogenic phase. While hydrogen is explosive and is occasionally detected in landfill gas, it readily reacts to form methane or hydrogen sulfide. Hydrogen sulfide is toxic and is readily identified by its "rotten egg" smell at a threshold concentration near 5 ppb.

Landfill gas production rates vary spatially within a landfill unit as a result of pockets of elevated microbial activity but, due to partial pressure gradients, differences in gas composition are reduced as the gases commingle within and outside the landfill unit. Although methane gas is lighter than air and carbon dioxide is heavier, these gases are concurrently produced at the microbial level and will not separate by their individual density. The gases will remain mixed and will migrate according to the density gradients between the landfill gas and the surrounding gases (i.e., a mixture of methane and carbon dioxide in a landfill unit or in surrounding soil will not separate by rising and sinking respectively, but will migrate as a mass in accordance with the density of the mixture and other gradients such as temperature and partial pressure).

When undergoing vigorous microbial production, gas pressures on the order of 1 to 3 inches of water relative to atmospheric pressure are common at landfill facilities, with much higher pressures occasionally reported. A barometric pressure change of 2 inches of mercury is equivalent to 27.2 inches of water. Relative gauge pressures at a particular landfill unit or portion of a landfill unit, the ability of site conditions to contain landfill gas, barometric pressure variations, and the microbial gas production rate control pressure-induced landfill gas migration. Negative gas pressures are commonly observed and are believed to occur as a result of the delayed response within a landfill unit to the passage of a high pressure system outside the landfill unit. Barometric highs will tend to introduce atmospheric oxygen into surface soils in shallow portions of the landfill unit, which may alter microbial activity, particularly methane production and gas composition.

Migration of landfill gas is caused by concentration gradients, pressure gradients, and density gradients. The direction in which landfill gas will migrate is controlled by the driving gradients and gas permeability of the porous material through which it is migrating. Generally, landfill gas will migrate through the path of least resistance.

Coarse, porous soils such as sand and gravel will allow greater lateral migration or transport of gases than finer-grained soils. Generally, resistance to landfill gas flow increases as moisture content increases and, therefore, an effective barrier to gas flow can be created under saturated conditions. Thus, readily drained soil conditions, such as sands and gravels above the water table, may provide a preferred flowpath, but unless finer-grained soils are fully saturated, landfill gases also can migrate in a "semi-saturated" zone. Figure 3-2 illustrates the potential effects of surrounding geology on gas migration.

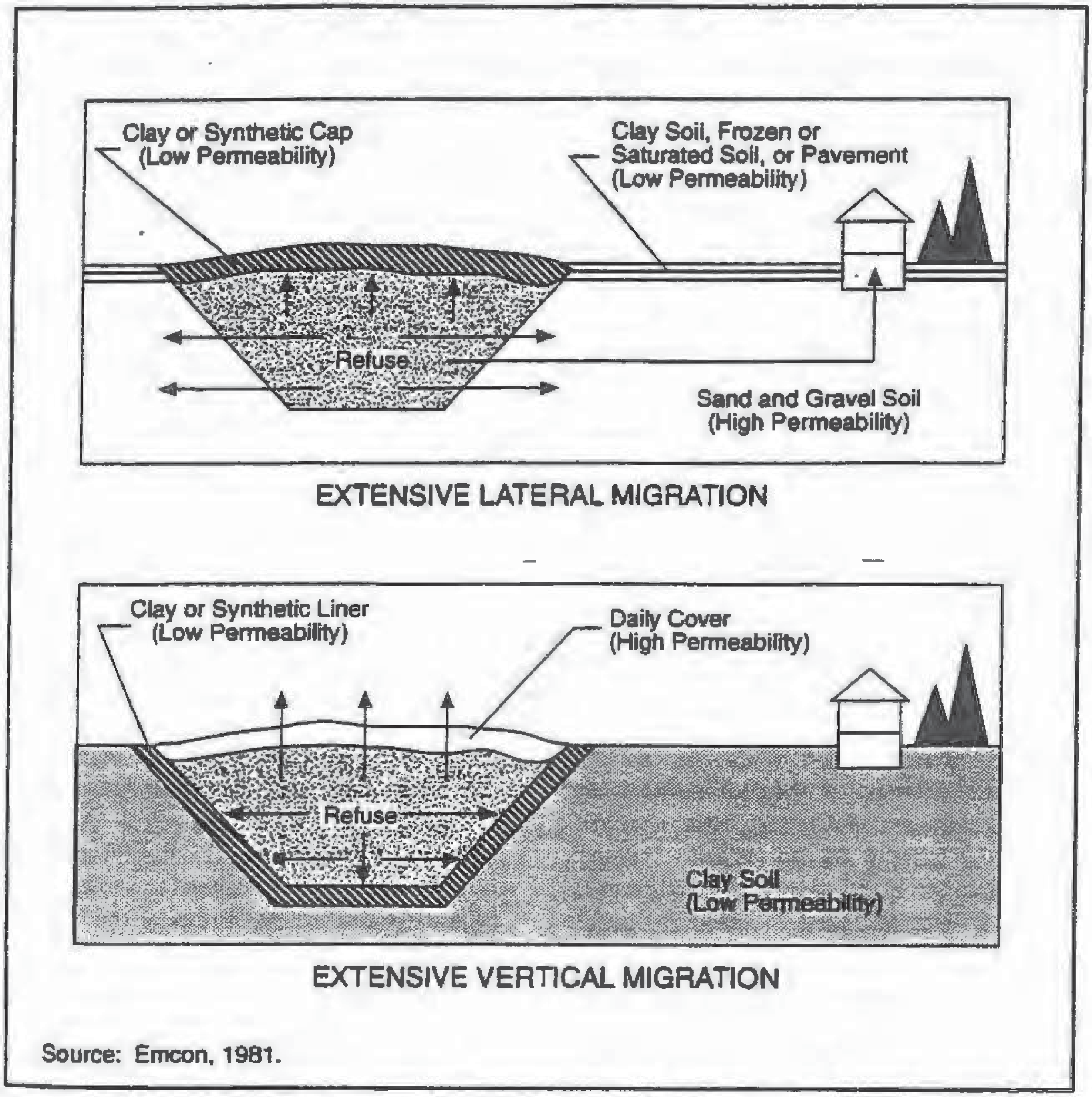
While geomembranes may not eliminate landfill gas migration, landfill gas in a closed MSWLF unit will tend to migrate laterally if the final cover contains a geomembrane and if the side slopes of the landfill do not contain an effective gas barrier. Lateral gas migration is more common in older facilities that lack appropriate gas control systems. The degree of lateral migration in older facilities also may depend on the type of natural soils surrounding the facility.

Stressed vegetation may indicate migration. Landfill gas present in the atmosphere tends to make the soil anaerobic by displacing the oxygen, thereby asphyxiating the roots of plants. Generally, the higher the concentration of combustible gas and/or carbon dioxide and the lower the amount of oxygen, the greater the extent of damage to vegetation (Flowers, et. al., 1982).

**Gas Monitoring**

The owner or operator of a MSWLF unit/facility must implement a routine methane monitoring program to comply with the lower explosive limit (LEL) requirements for methane. Methane is explosive when present in the range of 5 to 15 percent by volume in air. When present in air at concentrations greater than 15 percent, the mixture will not explode. This 15 percent threshold is the Upper Explosive Limit (UEL). The UEL is the maximum concentration of a gas or vapor above which the substance will not explode when exposed to a source of ignition. The explosive hazard range is between the LEL and the UEL. Note, however, that methane concentrations above the UEL remain a significant concern; fire and asphyxiation can still occur at these levels. In addition, even a minor dilution of the methane by increased ventilation can bring the mixture back into the explosive range.

To demonstrate compliance, the owner/operator would sample air within facility structures where gas may accumulate and in soil at the property boundary. Other monitoring methods may include: (1) sampling gases from probes within the landfill unit or from within the leachate collection system; or (2) sampling gases




Source: Emcon, 1981.

**Figure 3-2**
**Potential Effects of**
**Surrounding Geology on Gas Migration**

from monitoring probes installed in soil between the landfill unit and either the property boundary or structures where gas migration may pose a danger. A typical gas monitoring probe installation is depicted in Figure 3-3.

Although not required by the regulations, collection of data such as water presence and level, gas probe pressure, ambient temperature, barometric pressure, and the occurrence of precipitation during sampling, provides useful information in assessing monitoring results. For example, falling barometric pressure may cause increased subsurface (gas) pressures and corresponding increased methane content as gas more readily migrates from the landfill. Gas probe pressure can be measured using a portable gauge capable of measuring both vacuum and pressure in the range of zero to five inches of water pressure (or other suitable ranges for pressure conditions); this pressure should be measured prior to methane measurement or sample collection in the gas probe. A representative sample of formation (subsurface) gases can be collected directly from the probe. Purging typically is not necessary due to the small volume of the probe. A water trap is recommended to protect instrumentation that is connected directly to the gas probe. After measurements are obtained, the gas probe should be capped to reduce the effects of venting or barometric pressure variations on gas composition in the vicinity of the probe.

The frequency of monitoring should be sufficient to detect landfill gas migration based on subsurface conditions and changing landfill conditions such as partial or complete capping, landfill expansion, gas migration control system operation or failure, construction of new or replacement structures, and changes in landscaping or land use practices. The rate of landfill gas migration as a result of these anticipated changes and the site-specific conditions provides the basis for establishing monitoring frequency. Monitoring is to be conducted at least quarterly.

The number and location of gas probes is also site-specific and highly dependent on subsurface conditions, land use, and location and design of facility structures. Monitoring for gas migration should be within the more permeable strata. Multiple or nested probes are useful in defining the vertical configuration of the migration pathway. Structures with basements or crawl spaces are more susceptible to landfill gas infiltration. Elevated structures are typically not at risk.

Measurements are usually made in the field with a portable methane meter, explosimeter, or organic vapor analyzer. Gas samples also may be collected in glass or metal containers for laboratory analysis. Instruments with scales of measure in "percent of LEL" can be calibrated and used to detect the presence of methane. Instruments of the hot-wire Wheatstone bridge type (i.e., catalytic combustion) directly measure combustibility of the gas mixture withdrawn from the probe. The thermal conductivity type meter is susceptible to interference as the relative gas composition and, therefore, the thermal conductivity, changes. Field instruments should be calibrated prior to measurements and should be rechecked after each day's monitoring activity.

ɔeriods (during actual
ɔs) during which the
temperature is 5 or
ees above the average
sured during the most
ɔce test that dem-
ɔnce;
'ected facilities moni-
cinerator combustion
all 3-hour periods
ɪting operations) dur-
rage combustion tem-
ɜvice is more than 28
low the average com-
ɪre of the device dur-
ɜnt performance test
l compliance;
ected facilities moni-
incinerator catalyst
all 3-hour periods
ɪting operations) dur-
rage gas temperature
ɘ the catalyst bed is
ɪus degrees below the
perature during the
formance test that
npliance and all 3-
ɪg actual coating op-
hich the average gas
ence across the cata-
an 80 percent of the
ɪperature difference
recent performance
ated compliance;
ected facility moni-
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rcent or more from
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of this section be-
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t semiannual state-
is fact.
r operator of an af-
operation, dem-
ance by the test
in §60.743(a)(3) (liq-
balance) shall sub-



(1) For months of compliance, semiannual reports to the Administrator stating that the affected coating operation was in compliance for each 1-month period; and

(2) For months of noncompliance, quarterly reports to the Administrator documenting the 1-month amount of VOC contained in the coatings, the 1-month amount of VOC recovered, and the percent emission reduction for each month.

(f) Each owner or operator of an affected coating operation, either by itself or with associated coating mix preparation equipment, shall submit the following with the reports required under paragraphs (d) and (e) of this section:

(1) All periods during actual mixing or coating operations when a required monitoring device (if any) was malfunctioning or not operating; and

(2) All periods during actual mixing or coating operations when the control device was malfunctioning or not operating.

(g) The reports required under paragraphs (b), (c), (d), and (e) of this section shall be postmarked within 30 days of the end of the reporting period.

(h) Records required in §60.747 must be retained for at least 2 years.

(i) The requirements of this section remain in force until and unless EPA, in delegating enforcement authority to a State under section 111(c) of the Act, approves reporting requirements or an alternative means of compliance surveillance adopted by such States. In this event, affected sources within the State will be relieved of the obligation to comply with this subsection, provided that they comply with the requirements established by the State.

### §60.748 Delegation of authority.

(a) In delegating implementation and enforcement authority to a State under section 111(c) of the Act, the authorities contained in paragraph (b) of this section shall be retained by the Administrator and not transferred to a State.

(b) Authorities that will not be delegated to States: §§60.743(a)(3)(v) (A) and (B); 60.743(e); 60.745(a); 60.746.

## Subpart WWW—Standards of Performance for Municipal Solid Waste Landfills

SOURCE: 61 FR 9919, Mar. 12, 1996, unless otherwise noted.

### §60.750 Applicability, designation of affected facility, and delegation of authority.

(a) The provisions of this subpart apply to each municipal solid waste landfill that commenced construction, reconstruction or modification on or after May 30, 1991. Physical or operational changes made to an existing MSW landfill solely to comply with subpart Cc of this part are not considered construction, reconstruction, or modification for the purposes of this section.

(b) The following authorities shall be retained by the Administrator and not transferred to the State: §60.754(a)(5).

(c) Activities required by or conducted pursuant to a CERCLA, RCRA, or State remedial action are not considered construction, reconstruction, or modification for purposes of this subpart.

[61 FR 9919, Mar. 12, 1996, as amended at 63 FR 32750, June 16, 1998]

### §60.751 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act or in subpart A of this part.

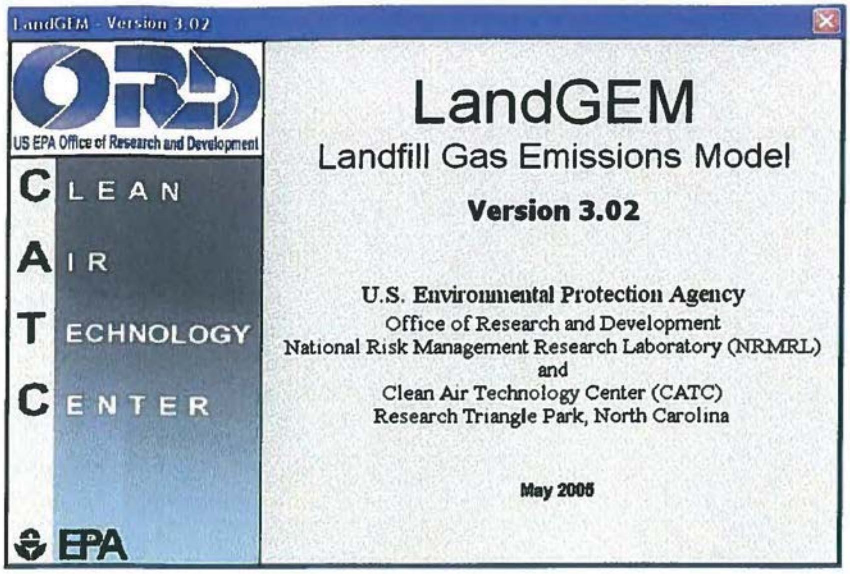
*Active collection system* means a gas collection system that uses gas mover equipment.

*Active landfill* means a landfill in which solid waste is being placed or a landfill that is planned to accept waste in the future.

*Closed landfill* means a landfill in which solid waste is no longer being placed, and in which no additional solid wastes will be placed without first filing a notification of modification as prescribed under §60.7(a)(4). Once a notification of modification has been filed, and additional solid waste is placed in the landfill, the landfill is no longer closed.

*Closure* means that point in time when a landfill becomes a closed landfill.

# APPENDIX 4-C
# LANDGEM MINIMUM METHANE GENERATION RATES, 2015




# Summary Report

**Landfill Name or Identifier:** Pickles Butte Landfill

**Date:** Tuesday, September 01, 2015

### About LandGEM:

First-Order Decomposition Rate Equation:

$$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10}\right) e^{-kt_{ij}}$$

Where,

$Q_{CH4}$ = annual methane generation in the year of the calculation (*$m^3$/year*)
i = 1-year time increment
n = (year of the calculation) - (initial year of waste acceptance)
j = 0.1-year time increment
k = methane generation rate (*$year^{-1}$*)
$L_o$ = potential methane generation capacity (*$m^3$/Mg*)

$M_i$ = mass of waste accepted in the $i^{th}$ year (*Mg*)
$t_{ij}$ = age of the $j^{th}$ section of waste mass $M_i$ accepted in the $i^{th}$ year (*decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

# Input Review

LANDFILL CHARACTERISTICS

| | | |
|---|---|---|
| Landfill Open Year | **1983** | |
| Landfill Closure Year (with 80-year limit) | **2050** | |
| *Actual Closure Year (without limit)* | ***2050*** | |
| Have Model Calculate Closure Year? | **No** | |
| Waste Design Capacity | **39,909,972** | *short tons* |

MODEL PARAMETERS

| | | |
|---|---|---|
| Methane Generation Rate, k | **0.020** | *year $^{-1}$* |
| Potential Methane Generation Capacity, $L_o$ | **100** | *$m^3$/Mg* |
| NMOC Concentration | **485** | *ppmv as hexane* |
| Methane Content | **50** | *% by volume* |

GASES / POLLUTANTS SELECTED

| | |
|---|---|
| Gas / Pollutant #1: | **Total landfill gas** |
| Gas / Pollutant #2: | **Methane** |
| Gas / Pollutant #3: | **Carbon dioxide** |
| Gas / Pollutant #4: | **NMOC** |

WASTE ACCEPTANCE RATES

| Year | Waste Accepted | | Waste-In-Place | |
|---|---|---|---|---|
| | *(Mg/year)* | *(short tons/year)* | *(Mg)* | *(short tons)* |
| 1983 | 16,798 | 18,478 | 0 | 0 |
| 1984 | 35,912 | 39,503 | 16,798 | 18,478 |
| 1985 | 38,369 | 42,206 | 52,710 | 57,981 |
| 1986 | 40,976 | 45,074 | 91,079 | 100,187 |
| 1987 | 43,743 | 48,117 | 132,055 | 145,261 |
| 1988 | 46,677 | 51,345 | 175,798 | 193,378 |
| 1989 | 49,791 | 54,770 | 222,475 | 244,723 |
| 1990 | 62,247 | 68,472 | 272,266 | 299,493 |
| 1991 | 66,045 | 72,649 | 334,514 | 367,965 |
| 1992 | 70,074 | 77,081 | 400,558 | 440,614 |
| 1993 | 74,527 | 81,980 | 470,632 | 517,695 |
| 1994 | 98,241 | 108,065 | 545,159 | 599,675 |
| 1995 | 103,113 | 113,424 | 643,400 | 707,740 |
| 1996 | 108,825 | 119,707 | 746,513 | 821,164 |
| 1997 | 113,990 | 125,389 | 855,337 | 940,871 |
| 1998 | 115,754 | 127,329 | 969,327 | 1,066,260 |
| 1999 | 119,748 | 131,723 | 1,085,081 | 1,193,589 |
| 2000 | 127,653 | 140,418 | 1,204,829 | 1,325,312 |
| 2001 | 136,172 | 149,789 | 1,332,482 | 1,465,730 |
| 2002 | 141,704 | 155,874 | 1,468,654 | 1,615,519 |
| 2003 | 154,645 | 170,110 | 1,610,357 | 1,771,393 |
| 2004 | 162,347 | 178,582 | 1,765,003 | 1,941,503 |
| 2005 | 177,793 | 195,572 | 1,927,350 | 2,120,085 |
| 2006 | 207,564 | 228,320 | 2,105,143 | 2,315,657 |
| 2007 | 202,250 | 222,475 | 2,312,706 | 2,543,977 |
| 2008 | 185,848 | 204,433 | 2,514,956 | 2,766,452 |
| 2009 | 160,258 | 176,284 | 2,700,805 | 2,970,885 |
| 2010 | 162,886 | 179,175 | 2,861,063 | 3,147,169 |
| 2011 | 153,761 | 169,137 | 3,023,949 | 3,326,344 |
| 2012 | 161,931 | 178,124 | 3,177,710 | 3,495,481 |
| 2013 | 171,465 | 188,611 | 3,339,641 | 3,673,605 |
| 2014 | 192,686 | 211,955 | 3,511,105 | 3,862,216 |
| 2015 | 195,577 | 215,134 | 3,703,792 | 4,074,171 |
| 2016 | 198,510 | 218,361 | 3,899,368 | 4,289,305 |
| 2017 | 201,488 | 221,637 | 4,097,879 | 4,507,667 |
| 2018 | 204,510 | 224,961 | 4,299,367 | 4,729,303 |
| 2019 | 207,578 | 228,336 | 4,503,877 | 4,954,265 |
| 2020 | 210,692 | 231,761 | 4,711,455 | 5,182,600 |
| 2021 | 213,852 | 235,237 | 4,922,147 | 5,414,361 |
| 2022 | 217,060 | 238,766 | 5,135,999 | 5,649,598 |

WASTE ACCEPTANCE RATES (Continued)

| Year | Waste Accepted | | Waste-In-Place | |
|---|---|---|---|---|
| | *(Mg/year)* | *(short tons/year)* | *(Mg)* | *(short tons)* |
| 2023 | 220,316 | 242,347 | 5,353,058 | 5,888,364 |
| 2024 | 223,620 | 245,982 | 5,573,374 | 6,130,711 |
| 2025 | 226,975 | 249,672 | 5,796,994 | 6,376,694 |
| 2026 | 230,379 | 253,417 | 6,023,969 | 6,626,366 |
| 2027 | 233,835 | 257,219 | 6,254,348 | 6,879,783 |
| 2028 | 237,343 | 261,077 | 6,488,183 | 7,137,002 |
| 2029 | 240,903 | 264,993 | 6,725,526 | 7,398,079 |
| 2030 | 244,516 | 268,968 | 6,966,429 | 7,663,071 |
| 2031 | 248,184 | 273,002 | 7,210,945 | 7,932,039 |
| 2032 | 251,907 | 277,097 | 7,459,129 | 8,205,042 |
| 2033 | 255,685 | 281,254 | 7,711,035 | 8,482,139 |
| 2034 | 259,521 | 285,473 | 7,966,721 | 8,763,393 |
| 2035 | 263,413 | 289,755 | 8,226,241 | 9,048,866 |
| 2036 | 267,365 | 294,101 | 8,489,655 | 9,338,620 |
| 2037 | 271,375 | 298,513 | 8,757,019 | 9,632,721 |
| 2038 | 275,446 | 302,990 | 9,028,394 | 9,931,234 |
| 2039 | 279,577 | 307,535 | 9,303,840 | 10,234,224 |
| 2040 | 283,771 | 312,148 | 9,583,418 | 10,541,759 |
| 2041 | 283,771 | 312,148 | 9,867,189 | 10,853,907 |
| 2042 | 283,771 | 312,148 | 10,150,960 | 11,166,056 |
| 2043 | 283,771 | 312,148 | 10,434,731 | 11,478,204 |
| 2044 | 283,771 | 312,148 | 10,718,502 | 11,790,352 |
| 2045 | 283,771 | 312,148 | 11,002,273 | 12,102,500 |
| 2046 | 283,771 | 312,148 | 11,286,044 | 12,414,648 |
| 2047 | 283,771 | 312,148 | 11,569,815 | 12,726,796 |
| 2048 | 283,771 | 312,148 | 11,853,586 | 13,038,944 |
| 2049 | 283,771 | 312,148 | 12,137,357 | 13,351,093 |
| 2050 | 0 | 0 | 12,421,128 | 13,663,241 |
| 2051 | 0 | 0 | 12,421,128 | 13,663,241 |
| 2052 | 0 | 0 | 12,421,128 | 13,663,241 |
| 2053 | 0 | 0 | 12,421,128 | 13,663,241 |
| 2054 | 0 | 0 | 12,421,128 | 13,663,241 |
| 2055 | 0 | 0 | 12,421,128 | 13,663,241 |
| 2056 | 0 | 0 | 12,421,128 | 13,663,241 |
| 2057 | 0 | 0 | 12,421,128 | 13,663,241 |
| 2058 | 0 | 0 | 12,421,128 | 13,663,241 |
| 2059 | 0 | 0 | 12,421,128 | 13,663,241 |
| 2060 | 0 | 0 | 12,421,128 | 13,663,241 |
| 2061 | 0 | 0 | 12,421,128 | 13,663,241 |
| 2062 | 0 | 0 | 12,421,128 | 13,663,241 |

## Pollutant Parameters

| | Compound | Gas / Pollutant Default Parameters: Concentration (*ppmv*) | Molecular Weight | User-specified Pollutant Parameters: Concentration (*ppmv*) | Molecular Weight |
|---|---|---|---|---|---|
| Gases | Total landfill gas | | 0.00 | | |
| | Methane | | 16.04 | | |
| | Carbon dioxide | | 44.01 | | |
| | NMOC | 4,000 | 86.18 | | |
| Pollutants | 1,1,1-Trichloroethane (methyl chloroform) - HAP | 0.48 | 133.41 | | |
| | 1,1,2,2-Tetrachloroethane - HAP/VOC | 1.1 | 167.85 | | |
| | 1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC | 2.4 | 98.97 | | |
| | 1,1-Dichloroethene (vinylidene chloride) - HAP/VOC | 0.20 | 96.94 | | |
| | 1,2-Dichloroethane (ethylene dichloride) - HAP/VOC | 0.41 | 98.96 | | |
| | 1,2-Dichloropropane (propylene dichloride) - HAP/VOC | 0.18 | 112.99 | | |
| | 2-Propanol (isopropyl alcohol) - VOC | 50 | 60.11 | | |
| | Acetone | 7.0 | 58.08 | | |
| | Acrylonitrile - HAP/VOC | 6.3 | 53.06 | | |
| | Benzene - No or Unknown Co-disposal - HAP/VOC | 1.9 | 78.11 | | |
| | Benzene - Co-disposal - HAP/VOC | 11 | 78.11 | | |
| | Bromodichloromethane - VOC | 3.1 | 163.83 | | |
| | Butane - VOC | 5.0 | 58.12 | | |
| | Carbon disulfide - HAP/VOC | 0.58 | 76.13 | | |
| | Carbon monoxide | 140 | 28.01 | | |
| | Carbon tetrachloride - HAP/VOC | 4.0E-03 | 153.84 | | |
| | Carbonyl sulfide - HAP/VOC | 0.49 | 60.07 | | |
| | Chlorobenzene - HAP/VOC | 0.25 | 112.56 | | |
| | Chlorodifluoromethane | 1.3 | 86.47 | | |
| | Chloroethane (ethyl chloride) - HAP/VOC | 1.3 | 64.52 | | |
| | Chloroform - HAP/VOC | 0.03 | 119.39 | | |
| | Chloromethane - VOC | 1.2 | 50.49 | | |
| | Dichlorobenzene - (HAP for para isomer/VOC) | 0.21 | 147 | | |
| | Dichlorodifluoromethane | 16 | 120.91 | | |
| | Dichlorofluoromethane - VOC | 2.6 | 102.92 | | |
| | Dichloromethane (methylene chloride) - HAP | 14 | 84.94 | | |
| | Dimethyl sulfide (methyl sulfide) - VOC | 7.8 | 62.13 | | |
| | Ethane | 890 | 30.07 | | |
| | Ethanol - VOC | 27 | 46.08 | | |

## Pollutant Parameters (Continued)

| | Gas / Pollutant Default Parameters: | | | User-specified Pollutant Parameters: | |
|---|---|---|---|---|---|
| | Compound | Concentration (*ppmv*) | Molecular Weight | Concentration (*ppmv*) | Molecular Weight |
| Pollutants | Ethyl mercaptan (ethanethiol) - VOC | 2.3 | 62.13 | | |
| | Ethylbenzene - HAP/VOC | 4.6 | 106.16 | | |
| | Ethylene dibromide - HAP/VOC | 1.0E-03 | 187.88 | | |
| | Fluorotrichloromethane - VOC | 0.76 | 137.38 | | |
| | Hexane - HAP/VOC | 6.6 | 86.18 | | |
| | Hydrogen sulfide | 36 | 34.08 | | |
| | Mercury (total) - HAP | 2.9E-04 | 200.61 | | |
| | Methyl ethyl ketone - HAP/VOC | 7.1 | 72.11 | | |
| | Methyl isobutyl ketone - HAP/VOC | 1.9 | 100.16 | | |
| | Methyl mercaptan - VOC | 2.5 | 48.11 | | |
| | Pentane - VOC | 3.3 | 72.15 | | |
| | Perchloroethylene (tetrachloroethylene) - HAP | 3.7 | 165.83 | | |
| | Propane - VOC | 11 | 44.09 | | |
| | t-1,2-Dichloroethene - VOC | 2.8 | 96.94 | | |
| | Toluene - No or Unknown Co-disposal - HAP/VOC | 39 | 92.13 | | |
| | Toluene - Co-disposal - HAP/VOC | 170 | 92.13 | | |
| | Trichloroethylene (trichloroethene) - HAP/VOC | 2.8 | 131.40 | | |
| | Vinyl chloride - HAP/VOC | 7.3 | 62.50 | | |
| | Xylenes - HAP/VOC | 12 | 106.16 | | |
| | | | | | |
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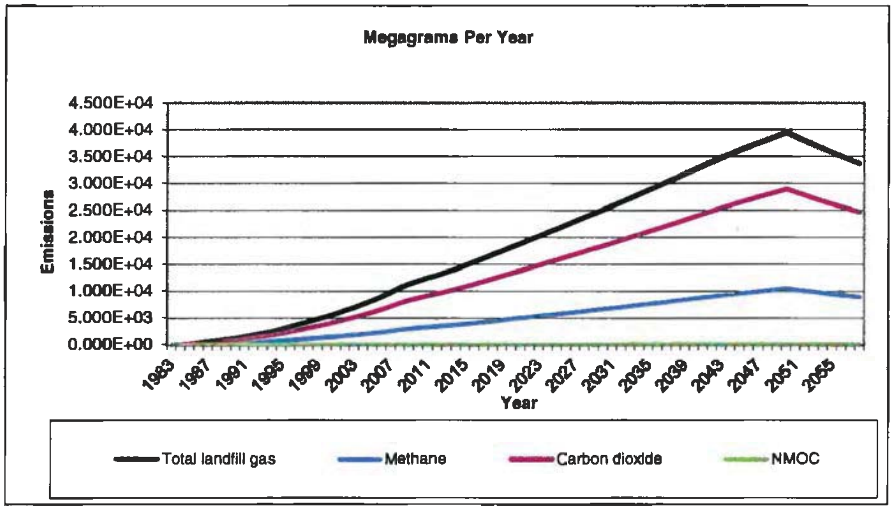
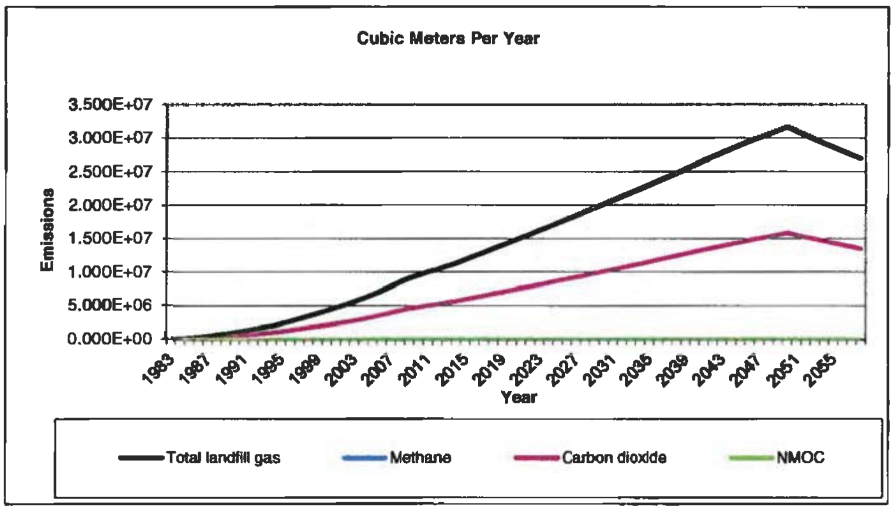
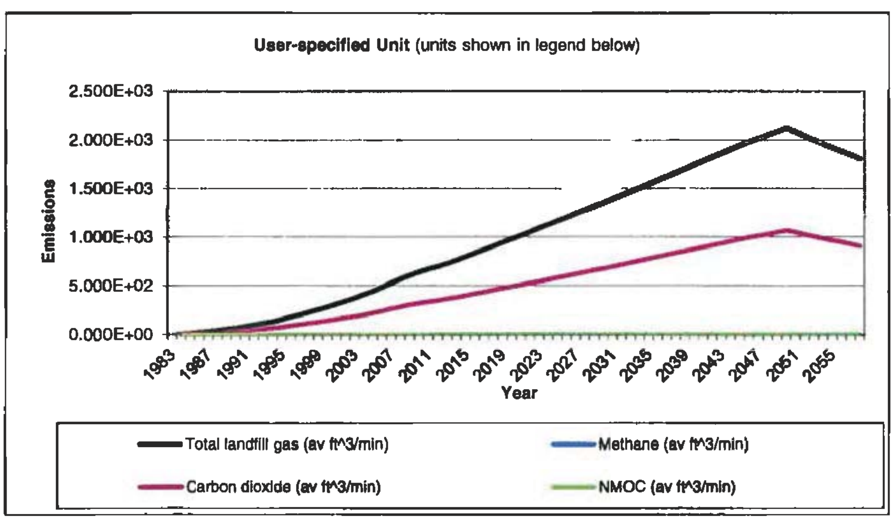
## Graphs


Megagrams Per Year
4.500E+04
4.000E+04
3.500E+04
3.000E+04
2.500E+04
2.000E+04
1.500E+04
1.000E+04
5.000E+03
0.000E+00
Emissions
1983 1987 1991 1995 1999 2003 2007 2011 2015 2019 2023 2027 2031 2035 2039 2043 2047 2051 2055
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
3.500E+07
3.000E+07
2.500E+07
2.000E+07
1.500E+07
1.000E+07
5.000E+06
0.000E+00
Emissions
1983 1987 1991 1995 1999 2003 2007 2011 2015 2019 2023 2027 2031 2035 2039 2043 2047 2051 2055
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
2.500E+03
2.000E+03
1.500E+03
1.000E+03
5.000E+02
0.000E+00
Emissions
1983 1987 1991 1995 1999 2003 2007 2011 2015 2019 2023 2027 2031 2035 2039 2043 2047 2051 2055
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

## Results

| Year | Total landfill gas | | | Methane | | |
|---|---|---|---|---|---|---|
| | *(Mg/year)* | *($m^3$/year)* | *(av ft^3/min)* | *(Mg/year)* | *($m^3$/year)* | *(av ft^3/min)* |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 8.316E+01 | 6.659E+04 | 4.474E+00 | 2.221E+01 | 3.330E+04 | 2.237E+00 |
| 1985 | 2.593E+02 | 2.076E+05 | 1.395E+01 | 6.926E+01 | 1.038E+05 | 6.976E+00 |
| 1986 | 4.441E+02 | 3.556E+05 | 2.389E+01 | 1.186E+02 | 1.778E+05 | 1.195E+01 |
| 1987 | 6.382E+02 | 5.110E+05 | 3.434E+01 | 1.705E+02 | 2.555E+05 | 1.717E+01 |
| 1988 | 8.421E+02 | 6.743E+05 | 4.531E+01 | 2.249E+02 | 3.372E+05 | 2.265E+01 |
| 1989 | 1.057E+03 | 8.460E+05 | 5.684E+01 | 2.822E+02 | 4.230E+05 | 2.842E+01 |
| 1990 | 1.282E+03 | 1.027E+06 | 6.898E+01 | 3.425E+02 | 5.133E+05 | 3.449E+01 |
| 1991 | 1.565E+03 | 1.253E+06 | 8.419E+01 | 4.180E+02 | 6.265E+05 | 4.210E+01 |
| 1992 | 1.861E+03 | 1.490E+06 | 1.001E+02 | 4.970E+02 | 7.450E+05 | 5.006E+01 |
| 1993 | 2.171E+03 | 1.738E+06 | 1.168E+02 | 5.799E+02 | 8.692E+05 | 5.840E+01 |
| 1994 | 2.497E+03 | 1.999E+06 | 1.343E+02 | 6.669E+02 | 9.997E+05 | 6.717E+01 |
| 1995 | 2.934E+03 | 2.349E+06 | 1.578E+02 | 7.836E+02 | 1.175E+06 | 7.892E+01 |
| 1996 | 3.386E+03 | 2.711E+06 | 1.822E+02 | 9.045E+02 | 1.356E+06 | 9.109E+01 |
| 1997 | 3.858E+03 | 3.089E+06 | 2.076E+02 | 1.030E+03 | 1.545E+06 | 1.038E+02 |
| 1998 | 4.346E+03 | 3.480E+06 | 2.338E+02 | 1.161E+03 | 1.740E+06 | 1.169E+02 |
| 1999 | 4.833E+03 | 3.870E+06 | 2.600E+02 | 1.291E+03 | 1.935E+06 | 1.300E+02 |
| 2000 | 5.330E+03 | 4.268E+06 | 2.868E+02 | 1.424E+03 | 2.134E+06 | 1.434E+02 |
| 2001 | 5.856E+03 | 4.689E+06 | 3.151E+02 | 1.564E+03 | 2.345E+06 | 1.575E+02 |
| 2002 | 6.415E+03 | 5.136E+06 | 3.451E+02 | 1.713E+03 | 2.568E+06 | 1.726E+02 |
| 2003 | 6.989E+03 | 5.596E+06 | 3.760E+02 | 1.867E+03 | 2.798E+06 | 1.880E+02 |
| 2004 | 7.616E+03 | 6.099E+06 | 4.098E+02 | 2.034E+03 | 3.049E+06 | 2.049E+02 |
| 2005 | 8.269E+03 | 6.622E+06 | 4.449E+02 | 2.209E+03 | 3.311E+06 | 2.224E+02 |
| 2006 | 8.986E+03 | 7.195E+06 | 4.834E+02 | 2.400E+03 | 3.598E+06 | 2.417E+02 |
| 2007 | 9.835E+03 | 7.876E+06 | 5.292E+02 | 2.627E+03 | 3.938E+06 | 2.646E+02 |
| 2008 | 1.064E+04 | 8.521E+06 | 5.726E+02 | 2.843E+03 | 4.261E+06 | 2.863E+02 |
| 2009 | 1.135E+04 | 9.089E+06 | 6.107E+02 | 3.032E+03 | 4.545E+06 | 3.054E+02 |
| 2010 | 1.192E+04 | 9.545E+06 | 6.413E+02 | 3.184E+03 | 4.772E+06 | 3.207E+02 |
| 2011 | 1.249E+04 | 1.000E+07 | 6.720E+02 | 3.336E+03 | 5.001E+06 | 3.360E+02 |
| 2012 | 1.300E+04 | 1.041E+07 | 6.996E+02 | 3.473E+03 | 5.206E+06 | 3.498E+02 |
| 2013 | 1.355E+04 | 1.085E+07 | 7.289E+02 | 3.619E+03 | 5.424E+06 | 3.645E+02 |
| 2014 | 1.413E+04 | 1.131E+07 | 7.602E+02 | 3.774E+03 | 5.657E+06 | 3.801E+02 |
| 2015 | 1.480E+04 | 1.185E+07 | 7.964E+02 | 3.954E+03 | 5.927E+06 | 3.982E+02 |
| 2016 | 1.548E+04 | 1.239E+07 | 8.328E+02 | 4.134E+03 | 6.197E+06 | 4.164E+02 |
| 2017 | 1.615E+04 | 1.294E+07 | 8.691E+02 | 4.315E+03 | 6.468E+06 | 4.346E+02 |
| 2018 | 1.683E+04 | 1.348E+07 | 9.056E+02 | 4.496E+03 | 6.739E+06 | 4.528E+02 |
| 2019 | 1.751E+04 | 1.402E+07 | 9.421E+02 | 4.677E+03 | 7.011E+06 | 4.711E+02 |
| 2020 | 1.819E+04 | 1.457E+07 | 9.788E+02 | 4.859E+03 | 7.284E+06 | 4.894E+02 |
| 2021 | 1.887E+04 | 1.511E+07 | 1.016E+03 | 5.042E+03 | 7.557E+06 | 5.078E+02 |
| 2022 | 1.956E+04 | 1.566E+07 | 1.052E+03 | 5.225E+03 | 7.831E+06 | 5.262E+02 |
| 2023 | 2.025E+04 | 1.621E+07 | 1.089E+03 | 5.408E+03 | 8.106E+06 | 5.447E+02 |
| 2024 | 2.094E+04 | 1.677E+07 | 1.126E+03 | 5.592E+03 | 8.383E+06 | 5.632E+02 |
| 2025 | 2.163E+04 | 1.732E+07 | 1.164E+03 | 5.777E+03 | 8.660E+06 | 5.819E+02 |
| 2026 | 2.232E+04 | 1.788E+07 | 1.201E+03 | 5.963E+03 | 8.938E+06 | 6.006E+02 |
| 2027 | 2.302E+04 | 1.844E+07 | 1.239E+03 | 6.150E+03 | 9.218E+06 | 6.193E+02 |
| 2028 | 2.372E+04 | 1.900E+07 | 1.276E+03 | 6.337E+03 | 9.499E+06 | 6.382E+02 |
| 2029 | 2.443E+04 | 1.956E+07 | 1.314E+03 | 6.526E+03 | 9.781E+06 | 6.572E+02 |
| 2030 | 2.514E+04 | 2.013E+07 | 1.353E+03 | 6.715E+03 | 1.007E+07 | 6.763E+02 |
| 2031 | 2.585E+04 | 2.070E+07 | 1.391E+03 | 6.905E+03 | 1.035E+07 | 6.954E+02 |
| 2032 | 2.657E+04 | 2.127E+07 | 1.429E+03 | 7.097E+03 | 1.064E+07 | 7.147E+02 |

## Results (Continued)

| Year | Total landfill gas | | | Methane | | |
|---|---|---|---|---|---|---|
| | (Mg/year) | ($m^3$/year) | (av ft^3/min) | (Mg/year) | ($m^3$/year) | (av ft^3/min) |
| 2033 | 2.729E+04 | 2.185E+07 | 1.468E+03 | 7.289E+03 | 1.093E+07 | 7.341E+02 |
| 2034 | 2.801E+04 | 2.243E+07 | 1.507E+03 | 7.483E+03 | 1.122E+07 | 7.536E+02 |
| 2035 | 2.874E+04 | 2.302E+07 | 1.547E+03 | 7.678E+03 | 1.151E+07 | 7.733E+02 |
| 2036 | 2.948E+04 | 2.361E+07 | 1.586E+03 | 7.874E+03 | 1.180E+07 | 7.930E+02 |
| 2037 | 3.022E+04 | 2.420E+07 | 1.626E+03 | 8.072E+03 | 1.210E+07 | 8.129E+02 |
| 2038 | 3.096E+04 | 2.480E+07 | 1.666E+03 | 8.271E+03 | 1.240E+07 | 8.330E+02 |
| 2039 | 3.172E+04 | 2.540E+07 | 1.706E+03 | 8.471E+03 | 1.270E+07 | 8.532E+02 |
| 2040 | 3.247E+04 | 2.600E+07 | 1.747E+03 | 8.673E+03 | 1.300E+07 | 8.735E+02 |
| 2041 | 3.323E+04 | 2.661E+07 | 1.788E+03 | 8.877E+03 | 1.331E+07 | 8.940E+02 |
| 2042 | 3.398E+04 | 2.721E+07 | 1.828E+03 | 9.076E+03 | 1.360E+07 | 9.141E+02 |
| 2043 | 3.471E+04 | 2.780E+07 | 1.868E+03 | 9.272E+03 | 1.390E+07 | 9.338E+02 |
| 2044 | 3.543E+04 | 2.837E+07 | 1.906E+03 | 9.464E+03 | 1.419E+07 | 9.531E+02 |
| 2045 | 3.613E+04 | 2.893E+07 | 1.944E+03 | 9.651E+03 | 1.447E+07 | 9.720E+02 |
| 2046 | 3.682E+04 | 2.949E+07 | 1.981E+03 | 9.836E+03 | 1.474E+07 | 9.906E+02 |
| 2047 | 3.750E+04 | 3.003E+07 | 2.017E+03 | 1.002E+04 | 1.501E+07 | 1.009E+03 |
| 2048 | 3.816E+04 | 3.056E+07 | 2.053E+03 | 1.019E+04 | 1.528E+07 | 1.027E+03 |
| 2049 | 3.881E+04 | 3.108E+07 | 2.088E+03 | 1.037E+04 | 1.554E+07 | 1.044E+03 |
| 2050 | 3.945E+04 | 3.159E+07 | 2.122E+03 | 1.054E+04 | 1.579E+07 | 1.061E+03 |
| 2051 | 3.866E+04 | 3.096E+07 | 2.080E+03 | 1.033E+04 | 1.548E+07 | 1.040E+03 |
| 2052 | 3.790E+04 | 3.035E+07 | 2.039E+03 | 1.012E+04 | 1.517E+07 | 1.020E+03 |
| 2053 | 3.715E+04 | 2.975E+07 | 1.999E+03 | 9.923E+03 | 1.487E+07 | 9.993E+02 |
| 2054 | 3.641E+04 | 2.916E+07 | 1.959E+03 | 9.726E+03 | 1.458E+07 | 9.796E+02 |
| 2055 | 3.569E+04 | 2.858E+07 | 1.920E+03 | 9.534E+03 | 1.429E+07 | 9.602E+02 |
| 2056 | 3.499E+04 | 2.801E+07 | 1.882E+03 | 9.345E+03 | 1.401E+07 | 9.411E+02 |
| 2057 | 3.429E+04 | 2.746E+07 | 1.845E+03 | 9.160E+03 | 1.373E+07 | 9.225E+02 |
| 2058 | 3.361E+04 | 2.692E+07 | 1.808E+03 | 8.979E+03 | 1.346E+07 | 9.042E+02 |
| 2059 | 3.295E+04 | 2.638E+07 | 1.773E+03 | 8.801E+03 | 1.319E+07 | 8.863E+02 |
| 2060 | 3.230E+04 | 2.586E+07 | 1.738E+03 | 8.626E+03 | 1.293E+07 | 8.688E+02 |
| 2061 | 3.166E+04 | 2.535E+07 | 1.703E+03 | 8.456E+03 | 1.267E+07 | 8.516E+02 |
| 2062 | 3.103E+04 | 2.485E+07 | 1.669E+03 | 8.288E+03 | 1.242E+07 | 8.347E+02 |
| 2063 | 3.041E+04 | 2.435E+07 | 1.636E+03 | 8.124E+03 | 1.218E+07 | 8.182E+02 |
| 2064 | 2.981E+04 | 2.387E+07 | 1.604E+03 | 7.963E+03 | 1.194E+07 | 8.020E+02 |
| 2065 | 2.922E+04 | 2.340E+07 | 1.572E+03 | 7.806E+03 | 1.170E+07 | 7.861E+02 |
| 2066 | 2.864E+04 | 2.294E+07 | 1.541E+03 | 7.651E+03 | 1.147E+07 | 7.705E+02 |
| 2067 | 2.808E+04 | 2.248E+07 | 1.511E+03 | 7.499E+03 | 1.124E+07 | 7.553E+02 |
| 2068 | 2.752E+04 | 2.204E+07 | 1.481E+03 | 7.351E+03 | 1.102E+07 | 7.403E+02 |
| 2069 | 2.698E+04 | 2.160E+07 | 1.451E+03 | 7.205E+03 | 1.080E+07 | 7.257E+02 |
| 2070 | 2.644E+04 | 2.117E+07 | 1.423E+03 | 7.063E+03 | 1.059E+07 | 7.113E+02 |
| 2071 | 2.592E+04 | 2.075E+07 | 1.394E+03 | 6.923E+03 | 1.038E+07 | 6.972E+02 |
| 2072 | 2.540E+04 | 2.034E+07 | 1.367E+03 | 6.786E+03 | 1.017E+07 | 6.834E+02 |
| 2073 | 2.490E+04 | 1.994E+07 | 1.340E+03 | 6.651E+03 | 9.970E+06 | 6.699E+02 |
| 2074 | 2.441E+04 | 1.955E+07 | 1.313E+03 | 6.520E+03 | 9.773E+06 | 6.566E+02 |
| 2075 | 2.393E+04 | 1.916E+07 | 1.287E+03 | 6.391E+03 | 9.579E+06 | 6.436E+02 |
| 2076 | 2.345E+04 | 1.878E+07 | 1.262E+03 | 6.264E+03 | 9.389E+06 | 6.309E+02 |
| 2077 | 2.299E+04 | 1.841E+07 | 1.237E+03 | 6.140E+03 | 9.203E+06 | 6.184E+02 |
| 2078 | 2.253E+04 | 1.804E+07 | 1.212E+03 | 6.018E+03 | 9.021E+06 | 6.061E+02 |
| 2079 | 2.209E+04 | 1.769E+07 | 1.188E+03 | 5.899E+03 | 8.843E+06 | 5.941E+02 |
| 2080 | 2.165E+04 | 1.733E+07 | 1.165E+03 | 5.782E+03 | 8.667E+06 | 5.824E+02 |
| 2081 | 2.122E+04 | 1.699E+07 | 1.142E+03 | 5.668E+03 | 8.496E+06 | 5.708E+02 |
| 2082 | 2.080E+04 | 1.666E+07 | 1.119E+03 | 5.556E+03 | 8.328E+06 | 5.595E+02 |
| 2083 | 2.039E+04 | 1.633E+07 | 1.097E+03 | 5.446E+03 | 8.163E+06 | 5.485E+02 |

## Results (Continued)

| Year | Total landfill gas | | | Methane | | |
|---|---|---|---|---|---|---|
| | (Mg/year) | ($m^3$/year) | (av ft^3/min) | (Mg/year) | ($m^3$/year) | (av ft^3/min) |
| 2084 | 1.998E+04 | 1.600E+07 | 1.075E+03 | 5.338E+03 | 8.001E+06 | 5.376E+02 |
| 2085 | 1.959E+04 | 1.569E+07 | 1.054E+03 | 5.232E+03 | 7.843E+06 | 5.269E+02 |
| 2086 | 1.920E+04 | 1.537E+07 | 1.033E+03 | 5.129E+03 | 7.687E+06 | 5.165E+02 |
| 2087 | 1.882E+04 | 1.507E+07 | 1.013E+03 | 5.027E+03 | 7.535E+06 | 5.063E+02 |
| 2088 | 1.845E+04 | 1.477E+07 | 9.925E+02 | 4.928E+03 | 7.386E+06 | 4.963E+02 |
| 2089 | 1.808E+04 | 1.448E+07 | 9.729E+02 | 4.830E+03 | 7.240E+06 | 4.864E+02 |
| 2090 | 1.772E+04 | 1.419E+07 | 9.536E+02 | 4.734E+03 | 7.096E+06 | 4.768E+02 |
| 2091 | 1.737E+04 | 1.391E+07 | 9.347E+02 | 4.641E+03 | 6.956E+06 | 4.674E+02 |
| 2092 | 1.703E+04 | 1.364E+07 | 9.162E+02 | 4.549E+03 | 6.818E+06 | 4.581E+02 |
| 2093 | 1.669E+04 | 1.337E+07 | 8.981E+02 | 4.459E+03 | 6.683E+06 | 4.490E+02 |
| 2094 | 1.636E+04 | 1.310E+07 | 8.803E+02 | 4.370E+03 | 6.551E+06 | 4.401E+02 |
| 2095 | 1.604E+04 | 1.284E+07 | 8.629E+02 | 4.284E+03 | 6.421E+06 | 4.314E+02 |
| 2096 | 1.572E+04 | 1.259E+07 | 8.458E+02 | 4.199E+03 | 6.294E+06 | 4.229E+02 |
| 2097 | 1.541E+04 | 1.234E+07 | 8.290E+02 | 4.116E+03 | 6.169E+06 | 4.145E+02 |
| 2098 | 1.510E+04 | 1.209E+07 | 8.126E+02 | 4.034E+03 | 6.047E+06 | 4.063E+02 |
| 2099 | 1.480E+04 | 1.185E+07 | 7.965E+02 | 3.954E+03 | 5.927E+06 | 3.983E+02 |
| 2100 | 1.451E+04 | 1.162E+07 | 7.807E+02 | 3.876E+03 | 5.810E+06 | 3.904E+02 |
| 2101 | 1.422E+04 | 1.139E+07 | 7.653E+02 | 3.799E+03 | 5.695E+06 | 3.826E+02 |
| 2102 | 1.394E+04 | 1.116E+07 | 7.501E+02 | 3.724E+03 | 5.582E+06 | 3.751E+02 |
| 2103 | 1.367E+04 | 1.094E+07 | 7.353E+02 | 3.650E+03 | 5.472E+06 | 3.676E+02 |
| 2104 | 1.340E+04 | 1.073E+07 | 7.207E+02 | 3.578E+03 | 5.363E+06 | 3.604E+02 |
| 2105 | 1.313E+04 | 1.051E+07 | 7.064E+02 | 3.507E+03 | 5.257E+06 | 3.532E+02 |
| 2106 | 1.287E+04 | 1.031E+07 | 6.925E+02 | 3.438E+03 | 5.153E+06 | 3.462E+02 |
| 2107 | 1.262E+04 | 1.010E+07 | 6.787E+02 | 3.370E+03 | 5.051E+06 | 3.394E+02 |
| 2108 | 1.237E+04 | 9.902E+06 | 6.653E+02 | 3.303E+03 | 4.951E+06 | 3.327E+02 |
| 2109 | 1.212E+04 | 9.706E+06 | 6.521E+02 | 3.238E+03 | 4.853E+06 | 3.261E+02 |
| 2110 | 1.188E+04 | 9.514E+06 | 6.392E+02 | 3.173E+03 | 4.757E+06 | 3.196E+02 |
| 2111 | 1.165E+04 | 9.325E+06 | 6.266E+02 | 3.111E+03 | 4.663E+06 | 3.133E+02 |
| 2112 | 1.141E+04 | 9.141E+06 | 6.142E+02 | 3.049E+03 | 4.570E+06 | 3.071E+02 |
| 2113 | 1.119E+04 | 8.960E+06 | 6.020E+02 | 2.989E+03 | 4.480E+06 | 3.010E+02 |
| 2114 | 1.097E+04 | 8.782E+06 | 5.901E+02 | 2.930E+03 | 4.391E+06 | 2.950E+02 |
| 2115 | 1.075E+04 | 8.608E+06 | 5.784E+02 | 2.871E+03 | 4.304E+06 | 2.892E+02 |
| 2116 | 1.054E+04 | 8.438E+06 | 5.669E+02 | 2.815E+03 | 4.219E+06 | 2.835E+02 |
| 2117 | 1.033E+04 | 8.271E+06 | 5.557E+02 | 2.759E+03 | 4.135E+06 | 2.779E+02 |
| 2118 | 1.012E+04 | 8.107E+06 | 5.447E+02 | 2.704E+03 | 4.053E+06 | 2.724E+02 |
| 2119 | 9.924E+03 | 7.946E+06 | 5.339E+02 | 2.651E+03 | 3.973E+06 | 2.670E+02 |
| 2120 | 9.727E+03 | 7.789E+06 | 5.233E+02 | 2.598E+03 | 3.895E+06 | 2.617E+02 |
| 2121 | 9.535E+03 | 7.635E+06 | 5.130E+02 | 2.547E+03 | 3.817E+06 | 2.565E+02 |
| 2122 | 9.346E+03 | 7.484E+06 | 5.028E+02 | 2.496E+03 | 3.742E+06 | 2.514E+02 |
| 2123 | 9.161E+03 | 7.335E+06 | 4.929E+02 | 2.447E+03 | 3.668E+06 | 2.464E+02 |

## Results (Continued)

| Year | Carbon dioxide | | | NMOC | | |
|---|---|---|---|---|---|---|
| | *(Mg/year)* | *($m^3$/year)* | *(av ft^3/min)* | *(Mg/year)* | *($m^3$/year)* | *(av ft^3/min)* |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 6.095E+01 | 3.330E+04 | 2.237E+00 | 1.158E-01 | 3.230E+01 | 2.170E-03 |
| 1985 | 1.900E+02 | 1.038E+05 | 6.976E+00 | 3.610E-01 | 1.007E+02 | 6.766E-03 |
| 1986 | 3.255E+02 | 1.778E+05 | 1.195E+01 | 6.182E-01 | 1.725E+02 | 1.159E-02 |
| 1987 | 4.677E+02 | 2.555E+05 | 1.717E+01 | 8.884E-01 | 2.478E+02 | 1.665E-02 |
| 1988 | 6.172E+02 | 3.372E+05 | 2.265E+01 | 1.172E+00 | 3.270E+02 | 2.197E-02 |
| 1989 | 7.743E+02 | 4.230E+05 | 2.842E+01 | 1.471E+00 | 4.103E+02 | 2.757E-02 |
| 1990 | 9.396E+02 | 5.133E+05 | 3.449E+01 | 1.785E+00 | 4.979E+02 | 3.345E-02 |
| 1991 | 1.147E+03 | 6.265E+05 | 4.210E+01 | 2.178E+00 | 6.077E+02 | 4.083E-02 |
| 1992 | 1.364E+03 | 7.450E+05 | 5.006E+01 | 2.590E+00 | 7.227E+02 | 4.856E-02 |
| 1993 | 1.591E+03 | 8.692E+05 | 5.840E+01 | 3.022E+00 | 8.431E+02 | 5.665E-02 |
| 1994 | 1.830E+03 | 9.997E+05 | 6.717E+01 | 3.476E+00 | 9.697E+02 | 6.515E-02 |
| 1995 | 2.150E+03 | 1.175E+06 | 7.892E+01 | 4.084E+00 | 1.139E+03 | 7.655E-02 |
| 1996 | 2.482E+03 | 1.356E+06 | 9.109E+01 | 4.714E+00 | 1.315E+03 | 8.836E-02 |
| 1997 | 2.827E+03 | 1.545E+06 | 1.038E+02 | 5.370E+00 | 1.498E+03 | 1.007E-01 |
| 1998 | 3.185E+03 | 1.740E+06 | 1.169E+02 | 6.050E+00 | 1.688E+03 | 1.134E-01 |
| 1999 | 3.542E+03 | 1.935E+06 | 1.300E+02 | 6.728E+00 | 1.877E+03 | 1.261E-01 |
| 2000 | 3.906E+03 | 2.134E+06 | 1.434E+02 | 7.420E+00 | 2.070E+03 | 1.391E-01 |
| 2001 | 4.292E+03 | 2.345E+06 | 1.575E+02 | 8.153E+00 | 2.274E+03 | 1.528E-01 |
| 2002 | 4.701E+03 | 2.568E+06 | 1.726E+02 | 8.930E+00 | 2.491E+03 | 1.674E-01 |
| 2003 | 5.122E+03 | 2.798E+06 | 1.880E+02 | 9.729E+00 | 2.714E+03 | 1.824E-01 |
| 2004 | 5.582E+03 | 3.049E+06 | 2.049E+02 | 1.060E+01 | 2.958E+03 | 1.987E-01 |
| 2005 | 6.060E+03 | 3.311E+06 | 2.224E+02 | 1.151E+01 | 3.211E+03 | 2.158E-01 |
| 2006 | 6.585E+03 | 3.598E+06 | 2.417E+02 | 1.251E+01 | 3.490E+03 | 2.345E-01 |
| 2007 | 7.208E+03 | 3.938E+06 | 2.646E+02 | 1.369E+01 | 3.820E+03 | 2.566E-01 |
| 2008 | 7.799E+03 | 4.261E+06 | 2.863E+02 | 1.481E+01 | 4.133E+03 | 2.777E-01 |
| 2009 | 8.319E+03 | 4.545E+06 | 3.054E+02 | 1.580E+01 | 4.408E+03 | 2.962E-01 |
| 2010 | 8.736E+03 | 4.772E+06 | 3.207E+02 | 1.659E+01 | 4.629E+03 | 3.110E-01 |
| 2011 | 9.154E+03 | 5.001E+06 | 3.360E+02 | 1.739E+01 | 4.851E+03 | 3.259E-01 |
| 2012 | 9.530E+03 | 5.206E+06 | 3.498E+02 | 1.810E+01 | 5.050E+03 | 3.393E-01 |
| 2013 | 9.929E+03 | 5.424E+06 | 3.645E+02 | 1.886E+01 | 5.262E+03 | 3.535E-01 |
| 2014 | 1.035E+04 | 5.657E+06 | 3.801E+02 | 1.967E+01 | 5.487E+03 | 3.687E-01 |
| 2015 | 1.085E+04 | 5.927E+06 | 3.982E+02 | 2.061E+01 | 5.749E+03 | 3.863E-01 |
| 2016 | 1.134E+04 | 6.197E+06 | 4.164E+02 | 2.155E+01 | 6.011E+03 | 4.039E-01 |
| 2017 | 1.184E+04 | 6.468E+06 | 4.346E+02 | 2.249E+01 | 6.274E+03 | 4.215E-01 |
| 2018 | 1.234E+04 | 6.739E+06 | 4.528E+02 | 2.343E+01 | 6.537E+03 | 4.392E-01 |
| 2019 | 1.283E+04 | 7.011E+06 | 4.711E+02 | 2.438E+01 | 6.801E+03 | 4.569E-01 |
| 2020 | 1.333E+04 | 7.284E+06 | 4.894E+02 | 2.532E+01 | 7.065E+03 | 4.747E-01 |
| 2021 | 1.383E+04 | 7.557E+06 | 5.078E+02 | 2.628E+01 | 7.330E+03 | 4.925E-01 |
| 2022 | 1.434E+04 | 7.831E+06 | 5.262E+02 | 2.723E+01 | 7.596E+03 | 5.104E-01 |
| 2023 | 1.484E+04 | 8.106E+06 | 5.447E+02 | 2.819E+01 | 7.863E+03 | 5.283E-01 |
| 2024 | 1.534E+04 | 8.383E+06 | 5.632E+02 | 2.915E+01 | 8.131E+03 | 5.463E-01 |
| 2025 | 1.585E+04 | 8.660E+06 | 5.819E+02 | 3.011E+01 | 8.400E+03 | 5.644E-01 |
| 2026 | 1.636E+04 | 8.938E+06 | 6.006E+02 | 3.108E+01 | 8.670E+03 | 5.825E-01 |
| 2027 | 1.687E+04 | 9.218E+06 | 6.193E+02 | 3.205E+01 | 8.941E+03 | 6.008E-01 |
| 2028 | 1.739E+04 | 9.499E+06 | 6.382E+02 | 3.303E+01 | 9.214E+03 | 6.191E-01 |
| 2029 | 1.790E+04 | 9.781E+06 | 6.572E+02 | 3.401E+01 | 9.488E+03 | 6.375E-01 |
| 2030 | 1.842E+04 | 1.007E+07 | 6.763E+02 | 3.500E+01 | 9.763E+03 | 6.560E-01 |
| 2031 | 1.895E+04 | 1.035E+07 | 6.954E+02 | 3.599E+01 | 1.004E+04 | 6.746E-01 |
| 2032 | 1.947E+04 | 1.064E+07 | 7.147E+02 | 3.699E+01 | 1.032E+04 | 6.933E-01 |

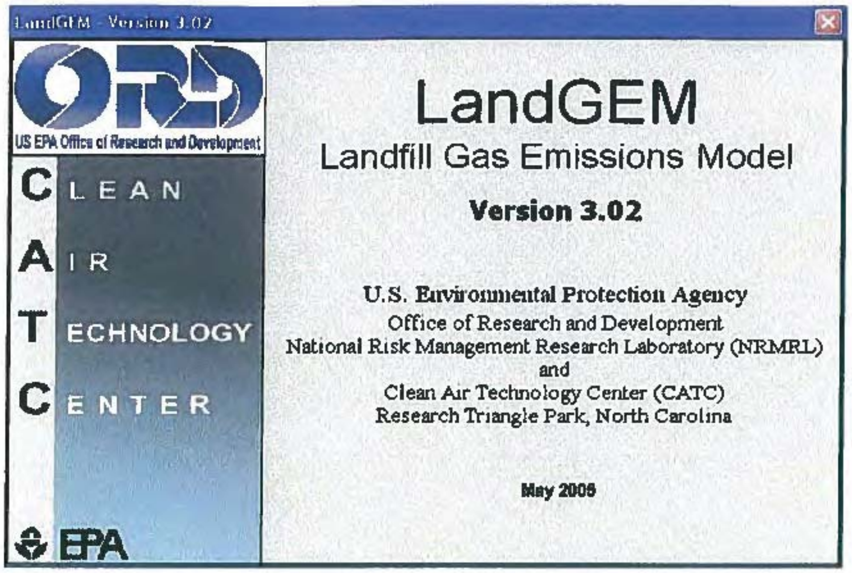
## Results (Continued)

| Year | Carbon dioxide | | | NMOC | | |
|---|---|---|---|---|---|---|
| | (Mg/year) | ($m^3$/year) | (av ft^3/min) | (Mg/year) | ($m^3$/year) | (av ft^3/min) |
| 2033 | 2.000E+04 | 1.093E+07 | 7.341E+02 | 3.799E+01 | 1.060E+04 | 7.121E-01 |
| 2034 | 2.053E+04 | 1.122E+07 | 7.536E+02 | 3.900E+01 | 1.088E+04 | 7.310E-01 |
| 2035 | 2.107E+04 | 1.151E+07 | 7.733E+02 | 4.002E+01 | 1.116E+04 | 7.501E-01 |
| 2036 | 2.161E+04 | 1.180E+07 | 7.930E+02 | 4.104E+01 | 1.145E+04 | 7.693E-01 |
| 2037 | 2.215E+04 | 1.210E+07 | 8.129E+02 | 4.207E+01 | 1.174E+04 | 7.886E-01 |
| 2038 | 2.269E+04 | 1.240E+07 | 8.330E+02 | 4.311E+01 | 1.203E+04 | 8.080E-01 |
| 2039 | 2.324E+04 | 1.270E+07 | 8.532E+02 | 4.415E+01 | 1.232E+04 | 8.276E-01 |
| 2040 | 2.380E+04 | 1.300E+07 | 8.735E+02 | 4.520E+01 | 1.261E+04 | 8.473E-01 |
| 2041 | 2.436E+04 | 1.331E+07 | 8.940E+02 | 4.626E+01 | 1.291E+04 | 8.672E-01 |
| 2042 | 2.490E+04 | 1.360E+07 | 9.141E+02 | 4.730E+01 | 1.320E+04 | 8.867E-01 |
| 2043 | 2.544E+04 | 1.390E+07 | 9.338E+02 | 4.832E+01 | 1.348E+04 | 9.058E-01 |
| 2044 | 2.597E+04 | 1.419E+07 | 9.531E+02 | 4.932E+01 | 1.376E+04 | 9.245E-01 |
| 2045 | 2.648E+04 | 1.447E+07 | 9.720E+02 | 5.030E+01 | 1.403E+04 | 9.429E-01 |
| 2046 | 2.699E+04 | 1.474E+07 | 9.906E+02 | 5.126E+01 | 1.430E+04 | 9.608E-01 |
| 2047 | 2.748E+04 | 1.501E+07 | 1.009E+03 | 5.220E+01 | 1.456E+04 | 9.785E-01 |
| 2048 | 2.797E+04 | 1.528E+07 | 1.027E+03 | 5.312E+01 | 1.482E+04 | 9.958E-01 |
| 2049 | 2.844E+04 | 1.554E+07 | 1.044E+03 | 5.403E+01 | 1.507E+04 | 1.013E+00 |
| 2050 | 2.891E+04 | 1.579E+07 | 1.061E+03 | 5.491E+01 | 1.532E+04 | 1.029E+00 |
| 2051 | 2.834E+04 | 1.548E+07 | 1.040E+03 | 5.382E+01 | 1.502E+04 | 1.009E+00 |
| 2052 | 2.778E+04 | 1.517E+07 | 1.020E+03 | 5.276E+01 | 1.472E+04 | 9.889E-01 |
| 2053 | 2.723E+04 | 1.487E+07 | 9.993E+02 | 5.171E+01 | 1.443E+04 | 9.694E-01 |
| 2054 | 2.669E+04 | 1.458E+07 | 9.796E+02 | 5.069E+01 | 1.414E+04 | 9.502E-01 |
| 2055 | 2.616E+04 | 1.429E+07 | 9.602E+02 | 4.969E+01 | 1.386E+04 | 9.314E-01 |
| 2056 | 2.564E+04 | 1.401E+07 | 9.411E+02 | 4.870E+01 | 1.359E+04 | 9.129E-01 |
| 2057 | 2.513E+04 | 1.373E+07 | 9.225E+02 | 4.774E+01 | 1.332E+04 | 8.948E-01 |
| 2058 | 2.463E+04 | 1.346E+07 | 9.042E+02 | 4.679E+01 | 1.305E+04 | 8.771E-01 |
| 2059 | 2.415E+04 | 1.319E+07 | 8.863E+02 | 4.587E+01 | 1.280E+04 | 8.597E-01 |
| 2060 | 2.367E+04 | 1.293E+07 | 8.688E+02 | 4.496E+01 | 1.254E+04 | 8.427E-01 |
| 2061 | 2.320E+04 | 1.267E+07 | 8.516E+02 | 4.407E+01 | 1.229E+04 | 8.260E-01 |
| 2062 | 2.274E+04 | 1.242E+07 | 8.347E+02 | 4.320E+01 | 1.205E+04 | 8.097E-01 |
| 2063 | 2.229E+04 | 1.218E+07 | 8.182E+02 | 4.234E+01 | 1.181E+04 | 7.936E-01 |
| 2064 | 2.185E+04 | 1.194E+07 | 8.020E+02 | 4.150E+01 | 1.158E+04 | 7.779E-01 |
| 2065 | 2.142E+04 | 1.170E+07 | 7.861E+02 | 4.068E+01 | 1.135E+04 | 7.625E-01 |
| 2066 | 2.099E+04 | 1.147E+07 | 7.705E+02 | 3.987E+01 | 1.112E+04 | 7.474E-01 |
| 2067 | 2.058E+04 | 1.124E+07 | 7.553E+02 | 3.908E+01 | 1.090E+04 | 7.326E-01 |
| 2068 | 2.017E+04 | 1.102E+07 | 7.403E+02 | 3.831E+01 | 1.069E+04 | 7.181E-01 |
| 2069 | 1.977E+04 | 1.080E+07 | 7.257E+02 | 3.755E+01 | 1.048E+04 | 7.039E-01 |
| 2070 | 1.938E+04 | 1.059E+07 | 7.113E+02 | 3.681E+01 | 1.027E+04 | 6.900E-01 |
| 2071 | 1.899E+04 | 1.038E+07 | 6.972E+02 | 3.608E+01 | 1.007E+04 | 6.763E-01 |
| 2072 | 1.862E+04 | 1.017E+07 | 6.834E+02 | 3.537E+01 | 9.866E+03 | 6.629E-01 |
| 2073 | 1.825E+04 | 9.970E+06 | 6.699E+02 | 3.466E+01 | 9.671E+03 | 6.498E-01 |
| 2074 | 1.789E+04 | 9.773E+06 | 6.566E+02 | 3.398E+01 | 9.479E+03 | 6.369E-01 |
| 2075 | 1.753E+04 | 9.579E+06 | 6.436E+02 | 3.331E+01 | 9.292E+03 | 6.243E-01 |
| 2076 | 1.719E+04 | 9.389E+06 | 6.309E+02 | 3.265E+01 | 9.108E+03 | 6.119E-01 |
| 2077 | 1.685E+04 | 9.203E+06 | 6.184E+02 | 3.200E+01 | 8.927E+03 | 5.998E-01 |
| 2078 | 1.651E+04 | 9.021E+06 | 6.061E+02 | 3.137E+01 | 8.751E+03 | 5.879E-01 |
| 2079 | 1.619E+04 | 8.843E+06 | 5.941E+02 | 3.074E+01 | 8.577E+03 | 5.763E-01 |
| 2080 | 1.587E+04 | 8.667E+06 | 5.824E+02 | 3.014E+01 | 8.407E+03 | 5.649E-01 |
| 2081 | 1.555E+04 | 8.496E+06 | 5.708E+02 | 2.954E+01 | 8.241E+03 | 5.537E-01 |
| 2082 | 1.524E+04 | 8.328E+06 | 5.595E+02 | 2.895E+01 | 8.078E+03 | 5.427E-01 |
| 2083 | 1.494E+04 | 8.163E+06 | 5.485E+02 | 2.838E+01 | 7.918E+03 | 5.320E-01 |

## Results (Continued)

| Year | Carbon dioxide | | | NMOC | | |
|---|---|---|---|---|---|---|
| | (Mg/year) | ($m^3$/year) | (av ft^3/min) | (Mg/year) | ($m^3$/year) | (av ft^3/min) |
| 2084 | 1.465E+04 | 8.001E+06 | 5.376E+02 | 2.782E+01 | 7.761E+03 | 5.215E-01 |
| 2085 | 1.436E+04 | 7.843E+06 | 5.269E+02 | 2.727E+01 | 7.607E+03 | 5.111E-01 |
| 2086 | 1.407E+04 | 7.687E+06 | 5.165E+02 | 2.673E+01 | 7.457E+03 | 5.010E-01 |
| 2087 | 1.379E+04 | 7.535E+06 | 5.063E+02 | 2.620E+01 | 7.309E+03 | 4.911E-01 |
| 2088 | 1.352E+04 | 7.386E+06 | 4.963E+02 | 2.568E+01 | 7.164E+03 | 4.814E-01 |
| 2089 | 1.325E+04 | 7.240E+06 | 4.864E+02 | 2.517E+01 | 7.022E+03 | 4.718E-01 |
| 2090 | 1.299E+04 | 7.096E+06 | 4.768E+02 | 2.467E+01 | 6.883E+03 | 4.625E-01 |
| 2091 | 1.273E+04 | 6.956E+06 | 4.674E+02 | 2.418E+01 | 6.747E+03 | 4.533E-01 |
| 2092 | 1.248E+04 | 6.818E+06 | 4.581E+02 | 2.371E+01 | 6.614E+03 | 4.444E-01 |
| 2093 | 1.223E+04 | 6.683E+06 | 4.490E+02 | 2.324E+01 | 6.483E+03 | 4.356E-01 |
| 2094 | 1.199E+04 | 6.551E+06 | 4.401E+02 | 2.278E+01 | 6.354E+03 | 4.269E-01 |
| 2095 | 1.175E+04 | 6.421E+06 | 4.314E+02 | 2.233E+01 | 6.228E+03 | 4.185E-01 |
| 2096 | 1.152E+04 | 6.294E+06 | 4.229E+02 | 2.188E+01 | 6.105E+03 | 4.102E-01 |
| 2097 | 1.129E+04 | 6.169E+06 | 4.145E+02 | 2.145E+01 | 5.984E+03 | 4.021E-01 |
| 2098 | 1.107E+04 | 6.047E+06 | 4.063E+02 | 2.103E+01 | 5.866E+03 | 3.941E-01 |
| 2099 | 1.085E+04 | 5.927E+06 | 3.983E+02 | 2.061E+01 | 5.750E+03 | 3.863E-01 |
| 2100 | 1.064E+04 | 5.810E+06 | 3.904E+02 | 2.020E+01 | 5.636E+03 | 3.787E-01 |
| 2101 | 1.042E+04 | 5.695E+06 | 3.826E+02 | 1.980E+01 | 5.524E+03 | 3.712E-01 |
| 2102 | 1.022E+04 | 5.582E+06 | 3.751E+02 | 1.941E+01 | 5.415E+03 | 3.638E-01 |
| 2103 | 1.002E+04 | 5.472E+06 | 3.676E+02 | 1.902E+01 | 5.307E+03 | 3.566E-01 |
| 2104 | 9.817E+03 | 5.363E+06 | 3.604E+02 | 1.865E+01 | 5.202E+03 | 3.495E-01 |
| 2105 | 9.623E+03 | 5.257E+06 | 3.532E+02 | 1.828E+01 | 5.099E+03 | 3.426E-01 |
| 2106 | 9.433E+03 | 5.153E+06 | 3.462E+02 | 1.792E+01 | 4.998E+03 | 3.358E-01 |
| 2107 | 9.246E+03 | 5.051E+06 | 3.394E+02 | 1.756E+01 | 4.899E+03 | 3.292E-01 |
| 2108 | 9.063E+03 | 4.951E+06 | 3.327E+02 | 1.721E+01 | 4.802E+03 | 3.227E-01 |
| 2109 | 8.883E+03 | 4.853E+06 | 3.261E+02 | 1.687E+01 | 4.707E+03 | 3.163E-01 |
| 2110 | 8.707E+03 | 4.757E+06 | 3.196E+02 | 1.654E+01 | 4.614E+03 | 3.100E-01 |
| 2111 | 8.535E+03 | 4.663E+06 | 3.133E+02 | 1.621E+01 | 4.523E+03 | 3.039E-01 |
| 2112 | 8.366E+03 | 4.570E+06 | 3.071E+02 | 1.589E+01 | 4.433E+03 | 2.979E-01 |
| 2113 | 8.200E+03 | 4.480E+06 | 3.010E+02 | 1.558E+01 | 4.345E+03 | 2.920E-01 |
| 2114 | 8.038E+03 | 4.391E+06 | 2.950E+02 | 1.527E+01 | 4.259E+03 | 2.862E-01 |
| 2115 | 7.879E+03 | 4.304E+06 | 2.892E+02 | 1.497E+01 | 4.175E+03 | 2.805E-01 |
| 2116 | 7.723E+03 | 4.219E+06 | 2.835E+02 | 1.467E+01 | 4.092E+03 | 2.750E-01 |
| 2117 | 7.570E+03 | 4.135E+06 | 2.779E+02 | 1.438E+01 | 4.011E+03 | 2.695E-01 |
| 2118 | 7.420E+03 | 4.053E+06 | 2.724E+02 | 1.409E+01 | 3.932E+03 | 2.642E-01 |
| 2119 | 7.273E+03 | 3.973E+06 | 2.670E+02 | 1.381E+01 | 3.854E+03 | 2.590E-01 |
| 2120 | 7.129E+03 | 3.895E+06 | 2.617E+02 | 1.354E+01 | 3.778E+03 | 2.538E-01 |
| 2121 | 6.988E+03 | 3.817E+06 | 2.565E+02 | 1.327E+01 | 3.703E+03 | 2.488E-01 |
| 2122 | 6.849E+03 | 3.742E+06 | 2.514E+02 | 1.301E+01 | 3.630E+03 | 2.439E-01 |
| 2123 | 6.714E+03 | 3.668E+06 | 2.464E+02 | 1.275E+01 | 3.558E+03 | 2.390E-01 |

# APPENDIX 4-D
# LANDGEM MAXIMUM METHANE GENERATION RATES, 2015




# Summary Report

**Landfill Name or Identifier:** Pickles Butte Landfill

**Date:** Tuesday, September 01, 2015

**About LandGEM:**

First-Order Decomposition Rate Equation:

$$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} k L_o \left( \frac{M_i}{10} \right) e^{-k t_{ij}}$$

Where,

$Q_{CH4}$ = annual methane generation in the year of the calculation ($m^3$/*year*)
i = 1-year time increment
n = (year of the calculation) - (initial year of waste acceptance)
j = 0.1-year time increment
k = methane generation rate (*year*$^{-1}$)
$L_o$ = potential methane generation capacity ($m^3$/*Mg*)

$M_i$ = mass of waste accepted in the $i^{th}$ year (*Mg*)
$t_{ij}$ = age of the $j^{th}$ section of waste mass $M_i$ accepted in the $i^{th}$ year (*decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

# Input Review

LANDFILL CHARACTERISTICS

| | | |
|---|---|---|
| **Landfill Open Year** | **1983** | |
| Landfill Closure Year (with 80-year limit) | **2050** | |
| *Actual Closure Year (without limit)* | ***2050*** | |
| Have Model Calculate Closure Year? | **No** | |
| Waste Design Capacity | **39,909,972** | *short tons* |

MODEL PARAMETERS

| | | |
|---|---|---|
| Methane Generation Rate, k | **0.020** | *$year^{-1}$* |
| Potential Methane Generation Capacity, $L_o$ | **170** | *$m^3/Mg$* |
| NMOC Concentration | **485** | *ppmv as hexane* |
| Methane Content | **50** | *% by volume* |

GASES / POLLUTANTS SELECTED

| | |
|---|---|
| Gas / Pollutant #1: | **Total landfill gas** |
| Gas / Pollutant #2: | **Methane** |
| Gas / Pollutant #3: | **Carbon dioxide** |
| Gas / Pollutant #4: | **NMOC** |

WASTE ACCEPTANCE RATES

| Year | Waste Accepted | | Waste-In-Place | |
|---|---|---|---|---|
| | *(Mg/year)* | *(short tons/year)* | *(Mg)* | *(short tons)* |
| 1983 | 16,798 | 18,478 | 0 | 0 |
| 1984 | 35,912 | 39,503 | 16,798 | 18,478 |
| 1985 | 38,369 | 42,206 | 52,710 | 57,981 |
| 1986 | 40,976 | 45,074 | 91,079 | 100,187 |
| 1987 | 43,743 | 48,117 | 132,055 | 145,261 |
| 1988 | 46,677 | 51,345 | 175,798 | 193,378 |
| 1989 | 49,791 | 54,770 | 222,475 | 244,723 |
| 1990 | 62,247 | 68,472 | 272,266 | 299,493 |
| 1991 | 66,045 | 72,649 | 334,514 | 367,965 |
| 1992 | 70,074 | 77,081 | 400,558 | 440,614 |
| 1993 | 74,527 | 81,980 | 470,632 | 517,695 |
| 1994 | 98,241 | 108,065 | 545,159 | 599,675 |
| 1995 | 103,113 | 113,424 | 643,400 | 707,740 |
| 1996 | 108,825 | 119,707 | 746,513 | 821,164 |
| 1997 | 113,990 | 125,389 | 855,337 | 940,871 |
| 1998 | 115,754 | 127,329 | 969,327 | 1,066,260 |
| 1999 | 119,748 | 131,723 | 1,085,081 | 1,193,589 |
| 2000 | 127,653 | 140,418 | 1,204,829 | 1,325,312 |
| 2001 | 136,172 | 149,789 | 1,332,482 | 1,465,730 |
| 2002 | 141,704 | 155,874 | 1,468,654 | 1,615,519 |
| 2003 | 154,645 | 170,110 | 1,610,357 | 1,771,393 |
| 2004 | 162,347 | 178,582 | 1,765,003 | 1,941,503 |
| 2005 | 177,793 | 195,572 | 1,927,350 | 2,120,085 |
| 2006 | 207,564 | 228,320 | 2,105,143 | 2,315,657 |
| 2007 | 202,250 | 222,475 | 2,312,706 | 2,543,977 |
| 2008 | 185,848 | 204,433 | 2,514,956 | 2,766,452 |
| 2009 | 160,258 | 176,284 | 2,700,805 | 2,970,885 |
| 2010 | 162,886 | 179,175 | 2,861,063 | 3,147,169 |
| 2011 | 153,761 | 169,137 | 3,023,949 | 3,326,344 |
| 2012 | 161,931 | 178,124 | 3,177,710 | 3,495,481 |
| 2013 | 171,465 | 188,611 | 3,339,641 | 3,673,605 |
| 2014 | 192,686 | 211,955 | 3,511,105 | 3,862,216 |
| 2015 | 195,577 | 215,134 | 3,703,792 | 4,074,171 |
| 2016 | 198,510 | 218,361 | 3,899,368 | 4,289,305 |
| 2017 | 201,488 | 221,637 | 4,097,879 | 4,507,667 |
| 2018 | 204,510 | 224,961 | 4,299,367 | 4,729,303 |
| 2019 | 207,578 | 228,336 | 4,503,877 | 4,954,265 |
| 2020 | 210,692 | 231,761 | 4,711,455 | 5,182,600 |
| 2021 | 213,852 | 235,237 | 4,922,147 | 5,414,361 |
| 2022 | 217,060 | 238,766 | 5,135,999 | 5,649,598 |

WASTE ACCEPTANCE RATES (Continued)

| Year | Waste Accepted | | Waste-In-Place | |
|---|---|---|---|---|
| | (Mg/year) | (short tons/year) | (Mg) | (short tons) |
| 2023 | 220,316 | 242,347 | 5,353,058 | 5,888,364 |
| 2024 | 223,620 | 245,982 | 5,573,374 | 6,130,711 |
| 2025 | 226,975 | 249,672 | 5,796,994 | 6,376,694 |
| 2026 | 230,379 | 253,417 | 6,023,969 | 6,626,366 |
| 2027 | 233,835 | 257,219 | 6,254,348 | 6,879,783 |
| 2028 | 237,343 | 261,077 | 6,488,183 | 7,137,002 |
| 2029 | 240,903 | 264,993 | 6,725,526 | 7,398,079 |
| 2030 | 244,516 | 268,968 | 6,966,429 | 7,663,071 |
| 2031 | 248,184 | 273,002 | 7,210,945 | 7,932,039 |
| 2032 | 251,907 | 277,097 | 7,459,129 | 8,205,042 |
| 2033 | 255,685 | 281,254 | 7,711,035 | 8,482,139 |
| 2034 | 259,521 | 285,473 | 7,966,721 | 8,763,393 |
| 2035 | 263,413 | 289,755 | 8,226,241 | 9,048,866 |
| 2036 | 267,365 | 294,101 | 8,489,655 | 9,338,620 |
| 2037 | 271,375 | 298,513 | 8,757,019 | 9,632,721 |
| 2038 | 275,446 | 302,990 | 9,028,394 | 9,931,234 |
| 2039 | 279,577 | 307,535 | 9,303,840 | 10,234,224 |
| 2040 | 283,771 | 312,148 | 9,583,418 | 10,541,759 |
| 2041 | 283,771 | 312,148 | 9,867,189 | 10,853,907 |
| 2042 | 283,771 | 312,148 | 10,150,960 | 11,166,056 |
| 2043 | 283,771 | 312,148 | 10,434,731 | 11,478,204 |
| 2044 | 283,771 | 312,148 | 10,718,502 | 11,790,352 |
| 2045 | 283,771 | 312,148 | 11,002,273 | 12,102,500 |
| 2046 | 283,771 | 312,148 | 11,286,044 | 12,414,648 |
| 2047 | 283,771 | 312,148 | 11,569,815 | 12,726,796 |
| 2048 | 283,771 | 312,148 | 11,853,586 | 13,038,944 |
| 2049 | 283,771 | 312,148 | 12,137,357 | 13,351,093 |
| 2050 | 0 | 0 | 12,421,128 | 13,663,241 |
| 2051 | 0 | 0 | 12,421,128 | 13,663,241 |
| 2052 | 0 | 0 | 12,421,128 | 13,663,241 |
| 2053 | 0 | 0 | 12,421,128 | 13,663,241 |
| 2054 | 0 | 0 | 12,421,128 | 13,663,241 |
| 2055 | 0 | 0 | 12,421,128 | 13,663,241 |
| 2056 | 0 | 0 | 12,421,128 | 13,663,241 |
| 2057 | 0 | 0 | 12,421,128 | 13,663,241 |
| 2058 | 0 | 0 | 12,421,128 | 13,663,241 |
| 2059 | 0 | 0 | 12,421,128 | 13,663,241 |
| 2060 | 0 | 0 | 12,421,128 | 13,663,241 |
| 2061 | 0 | 0 | 12,421,128 | 13,663,241 |
| 2062 | 0 | 0 | 12,421,128 | 13,663,241 |

## Pollutant Parameters

| | Gas / Pollutant Default Parameters: | | | User-specified Pollutant Parameters: | |
|---|---|---|---|---|---|
| | Compound | Concentration (*ppmv*) | Molecular Weight | Concentration (*ppmv*) | Molecular Weight |
| Gases | Total landfill gas | | 0.00 | | |
| | Methane | | 16.04 | | |
| | Carbon dioxide | | 44.01 | | |
| | NMOC | 4,000 | 86.18 | | |
| Pollutants | 1,1,1-Trichloroethane (methyl chloroform) - HAP | 0.48 | 133.41 | | |
| | 1,1,2,2-Tetrachloroethane - HAP/VOC | 1.1 | 167.85 | | |
| | 1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC | 2.4 | 98.97 | | |
| | 1,1-Dichloroethene (vinylidene chloride) - HAP/VOC | 0.20 | 96.94 | | |
| | 1,2-Dichloroethane (ethylene dichloride) - HAP/VOC | 0.41 | 98.96 | | |
| | 1,2-Dichloropropane (propylene dichloride) - HAP/VOC | 0.18 | 112.99 | | |
| | 2-Propanol (isopropyl alcohol) - VOC | 50 | 60.11 | | |
| | Acetone | 7.0 | 58.08 | | |
| | Acrylonitrile - HAP/VOC | 6.3 | 53.06 | | |
| | Benzene - No or Unknown Co-disposal - HAP/VOC | 1.9 | 78.11 | | |
| | Benzene - Co-disposal - HAP/VOC | 11 | 78.11 | | |
| | Bromodichloromethane - VOC | 3.1 | 163.83 | | |
| | Butane - VOC | 5.0 | 58.12 | | |
| | Carbon disulfide - HAP/VOC | 0.58 | 76.13 | | |
| | Carbon monoxide | 140 | 28.01 | | |
| | Carbon tetrachloride - HAP/VOC | 4.0E-03 | 153.84 | | |
| | Carbonyl sulfide - HAP/VOC | 0.49 | 60.07 | | |
| | Chlorobenzene - HAP/VOC | 0.25 | 112.56 | | |
| | Chlorodifluoromethane | 1.3 | 86.47 | | |
| | Chloroethane (ethyl chloride) - HAP/VOC | 1.3 | 64.52 | | |
| | Chloroform - HAP/VOC | 0.03 | 119.39 | | |
| | Chloromethane - VOC | 1.2 | 50.49 | | |
| | Dichlorobenzene - (HAP for para isomer/VOC) | 0.21 | 147 | | |
| | Dichlorodifluoromethane | 16 | 120.91 | | |
| | Dichlorofluoromethane - VOC | 2.6 | 102.92 | | |
| | Dichloromethane (methylene chloride) - HAP | 14 | 84.94 | | |
| | Dimethyl sulfide (methyl sulfide) - VOC | 7.8 | 62.13 | | |
| | Ethane | 890 | 30.07 | | |
| | Ethanol - VOC | 27 | 46.08 | | |

## Pollutant Parameters (Continued)

| | Gas / Pollutant Default Parameters: | | | User-specified Pollutant Parameters: | |
|---|---|---|---|---|---|
| | Compound | Concentration (*ppmv*) | Molecular Weight | Concentration (*ppmv*) | Molecular Weight |
| Pollutants | Ethyl mercaptan (ethanethiol) - VOC | 2.3 | 62.13 | | |
| | Ethylbenzene - HAP/VOC | 4.6 | 106.16 | | |
| | Ethylene dibromide - HAP/VOC | 1.0E-03 | 187.88 | | |
| | Fluorotrichloromethane - VOC | 0.76 | 137.38 | | |
| | Hexane - HAP/VOC | 6.6 | 86.18 | | |
| | Hydrogen sulfide | 36 | 34.08 | | |
| | Mercury (total) - HAP | 2.9E-04 | 200.61 | | |
| | Methyl ethyl ketone - HAP/VOC | 7.1 | 72.11 | | |
| | Methyl isobutyl ketone - HAP/VOC | 1.9 | 100.16 | | |
| | Methyl mercaptan - VOC | 2.5 | 48.11 | | |
| | Pentane - VOC | 3.3 | 72.15 | | |
| | Perchloroethylene (tetrachloroethylene) - HAP | 3.7 | 165.83 | | |
| | Propane - VOC | 11 | 44.09 | | |
| | t-1,2-Dichloroethene - VOC | 2.8 | 96.94 | | |
| | Toluene - No or Unknown Co-disposal - HAP/VOC | 39 | 92.13 | | |
| | Toluene - Co-disposal - HAP/VOC | 170 | 92.13 | | |
| | Trichloroethylene (trichloroethene) - HAP/VOC | 2.8 | 131.40 | | |
| | Vinyl chloride - HAP/VOC | 7.3 | 62.50 | | |
| | Xylenes - HAP/VOC | 12 | 106.16 | | |
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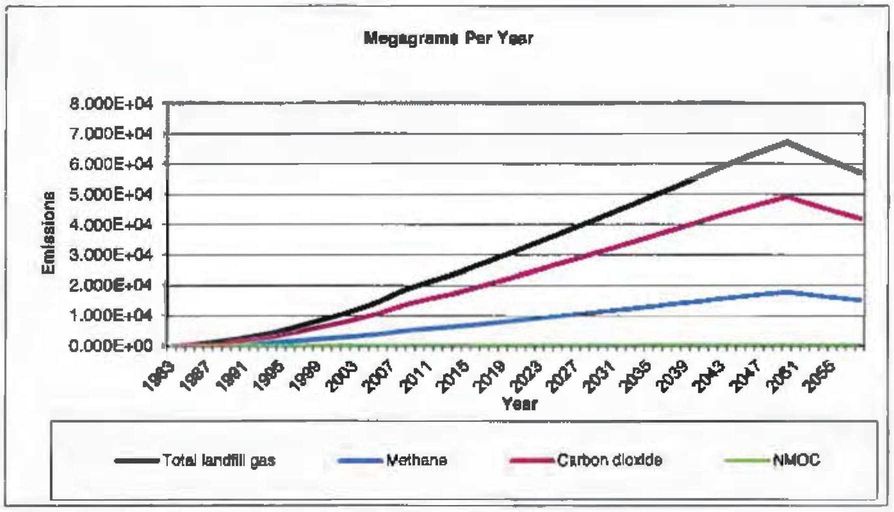
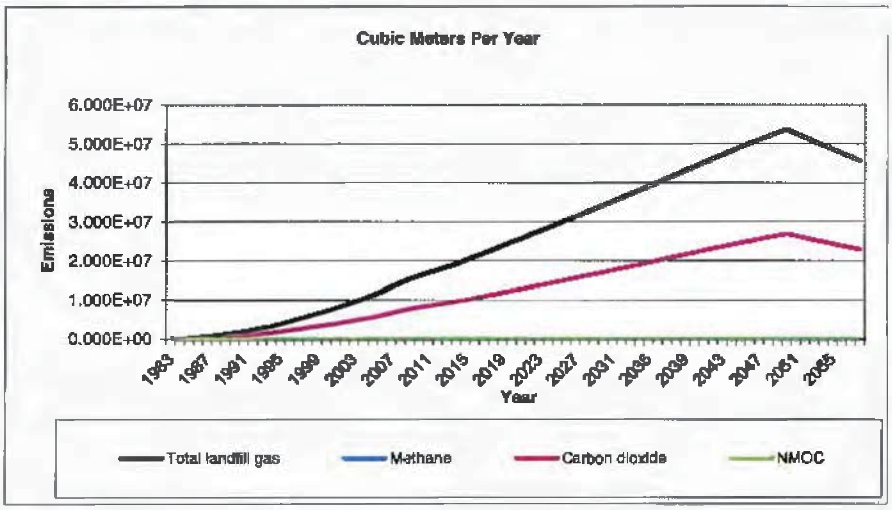
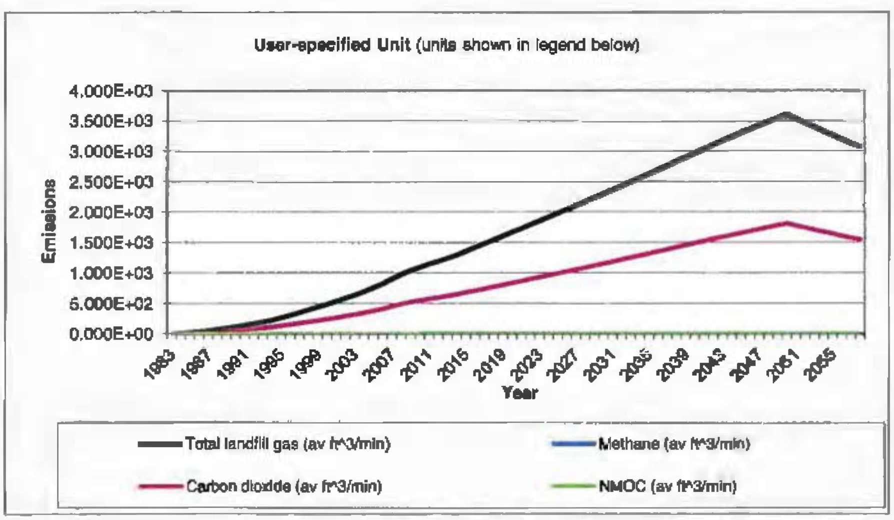
## Graphs


Megagrams Per Year
Emissions
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
Emissions
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
Emissions
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

## Results

| Year | Total landfill gas | | | Methane | | |
|---|---|---|---|---|---|---|
| | (Mg/year) | ($m^3$/year) | (av ft^3/min) | (Mg/year) | ($m^3$/year) | (av ft^3/min) |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 1.414E+02 | 1.132E+05 | 7.606E+00 | 3.776E+01 | 5.660E+04 | 3.803E+00 |
| 1985 | 4.408E+02 | 3.530E+05 | 2.372E+01 | 1.177E+02 | 1.765E+05 | 1.186E+01 |
| 1986 | 7.550E+02 | 6.046E+05 | 4.062E+01 | 2.017E+02 | 3.023E+05 | 2.031E+01 |
| 1987 | 1.085E+03 | 8.687E+05 | 5.837E+01 | 2.898E+02 | 4.344E+05 | 2.919E+01 |
| 1988 | 1.432E+03 | 1.146E+06 | 7.702E+01 | 3.824E+02 | 5.732E+05 | 3.851E+01 |
| 1989 | 1.796E+03 | 1.438E+06 | 9.663E+01 | 4.797E+02 | 7.191E+05 | 4.832E+01 |
| 1990 | 2.180E+03 | 1.745E+06 | 1.173E+02 | 5.822E+02 | 8.726E+05 | 5.863E+01 |
| 1991 | 2.660E+03 | 2.130E+06 | 1.431E+02 | 7.106E+02 | 1.065E+06 | 7.156E+01 |
| 1992 | 3.163E+03 | 2.533E+06 | 1.702E+02 | 8.450E+02 | 1.267E+06 | 8.510E+01 |
| 1993 | 3.691E+03 | 2.955E+06 | 1.986E+02 | 9.858E+02 | 1.478E+06 | 9.928E+01 |
| 1994 | 4.245E+03 | 3.399E+06 | 2.284E+02 | 1.134E+03 | 1.699E+06 | 1.142E+02 |
| 1995 | 4.987E+03 | 3.994E+06 | 2.683E+02 | 1.332E+03 | 1.997E+06 | 1.342E+02 |
| 1996 | 5.756E+03 | 4.610E+06 | 3.097E+02 | 1.538E+03 | 2.305E+06 | 1.549E+02 |
| 1997 | 6.558E+03 | 5.252E+06 | 3.529E+02 | 1.752E+03 | 2.626E+06 | 1.764E+02 |
| 1998 | 7.388E+03 | 5.916E+06 | 3.975E+02 | 1.973E+03 | 2.958E+06 | 1.987E+02 |
| 1999 | 8.216E+03 | 6.579E+06 | 4.420E+02 | 2.195E+03 | 3.289E+06 | 2.210E+02 |
| 2000 | 9.061E+03 | 7.256E+06 | 4.875E+02 | 2.420E+03 | 3.628E+06 | 2.437E+02 |
| 2001 | 9.956E+03 | 7.972E+06 | 5.356E+02 | 2.659E+03 | 3.986E+06 | 2.678E+02 |
| 2002 | 1.090E+04 | 8.732E+06 | 5.867E+02 | 2.913E+03 | 4.366E+06 | 2.933E+02 |
| 2003 | 1.188E+04 | 9.514E+06 | 6.392E+02 | 3.174E+03 | 4.757E+06 | 3.196E+02 |
| 2004 | 1.295E+04 | 1.037E+07 | 6.966E+02 | 3.458E+03 | 5.184E+06 | 3.483E+02 |
| 2005 | 1.406E+04 | 1.126E+07 | 7.563E+02 | 3.755E+03 | 5.628E+06 | 3.782E+02 |
| 2006 | 1.528E+04 | 1.223E+07 | 8.219E+02 | 4.080E+03 | 6.116E+06 | 4.109E+02 |
| 2007 | 1.672E+04 | 1.339E+07 | 8.996E+02 | 4.466E+03 | 6.694E+06 | 4.498E+02 |
| 2008 | 1.809E+04 | 1.449E+07 | 9.733E+02 | 4.832E+03 | 7.243E+06 | 4.867E+02 |
| 2009 | 1.930E+04 | 1.545E+07 | 1.038E+03 | 5.154E+03 | 7.726E+06 | 5.191E+02 |
| 2010 | 2.026E+04 | 1.623E+07 | 1.090E+03 | 5.413E+03 | 8.113E+06 | 5.451E+02 |
| 2011 | 2.123E+04 | 1.700E+07 | 1.142E+03 | 5.672E+03 | 8.501E+06 | 5.712E+02 |
| 2012 | 2.211E+04 | 1.770E+07 | 1.189E+03 | 5.905E+03 | 8.851E+06 | 5.947E+02 |
| 2013 | 2.303E+04 | 1.844E+07 | 1.239E+03 | 6.152E+03 | 9.221E+06 | 6.196E+02 |
| 2014 | 2.402E+04 | 1.923E+07 | 1.292E+03 | 6.416E+03 | 9.617E+06 | 6.461E+02 |
| 2015 | 2.516E+04 | 2.015E+07 | 1.354E+03 | 6.722E+03 | 1.008E+07 | 6.770E+02 |
| 2016 | 2.631E+04 | 2.107E+07 | 1.416E+03 | 7.028E+03 | 1.053E+07 | 7.078E+02 |
| 2017 | 2.746E+04 | 2.199E+07 | 1.478E+03 | 7.335E+03 | 1.100E+07 | 7.388E+02 |
| 2018 | 2.861E+04 | 2.291E+07 | 1.540E+03 | 7.643E+03 | 1.146E+07 | 7.698E+02 |
| 2019 | 2.977E+04 | 2.384E+07 | 1.602E+03 | 7.952E+03 | 1.192E+07 | 8.008E+02 |
| 2020 | 3.093E+04 | 2.476E+07 | 1.664E+03 | 8.261E+03 | 1.238E+07 | 8.320E+02 |
| 2021 | 3.209E+04 | 2.569E+07 | 1.726E+03 | 8.571E+03 | 1.285E+07 | 8.632E+02 |
| 2022 | 3.325E+04 | 2.663E+07 | 1.789E+03 | 8.882E+03 | 1.331E+07 | 8.945E+02 |
| 2023 | 3.442E+04 | 2.756E+07 | 1.852E+03 | 9.194E+03 | 1.378E+07 | 9.259E+02 |
| 2024 | 3.559E+04 | 2.850E+07 | 1.915E+03 | 9.507E+03 | 1.425E+07 | 9.575E+02 |
| 2025 | 3.677E+04 | 2.944E+07 | 1.978E+03 | 9.822E+03 | 1.472E+07 | 9.892E+02 |
| 2026 | 3.795E+04 | 3.039E+07 | 2.042E+03 | 1.014E+04 | 1.520E+07 | 1.021E+03 |
| 2027 | 3.914E+04 | 3.134E+07 | 2.106E+03 | 1.045E+04 | 1.567E+07 | 1.053E+03 |
| 2028 | 4.033E+04 | 3.230E+07 | 2.170E+03 | 1.077E+04 | 1.615E+07 | 1.085E+03 |
| 2029 | 4.153E+04 | 3.326E+07 | 2.234E+03 | 1.109E+04 | 1.663E+07 | 1.117E+03 |
| 2030 | 4.274E+04 | 3.422E+07 | 2.299E+03 | 1.142E+04 | 1.711E+07 | 1.150E+03 |
| 2031 | 4.395E+04 | 3.519E+07 | 2.364E+03 | 1.174E+04 | 1.760E+07 | 1.182E+03 |
| 2032 | 4.517E+04 | 3.617E+07 | 2.430E+03 | 1.206E+04 | 1.808E+07 | 1.215E+03 |

## Results (Continued)

| Year | Total landfill gas | | | Methane | | |
|---|---|---|---|---|---|---|
| | (Mg/year) | ($m^3$/year) | (av ft^3/min) | (Mg/year) | ($m^3$/year) | (av ft^3/min) |
| 2033 | 4.639E+04 | 3.715E+07 | 2.496E+03 | 1.239E+04 | 1.857E+07 | 1.248E+03 |
| 2034 | 4.763E+04 | 3.814E+07 | 2.562E+03 | 1.272E+04 | 1.907E+07 | 1.281E+03 |
| 2035 | 4.887E+04 | 3.913E+07 | 2.629E+03 | 1.305E+04 | 1.956E+07 | 1.315E+03 |
| 2036 | 5.012E+04 | 4.013E+07 | 2.696E+03 | 1.339E+04 | 2.007E+07 | 1.348E+03 |
| 2037 | 5.137E+04 | 4.114E+07 | 2.764E+03 | 1.372E+04 | 2.057E+07 | 1.382E+03 |
| 2038 | 5.264E+04 | 4.215E+07 | 2.832E+03 | 1.406E+04 | 2.108E+07 | 1.416E+03 |
| 2039 | 5.392E+04 | 4.317E+07 | 2.901E+03 | 1.440E+04 | 2.159E+07 | 1.450E+03 |
| 2040 | 5.520E+04 | 4.420E+07 | 2.970E+03 | 1.474E+04 | 2.210E+07 | 1.485E+03 |
| 2041 | 5.650E+04 | 4.524E+07 | 3.040E+03 | 1.509E+04 | 2.262E+07 | 1.520E+03 |
| 2042 | 5.777E+04 | 4.626E+07 | 3.108E+03 | 1.543E+04 | 2.313E+07 | 1.554E+03 |
| 2043 | 5.901E+04 | 4.725E+07 | 3.175E+03 | 1.576E+04 | 2.363E+07 | 1.587E+03 |
| 2044 | 6.023E+04 | 4.823E+07 | 3.241E+03 | 1.609E+04 | 2.411E+07 | 1.620E+03 |
| 2045 | 6.143E+04 | 4.919E+07 | 3.305E+03 | 1.641E+04 | 2.459E+07 | 1.652E+03 |
| 2046 | 6.260E+04 | 5.013E+07 | 3.368E+03 | 1.672E+04 | 2.506E+07 | 1.684E+03 |
| 2047 | 6.375E+04 | 5.105E+07 | 3.430E+03 | 1.703E+04 | 2.552E+07 | 1.715E+03 |
| 2048 | 6.487E+04 | 5.195E+07 | 3.490E+03 | 1.733E+04 | 2.597E+07 | 1.745E+03 |
| 2049 | 6.598E+04 | 5.283E+07 | 3.550E+03 | 1.762E+04 | 2.642E+07 | 1.775E+03 |
| 2050 | 6.706E+04 | 5.370E+07 | 3.608E+03 | 1.791E+04 | 2.685E+07 | 1.804E+03 |
| 2051 | 6.573E+04 | 5.263E+07 | 3.536E+03 | 1.756E+04 | 2.632E+07 | 1.768E+03 |
| 2052 | 6.443E+04 | 5.159E+07 | 3.466E+03 | 1.721E+04 | 2.580E+07 | 1.733E+03 |
| 2053 | 6.315E+04 | 5.057E+07 | 3.398E+03 | 1.687E+04 | 2.528E+07 | 1.699E+03 |
| 2054 | 6.190E+04 | 4.957E+07 | 3.330E+03 | 1.653E+04 | 2.478E+07 | 1.665E+03 |
| 2055 | 6.068E+04 | 4.859E+07 | 3.265E+03 | 1.621E+04 | 2.429E+07 | 1.632E+03 |
| 2056 | 5.947E+04 | 4.762E+07 | 3.200E+03 | 1.589E+04 | 2.381E+07 | 1.600E+03 |
| 2057 | 5.830E+04 | 4.668E+07 | 3.137E+03 | 1.557E+04 | 2.334E+07 | 1.568E+03 |
| 2058 | 5.714E+04 | 4.576E+07 | 3.074E+03 | 1.526E+04 | 2.288E+07 | 1.537E+03 |
| 2059 | 5.601E+04 | 4.485E+07 | 3.014E+03 | 1.496E+04 | 2.243E+07 | 1.507E+03 |
| 2060 | 5.490E+04 | 4.396E+07 | 2.954E+03 | 1.466E+04 | 2.198E+07 | 1.477E+03 |
| 2061 | 5.382E+04 | 4.309E+07 | 2.895E+03 | 1.437E+04 | 2.155E+07 | 1.448E+03 |
| 2062 | 5.275E+04 | 4.224E+07 | 2.838E+03 | 1.409E+04 | 2.112E+07 | 1.419E+03 |
| 2063 | 5.170E+04 | 4.140E+07 | 2.782E+03 | 1.381E+04 | 2.070E+07 | 1.391E+03 |
| 2064 | 5.068E+04 | 4.058E+07 | 2.727E+03 | 1.354E+04 | 2.029E+07 | 1.363E+03 |
| 2065 | 4.968E+04 | 3.978E+07 | 2.673E+03 | 1.327E+04 | 1.989E+07 | 1.336E+03 |
| 2066 | 4.869E+04 | 3.899E+07 | 2.620E+03 | 1.301E+04 | 1.950E+07 | 1.310E+03 |
| 2067 | 4.773E+04 | 3.822E+07 | 2.568E+03 | 1.275E+04 | 1.911E+07 | 1.284E+03 |
| 2068 | 4.678E+04 | 3.746E+07 | 2.517E+03 | 1.250E+04 | 1.873E+07 | 1.259E+03 |
| 2069 | 4.586E+04 | 3.672E+07 | 2.467E+03 | 1.225E+04 | 1.836E+07 | 1.234E+03 |
| 2070 | 4.495E+04 | 3.599E+07 | 2.418E+03 | 1.201E+04 | 1.800E+07 | 1.209E+03 |
| 2071 | 4.406E+04 | 3.528E+07 | 2.371E+03 | 1.177E+04 | 1.764E+07 | 1.185E+03 |
| 2072 | 4.319E+04 | 3.458E+07 | 2.324E+03 | 1.154E+04 | 1.729E+07 | 1.162E+03 |
| 2073 | 4.233E+04 | 3.390E+07 | 2.278E+03 | 1.131E+04 | 1.695E+07 | 1.139E+03 |
| 2074 | 4.149E+04 | 3.323E+07 | 2.232E+03 | 1.108E+04 | 1.661E+07 | 1.116E+03 |
| 2075 | 4.067E+04 | 3.257E+07 | 2.188E+03 | 1.086E+04 | 1.628E+07 | 1.094E+03 |
| 2076 | 3.987E+04 | 3.192E+07 | 2.145E+03 | 1.065E+04 | 1.596E+07 | 1.072E+03 |
| 2077 | 3.908E+04 | 3.129E+07 | 2.102E+03 | 1.044E+04 | 1.565E+07 | 1.051E+03 |
| 2078 | 3.830E+04 | 3.067E+07 | 2.061E+03 | 1.023E+04 | 1.534E+07 | 1.030E+03 |
| 2079 | 3.755E+04 | 3.006E+07 | 2.020E+03 | 1.003E+04 | 1.503E+07 | 1.010E+03 |
| 2080 | 3.680E+04 | 2.947E+07 | 1.980E+03 | 9.830E+03 | 1.473E+07 | 9.900E+02 |
| 2081 | 3.607E+04 | 2.889E+07 | 1.941E+03 | 9.636E+03 | 1.444E+07 | 9.704E+02 |
| 2082 | 3.536E+04 | 2.831E+07 | 1.902E+03 | 9.445E+03 | 1.416E+07 | 9.512E+02 |
| 2083 | 3.466E+04 | 2.775E+07 | 1.865E+03 | 9.258E+03 | 1.388E+07 | 9.324E+02 |

## Results (Continued)

| Year | Total landfill gas | | | Methane | | |
|---|---|---|---|---|---|---|
| | (Mg/year) | ($m^3$/year) | (av ft^3/min) | (Mg/year) | ($m^3$/year) | (av ft^3/min) |
| 2084 | 3.397E+04 | 2.720E+07 | 1.828E+03 | 9.074E+03 | 1.360E+07 | 9.139E+02 |
| 2085 | 3.330E+04 | 2.666E+07 | 1.792E+03 | 8.895E+03 | 1.333E+07 | 8.958E+02 |
| 2086 | 3.264E+04 | 2.614E+07 | 1.756E+03 | 8.719E+03 | 1.307E+07 | 8.781E+02 |
| 2087 | 3.199E+04 | 2.562E+07 | 1.721E+03 | 8.546E+03 | 1.281E+07 | 8.607E+02 |
| 2088 | 3.136E+04 | 2.511E+07 | 1.687E+03 | 8.377E+03 | 1.256E+07 | 8.436E+02 |
| 2089 | 3.074E+04 | 2.461E+07 | 1.654E+03 | 8.211E+03 | 1.231E+07 | 8.269E+02 |
| 2090 | 3.013E+04 | 2.413E+07 | 1.621E+03 | 8.048E+03 | 1.206E+07 | 8.106E+02 |
| 2091 | 2.953E+04 | 2.365E+07 | 1.589E+03 | 7.889E+03 | 1.182E+07 | 7.945E+02 |
| 2092 | 2.895E+04 | 2.318E+07 | 1.558E+03 | 7.733E+03 | 1.159E+07 | 7.788E+02 |
| 2093 | 2.838E+04 | 2.272E+07 | 1.527E+03 | 7.580E+03 | 1.136E+07 | 7.634E+02 |
| 2094 | 2.781E+04 | 2.227E+07 | 1.496E+03 | 7.430E+03 | 1.114E+07 | 7.482E+02 |
| 2095 | 2.726E+04 | 2.183E+07 | 1.467E+03 | 7.282E+03 | 1.092E+07 | 7.334E+02 |
| 2096 | 2.672E+04 | 2.140E+07 | 1.438E+03 | 7.138E+03 | 1.070E+07 | 7.189E+02 |
| 2097 | 2.619E+04 | 2.098E+07 | 1.409E+03 | 6.997E+03 | 1.049E+07 | 7.047E+02 |
| 2098 | 2.568E+04 | 2.056E+07 | 1.381E+03 | 6.858E+03 | 1.028E+07 | 6.907E+02 |
| 2099 | 2.517E+04 | 2.015E+07 | 1.354E+03 | 6.723E+03 | 1.008E+07 | 6.770E+02 |
| 2100 | 2.467E+04 | 1.975E+07 | 1.327E+03 | 6.589E+03 | 9.877E+06 | 6.636E+02 |
| 2101 | 2.418E+04 | 1.936E+07 | 1.301E+03 | 6.459E+03 | 9.681E+06 | 6.505E+02 |
| 2102 | 2.370E+04 | 1.898E+07 | 1.275E+03 | 6.331E+03 | 9.490E+06 | 6.376E+02 |
| 2103 | 2.323E+04 | 1.860E+07 | 1.250E+03 | 6.206E+03 | 9.302E+06 | 6.250E+02 |
| 2104 | 2.277E+04 | 1.824E+07 | 1.225E+03 | 6.083E+03 | 9.118E+06 | 6.126E+02 |
| 2105 | 2.232E+04 | 1.787E+07 | 1.201E+03 | 5.962E+03 | 8.937E+06 | 6.005E+02 |
| 2106 | 2.188E+04 | 1.752E+07 | 1.177E+03 | 5.844E+03 | 8.760E+06 | 5.886E+02 |
| 2107 | 2.145E+04 | 1.717E+07 | 1.154E+03 | 5.729E+03 | 8.587E+06 | 5.769E+02 |
| 2108 | 2.102E+04 | 1.683E+07 | 1.131E+03 | 5.615E+03 | 8.417E+06 | 5.655E+02 |
| 2109 | 2.061E+04 | 1.650E+07 | 1.109E+03 | 5.504E+03 | 8.250E+06 | 5.543E+02 |
| 2110 | 2.020E+04 | 1.617E+07 | 1.087E+03 | 5.395E+03 | 8.087E+06 | 5.433E+02 |
| 2111 | 1.980E+04 | 1.585E+07 | 1.065E+03 | 5.288E+03 | 7.926E+06 | 5.326E+02 |
| 2112 | 1.941E+04 | 1.554E+07 | 1.044E+03 | 5.183E+03 | 7.769E+06 | 5.220E+02 |
| 2113 | 1.902E+04 | 1.523E+07 | 1.023E+03 | 5.081E+03 | 7.616E+06 | 5.117E+02 |
| 2114 | 1.864E+04 | 1.493E+07 | 1.003E+03 | 4.980E+03 | 7.465E+06 | 5.016E+02 |
| 2115 | 1.828E+04 | 1.463E+07 | 9.833E+02 | 4.882E+03 | 7.317E+06 | 4.916E+02 |
| 2116 | 1.791E+04 | 1.434E+07 | 9.638E+02 | 4.785E+03 | 7.172E+06 | 4.819E+02 |
| 2117 | 1.756E+04 | 1.406E+07 | 9.447E+02 | 4.690E+03 | 7.030E+06 | 4.724E+02 |
| 2118 | 1.721E+04 | 1.378E+07 | 9.260E+02 | 4.597E+03 | 6.891E+06 | 4.630E+02 |
| 2119 | 1.687E+04 | 1.351E+07 | 9.077E+02 | 4.506E+03 | 6.754E+06 | 4.538E+02 |
| 2120 | 1.654E+04 | 1.324E+07 | 8.897E+02 | 4.417E+03 | 6.621E+06 | 4.448E+02 |
| 2121 | 1.621E+04 | 1.298E+07 | 8.721E+02 | 4.330E+03 | 6.490E+06 | 4.360E+02 |
| 2122 | 1.589E+04 | 1.272E+07 | 8.548E+02 | 4.244E+03 | 6.361E+06 | 4.274E+02 |
| 2123 | 1.557E+04 | 1.247E+07 | 8.379E+02 | 4.160E+03 | 6.235E+06 | 4.189E+02 |

## Results (Continued)

| Year | Carbon dioxide | | | NMOC | | |
|---|---|---|---|---|---|---|
| | *(Mg/year)* | *($m^3$/year)* | *(av ft^3/min)* | *(Mg/year)* | *($m^3$/year)* | *(av ft^3/min)* |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 1.036E+02 | 5.660E+04 | 3.803E+00 | 1.968E-01 | 5.490E+01 | 3.689E-03 |
| 1985 | 3.231E+02 | 1.765E+05 | 1.186E+01 | 6.136E-01 | 1.712E+02 | 1.150E-02 |
| 1986 | 5.533E+02 | 3.023E+05 | 2.031E+01 | 1.051E+00 | 2.932E+02 | 1.970E-02 |
| 1987 | 7.951E+02 | 4.344E+05 | 2.919E+01 | 1.510E+00 | 4.213E+02 | 2.831E-02 |
| 1988 | 1.049E+03 | 5.732E+05 | 3.851E+01 | 1.993E+00 | 5.560E+02 | 3.736E-02 |
| 1989 | 1.316E+03 | 7.191E+05 | 4.832E+01 | 2.500E+00 | 6.975E+02 | 4.687E-02 |
| 1990 | 1.597E+03 | 8.726E+05 | 5.863E+01 | 3.034E+00 | 8.465E+02 | 5.687E-02 |
| 1991 | 1.950E+03 | 1.065E+06 | 7.156E+01 | 3.703E+00 | 1.033E+03 | 6.942E-02 |
| 1992 | 2.318E+03 | 1.267E+06 | 8.510E+01 | 4.404E+00 | 1.229E+03 | 8.255E-02 |
| 1993 | 2.705E+03 | 1.478E+06 | 9.928E+01 | 5.138E+00 | 1.433E+03 | 9.630E-02 |
| 1994 | 3.111E+03 | 1.699E+06 | 1.142E+02 | 5.909E+00 | 1.648E+03 | 1.108E-01 |
| 1995 | 3.655E+03 | 1.997E+06 | 1.342E+02 | 6.943E+00 | 1.937E+03 | 1.301E-01 |
| 1996 | 4.219E+03 | 2.305E+06 | 1.549E+02 | 8.013E+00 | 2.236E+03 | 1.502E-01 |
| 1997 | 4.807E+03 | 2.626E+06 | 1.764E+02 | 9.130E+00 | 2.547E+03 | 1.711E-01 |
| 1998 | 5.414E+03 | 2.958E+06 | 1.987E+02 | 1.028E+01 | 2.869E+03 | 1.928E-01 |
| 1999 | 6.021E+03 | 3.289E+06 | 2.210E+02 | 1.144E+01 | 3.191E+03 | 2.144E-01 |
| 2000 | 6.641E+03 | 3.628E+06 | 2.437E+02 | 1.261E+01 | 3.519E+03 | 2.364E-01 |
| 2001 | 7.296E+03 | 3.986E+06 | 2.678E+02 | 1.386E+01 | 3.866E+03 | 2.598E-01 |
| 2002 | 7.992E+03 | 4.366E+06 | 2.933E+02 | 1.518E+01 | 4.235E+03 | 2.845E-01 |
| 2003 | 8.708E+03 | 4.757E+06 | 3.196E+02 | 1.654E+01 | 4.614E+03 | 3.100E-01 |
| 2004 | 9.489E+03 | 5.184E+06 | 3.483E+02 | 1.802E+01 | 5.028E+03 | 3.379E-01 |
| 2005 | 1.030E+04 | 5.628E+06 | 3.782E+02 | 1.957E+01 | 5.459E+03 | 3.668E-01 |
| 2006 | 1.120E+04 | 6.116E+06 | 4.109E+02 | 2.126E+01 | 5.932E+03 | 3.986E-01 |
| 2007 | 1.225E+04 | 6.694E+06 | 4.498E+02 | 2.328E+01 | 6.493E+03 | 4.363E-01 |
| 2008 | 1.326E+04 | 7.243E+06 | 4.867E+02 | 2.518E+01 | 7.026E+03 | 4.721E-01 |
| 2009 | 1.414E+04 | 7.726E+06 | 5.191E+02 | 2.686E+01 | 7.494E+03 | 5.035E-01 |
| 2010 | 1.485E+04 | 8.113E+06 | 5.451E+02 | 2.821E+01 | 7.870E+03 | 5.288E-01 |
| 2011 | 1.556E+04 | 8.501E+06 | 5.712E+02 | 2.956E+01 | 8.246E+03 | 5.541E-01 |
| 2012 | 1.620E+04 | 8.851E+06 | 5.947E+02 | 3.077E+01 | 8.585E+03 | 5.769E-01 |
| 2013 | 1.688E+04 | 9.221E+06 | 6.196E+02 | 3.206E+01 | 8.945E+03 | 6.010E-01 |
| 2014 | 1.760E+04 | 9.617E+06 | 6.461E+02 | 3.344E+01 | 9.328E+03 | 6.268E-01 |
| 2015 | 1.844E+04 | 1.008E+07 | 6.770E+02 | 3.503E+01 | 9.773E+03 | 6.567E-01 |
| 2016 | 1.928E+04 | 1.053E+07 | 7.078E+02 | 3.663E+01 | 1.022E+04 | 6.866E-01 |
| 2017 | 2.013E+04 | 1.100E+07 | 7.388E+02 | 3.823E+01 | 1.067E+04 | 7.166E-01 |
| 2018 | 2.097E+04 | 1.146E+07 | 7.698E+02 | 3.983E+01 | 1.111E+04 | 7.467E-01 |
| 2019 | 2.182E+04 | 1.192E+07 | 8.008E+02 | 4.144E+01 | 1.156E+04 | 7.768E-01 |
| 2020 | 2.267E+04 | 1.238E+07 | 8.320E+02 | 4.305E+01 | 1.201E+04 | 8.070E-01 |
| 2021 | 2.352E+04 | 1.285E+07 | 8.632E+02 | 4.467E+01 | 1.246E+04 | 8.373E-01 |
| 2022 | 2.437E+04 | 1.331E+07 | 8.945E+02 | 4.629E+01 | 1.291E+04 | 8.677E-01 |
| 2023 | 2.523E+04 | 1.378E+07 | 9.259E+02 | 4.792E+01 | 1.337E+04 | 8.982E-01 |
| 2024 | 2.609E+04 | 1.425E+07 | 9.575E+02 | 4.955E+01 | 1.382E+04 | 9.288E-01 |
| 2025 | 2.695E+04 | 1.472E+07 | 9.892E+02 | 5.119E+01 | 1.428E+04 | 9.595E-01 |
| 2026 | 2.781E+04 | 1.520E+07 | 1.021E+03 | 5.283E+01 | 1.474E+04 | 9.903E-01 |
| 2027 | 2.868E+04 | 1.567E+07 | 1.053E+03 | 5.449E+01 | 1.520E+04 | 1.021E+00 |
| 2028 | 2.956E+04 | 1.615E+07 | 1.085E+03 | 5.615E+01 | 1.566E+04 | 1.052E+00 |
| 2029 | 3.044E+04 | 1.663E+07 | 1.117E+03 | 5.781E+01 | 1.613E+04 | 1.084E+00 |
| 2030 | 3.132E+04 | 1.711E+07 | 1.150E+03 | 5.949E+01 | 1.660E+04 | 1.115E+00 |
| 2031 | 3.221E+04 | 1.760E+07 | 1.182E+03 | 6.118E+01 | 1.707E+04 | 1.147E+00 |
| 2032 | 3.310E+04 | 1.808E+07 | 1.215E+03 | 6.288E+01 | 1.754E+04 | 1.179E+00 |

## Results (Continued)

| Year | Carbon dioxide | | | NMOC | | |
|---|---|---|---|---|---|---|
| | (Mg/year) | ($m^3$/year) | (av ft^3/min) | (Mg/year) | ($m^3$/year) | (av ft^3/min) |
| 2033 | 3.400E+04 | 1.857E+07 | 1.248E+03 | 6.458E+01 | 1.802E+04 | 1.211E+00 |
| 2034 | 3.490E+04 | 1.907E+07 | 1.281E+03 | 6.630E+01 | 1.850E+04 | 1.243E+00 |
| 2035 | 3.581E+04 | 1.956E+07 | 1.315E+03 | 6.803E+01 | 1.898E+04 | 1.275E+00 |
| 2036 | 3.673E+04 | 2.007E+07 | 1.348E+03 | 6.977E+01 | 1.946E+04 | 1.308E+00 |
| 2037 | 3.765E+04 | 2.057E+07 | 1.382E+03 | 7.152E+01 | 1.995E+04 | 1.341E+00 |
| 2038 | 3.858E+04 | 2.108E+07 | 1.416E+03 | 7.328E+01 | 2.044E+04 | 1.374E+00 |
| 2039 | 3.951E+04 | 2.159E+07 | 1.450E+03 | 7.506E+01 | 2.094E+04 | 1.407E+00 |
| 2040 | 4.046E+04 | 2.210E+07 | 1.485E+03 | 7.684E+01 | 2.144E+04 | 1.440E+00 |
| 2041 | 4.141E+04 | 2.262E+07 | 1.520E+03 | 7.865E+01 | 2.194E+04 | 1.474E+00 |
| 2042 | 4.234E+04 | 2.313E+07 | 1.554E+03 | 8.041E+01 | 2.243E+04 | 1.507E+00 |
| 2043 | 4.325E+04 | 2.363E+07 | 1.587E+03 | 8.215E+01 | 2.292E+04 | 1.540E+00 |
| 2044 | 4.414E+04 | 2.411E+07 | 1.620E+03 | 8.385E+01 | 2.339E+04 | 1.572E+00 |
| 2045 | 4.502E+04 | 2.459E+07 | 1.652E+03 | 8.551E+01 | 2.386E+04 | 1.603E+00 |
| 2046 | 4.588E+04 | 2.506E+07 | 1.684E+03 | 8.714E+01 | 2.431E+04 | 1.633E+00 |
| 2047 | 4.672E+04 | 2.552E+07 | 1.715E+03 | 8.874E+01 | 2.476E+04 | 1.663E+00 |
| 2048 | 4.754E+04 | 2.597E+07 | 1.745E+03 | 9.031E+01 | 2.519E+04 | 1.693E+00 |
| 2049 | 4.835E+04 | 2.642E+07 | 1.775E+03 | 9.184E+01 | 2.562E+04 | 1.722E+00 |
| 2050 | 4.915E+04 | 2.685E+07 | 1.804E+03 | 9.335E+01 | 2.604E+04 | 1.750E+00 |
| 2051 | 4.817E+04 | 2.632E+07 | 1.768E+03 | 9.150E+01 | 2.553E+04 | 1.715E+00 |
| 2052 | 4.722E+04 | 2.580E+07 | 1.733E+03 | 8.969E+01 | 2.502E+04 | 1.681E+00 |
| 2053 | 4.628E+04 | 2.528E+07 | 1.699E+03 | 8.791E+01 | 2.453E+04 | 1.648E+00 |
| 2054 | 4.537E+04 | 2.478E+07 | 1.665E+03 | 8.617E+01 | 2.404E+04 | 1.615E+00 |
| 2055 | 4.447E+04 | 2.429E+07 | 1.632E+03 | 8.447E+01 | 2.356E+04 | 1.583E+00 |
| 2056 | 4.359E+04 | 2.381E+07 | 1.600E+03 | 8.279E+01 | 2.310E+04 | 1.552E+00 |
| 2057 | 4.273E+04 | 2.334E+07 | 1.568E+03 | 8.115E+01 | 2.264E+04 | 1.521E+00 |
| 2058 | 4.188E+04 | 2.288E+07 | 1.537E+03 | 7.955E+01 | 2.219E+04 | 1.491E+00 |
| 2059 | 4.105E+04 | 2.243E+07 | 1.507E+03 | 7.797E+01 | 2.175E+04 | 1.462E+00 |
| 2060 | 4.024E+04 | 2.198E+07 | 1.477E+03 | 7.643E+01 | 2.132E+04 | 1.433E+00 |
| 2061 | 3.944E+04 | 2.155E+07 | 1.448E+03 | 7.492E+01 | 2.090E+04 | 1.404E+00 |
| 2062 | 3.866E+04 | 2.112E+07 | 1.419E+03 | 7.343E+01 | 2.049E+04 | 1.376E+00 |
| 2063 | 3.789E+04 | 2.070E+07 | 1.391E+03 | 7.198E+01 | 2.008E+04 | 1.349E+00 |
| 2064 | 3.714E+04 | 2.029E+07 | 1.363E+03 | 7.055E+01 | 1.968E+04 | 1.322E+00 |
| 2065 | 3.641E+04 | 1.989E+07 | 1.336E+03 | 6.916E+01 | 1.929E+04 | 1.296E+00 |
| 2066 | 3.569E+04 | 1.950E+07 | 1.310E+03 | 6.779E+01 | 1.891E+04 | 1.271E+00 |
| 2067 | 3.498E+04 | 1.911E+07 | 1.284E+03 | 6.644E+01 | 1.854E+04 | 1.245E+00 |
| 2068 | 3.429E+04 | 1.873E+07 | 1.259E+03 | 6.513E+01 | 1.817E+04 | 1.221E+00 |
| 2069 | 3.361E+04 | 1.836E+07 | 1.234E+03 | 6.384E+01 | 1.781E+04 | 1.197E+00 |
| 2070 | 3.294E+04 | 1.800E+07 | 1.209E+03 | 6.257E+01 | 1.746E+04 | 1.173E+00 |
| 2071 | 3.229E+04 | 1.764E+07 | 1.185E+03 | 6.134E+01 | 1.711E+04 | 1.150E+00 |
| 2072 | 3.165E+04 | 1.729E+07 | 1.162E+03 | 6.012E+01 | 1.677E+04 | 1.127E+00 |
| 2073 | 3.102E+04 | 1.695E+07 | 1.139E+03 | 5.893E+01 | 1.644E+04 | 1.105E+00 |
| 2074 | 3.041E+04 | 1.661E+07 | 1.116E+03 | 5.776E+01 | 1.611E+04 | 1.083E+00 |
| 2075 | 2.981E+04 | 1.628E+07 | 1.094E+03 | 5.662E+01 | 1.580E+04 | 1.061E+00 |
| 2076 | 2.922E+04 | 1.596E+07 | 1.072E+03 | 5.550E+01 | 1.548E+04 | 1.040E+00 |
| 2077 | 2.864E+04 | 1.565E+07 | 1.051E+03 | 5.440E+01 | 1.518E+04 | 1.020E+00 |
| 2078 | 2.807E+04 | 1.534E+07 | 1.030E+03 | 5.332E+01 | 1.488E+04 | 9.995E-01 |
| 2079 | 2.752E+04 | 1.503E+07 | 1.010E+03 | 5.227E+01 | 1.458E+04 | 9.797E-01 |
| 2080 | 2.697E+04 | 1.473E+07 | 9.900E+02 | 5.123E+01 | 1.429E+04 | 9.603E-01 |
| 2081 | 2.644E+04 | 1.444E+07 | 9.704E+02 | 5.022E+01 | 1.401E+04 | 9.413E-01 |
| 2082 | 2.591E+04 | 1.416E+07 | 9.512E+02 | 4.922E+01 | 1.373E+04 | 9.227E-01 |
| 2083 | 2.540E+04 | 1.388E+07 | 9.324E+02 | 4.825E+01 | 1.346E+04 | 9.044E-01 |

## Results (Continued)

| Year | Carbon dioxide | | | NMOC | | |
|---|---|---|---|---|---|---|
| | *(Mg/year)* | *($m^3$/year)* | *(av ft^3/min)* | *(Mg/year)* | *($m^3$/year)* | *(av ft^3/min)* |
| 2084 | 2.490E+04 | 1.360E+07 | 9.139E+02 | 4.729E+01 | 1.319E+04 | 8.865E-01 |
| 2085 | 2.441E+04 | 1.333E+07 | 8.958E+02 | 4.636E+01 | 1.293E+04 | 8.689E-01 |
| 2086 | 2.392E+04 | 1.307E+07 | 8.781E+02 | 4.544E+01 | 1.268E+04 | 8.517E-01 |
| 2087 | 2.345E+04 | 1.281E+07 | 8.607E+02 | 4.454E+01 | 1.243E+04 | 8.349E-01 |
| 2088 | 2.298E+04 | 1.256E+07 | 8.436E+02 | 4.366E+01 | 1.218E+04 | 8.183E-01 |
| 2089 | 2.253E+04 | 1.231E+07 | 8.269E+02 | 4.279E+01 | 1.194E+04 | 8.021E-01 |
| 2090 | 2.208E+04 | 1.206E+07 | 8.106E+02 | 4.194E+01 | 1.170E+04 | 7.862E-01 |
| 2091 | 2.165E+04 | 1.182E+07 | 7.945E+02 | 4.111E+01 | 1.147E+04 | 7.707E-01 |
| 2092 | 2.122E+04 | 1.159E+07 | 7.788E+02 | 4.030E+01 | 1.124E+04 | 7.554E-01 |
| 2093 | 2.080E+04 | 1.136E+07 | 7.634E+02 | 3.950E+01 | 1.102E+04 | 7.405E-01 |
| 2094 | 2.038E+04 | 1.114E+07 | 7.482E+02 | 3.872E+01 | 1.080E+04 | 7.258E-01 |
| 2095 | 1.998E+04 | 1.092E+07 | 7.334E+02 | 3.795E+01 | 1.059E+04 | 7.114E-01 |
| 2096 | 1.959E+04 | 1.070E+07 | 7.189E+02 | 3.720E+01 | 1.038E+04 | 6.973E-01 |
| 2097 | 1.920E+04 | 1.049E+07 | 7.047E+02 | 3.647E+01 | 1.017E+04 | 6.835E-01 |
| 2098 | 1.882E+04 | 1.028E+07 | 6.907E+02 | 3.574E+01 | 9.972E+03 | 6.700E-01 |
| 2099 | 1.844E+04 | 1.008E+07 | 6.770E+02 | 3.504E+01 | 9.774E+03 | 6.567E-01 |
| 2100 | 1.808E+04 | 9.877E+06 | 6.636E+02 | 3.434E+01 | 9.581E+03 | 6.437E-01 |
| 2101 | 1.772E+04 | 9.681E+06 | 6.505E+02 | 3.366E+01 | 9.391E+03 | 6.310E-01 |
| 2102 | 1.737E+04 | 9.490E+06 | 6.376E+02 | 3.299E+01 | 9.205E+03 | 6.185E-01 |
| 2103 | 1.703E+04 | 9.302E+06 | 6.250E+02 | 3.234E+01 | 9.023E+03 | 6.062E-01 |
| 2104 | 1.669E+04 | 9.118E+06 | 6.126E+02 | 3.170E+01 | 8.844E+03 | 5.942E-01 |
| 2105 | 1.636E+04 | 8.937E+06 | 6.005E+02 | 3.107E+01 | 8.669E+03 | 5.825E-01 |
| 2106 | 1.604E+04 | 8.760E+06 | 5.886E+02 | 3.046E+01 | 8.497E+03 | 5.709E-01 |
| 2107 | 1.572E+04 | 8.587E+06 | 5.769E+02 | 2.986E+01 | 8.329E+03 | 5.596E-01 |
| 2108 | 1.541E+04 | 8.417E+06 | 5.655E+02 | 2.926E+01 | 8.164E+03 | 5.485E-01 |
| 2109 | 1.510E+04 | 8.250E+06 | 5.543E+02 | 2.868E+01 | 8.002E+03 | 5.377E-01 |
| 2110 | 1.480E+04 | 8.087E+06 | 5.433E+02 | 2.812E+01 | 7.844E+03 | 5.270E-01 |
| 2111 | 1.451E+04 | 7.926E+06 | 5.326E+02 | 2.756E+01 | 7.689E+03 | 5.166E-01 |
| 2112 | 1.422E+04 | 7.769E+06 | 5.220E+02 | 2.701E+01 | 7.536E+03 | 5.064E-01 |
| 2113 | 1.394E+04 | 7.616E+06 | 5.117E+02 | 2.648E+01 | 7.387E+03 | 4.963E-01 |
| 2114 | 1.366E+04 | 7.465E+06 | 5.016E+02 | 2.595E+01 | 7.241E+03 | 4.865E-01 |
| 2115 | 1.339E+04 | 7.317E+06 | 4.916E+02 | 2.544E+01 | 7.098E+03 | 4.769E-01 |
| 2116 | 1.313E+04 | 7.172E+06 | 4.819E+02 | 2.494E+01 | 6.957E+03 | 4.674E-01 |
| 2117 | 1.287E+04 | 7.030E+06 | 4.724E+02 | 2.444E+01 | 6.819E+03 | 4.582E-01 |
| 2118 | 1.261E+04 | 6.891E+06 | 4.630E+02 | 2.396E+01 | 6.684E+03 | 4.491E-01 |
| 2119 | 1.236E+04 | 6.754E+06 | 4.538E+02 | 2.348E+01 | 6.552E+03 | 4.402E-01 |
| 2120 | 1.212E+04 | 6.621E+06 | 4.448E+02 | 2.302E+01 | 6.422E+03 | 4.315E-01 |
| 2121 | 1.188E+04 | 6.490E+06 | 4.360E+02 | 2.256E+01 | 6.295E+03 | 4.230E-01 |
| 2122 | 1.164E+04 | 6.361E+06 | 4.274E+02 | 2.212E+01 | 6.170E+03 | 4.146E-01 |
| 2123 | 1.141E+04 | 6.235E+06 | 4.189E+02 | 2.168E+01 | 6.048E+03 | 4.064E-01 |

# APPENDIX 4-E
# ESTIMATED METHANE GENERATION RATES BASED ON CARB AND NO BIOSOLIDS, 2015

Pickles Butte Sanitary Landfill Assumed Waste Composition

| | | | Compostion |
|---|---|---|---|
| | | Type of Waste | % by wt |
| 1 | | Dry Recoverable Fiber | 17.60% |
| 2 | | PET UBC's | 0.60% |
| 3 | | HDPE | 0.80% |
| 4 | | Film Plastics | 5.30% |
| 5 | | Mixed plastics | 3.40% |
| 6 | | Glass | 0.90% |
| 7 | | Aluminum UBC's | 0.20% |
| 8 | | Mixed Ferrous (Tin & Salvage) | 1.70% |
| 9 | | Mixed Non-Ferrous (Salvage) | 0.10% |
| 10 | | Inerts | 7.30% |
| 11 | | Hazardous Waste | 0.30% |
| 12 | | E-Waste | 1.00% |
| 13 | | Textiles | 7.00% |
| 14 | | Organics | 43.00% |
| | a | Yard Waste | 8.20% |
| | b | Food Waste | 19.10% |
| | c | Clean Wood | 3.40% |
| | d | Treated/Painted Wood | 3.30% |
| | e | Wet/Contaminated Fiber | 6.10% |
| | f | Rubber | 0.90% |
| | g | Allocated Organics | 2.00% |
| 15 | | Fines (<2" Items) | 1.30% |
| 16 | | Other | 9.50% |
| | | Total | 100.00% |
| | | Calculated | |
| | | Methane Correction Factor (MCF) | 1 |
| | | Degradable Organic Carbon (DOC) | 0.187952 |
| | | Fraction of DOC Dissimilated ($DOC_F$) | 0.494031 |

# Gas Generation Curve

## Summary Report

| | |
|---|---|
| Landfill Name or Identifier: | Canyon County Pickles Butte Landfill |
| Date: | Tuesday, September 01, 2015 |
| Rate Constant "k" (year^-1) | 0.02 |
| Starting Year: | 1983 |
| Collection Efficiency: | 95.00% |

First-Order Decomposition Rate Equation
(From Equation HH-1 in Subpart HH):

$$L_{0,m,x} = MCF * DOC * DOC_F * F * \frac{16}{12}$$

$$L_{0,v,x} = \frac{\left(\frac{L_{0,m}}{16.04} * R * T_{std}\right)}{P_{std}}$$

$$Q_{CH4} = \sum_{x=S}^{T-1} \{W_x * L_{0,v,x} * (e^{-k(T-x-1)} - e^{-k(T-x)})\}$$

| | |
|---|---|
| $Q_{CH4}$ = annual methane generation in the year of the calculation ($m^3$/year) | |
| x = Year in which waste was disposed. | T = Reporting year for which emissions are calculated. |
| S = Start year of calculation. | $W_X$=Quantity of waste disposed in the landfill in year x from (metric tons, as received (wet weight)). |
| MCF = Methane correction factor (fraction). | |
| DOC = Degradable organic carbon | $DOC_F$ = Fraction of DOC dissimilated (fraction) |
| $L_{o,v}$ = potential methane generation capacity for year x ($m^3$/Mg) | F = Fraction by volume of CH4 |
| $L_{o,m}$ = potential methane generation capacity for year x (Mg /Mg) | k = Rate constant (yr–1). |
| $P_{std}$ = Standard Pressure | $T_{std}$ = Standard Temperature |

| | Waste Accepted | | Methane Correction Factor (MCF) | Degradable Organic Carbon (DOC) | Fraction of DOC Dissimilated ($DOC_F$) | Fraction by volume of $CH_4$ (F) |
|---|---|---|---|---|---|---|
| Year | (Short Tons) | (Metric Tons) | Fraction | Fraction | Fraction | Fraction |
| 1983 | 18,478 | 20,369 | 1 | 0.187952 | 0.494031 | 0.55 |
| 1984 | 39,503 | 43,545 | 1 | 0.187952 | 0.494031 | 0.55 |
| 1985 | 42,206 | 46,524 | 1 | 0.187952 | 0.494031 | 0.55 |
| 1986 | 45,074 | 49,686 | 1 | 0.187952 | 0.494031 | 0.55 |
| 1987 | 48,117 | 53,040 | 1 | 0.187952 | 0.494031 | 0.55 |
| 1988 | 51,345 | 56,598 | 1 | 0.187952 | 0.494031 | 0.55 |
| 1989 | 54,770 | 60,374 | 1 | 0.187952 | 0.494031 | 0.55 |
| 1990 | 68,472 | 75,477 | 1 | 0.187952 | 0.494031 | 0.55 |
| 1991 | 72,649 | 80,082 | 1 | 0.187952 | 0.494031 | 0.55 |
| 1992 | 77,081 | 84,967 | 1 | 0.187952 | 0.494031 | 0.55 |
| 1993 | 81,980 | 90,367 | 1 | 0.187952 | 0.494031 | 0.55 |
| 1994 | 108,065 | 119,121 | 1 | 0.187952 | 0.494031 | 0.55 |
| 1995 | 113,424 | 125,029 | 1 | 0.187952 | 0.494031 | 0.55 |
| 1996 | 119,707 | 131,954 | 1 | 0.187952 | 0.494031 | 0.55 |
| 1997 | 125,389 | 138,218 | 1 | 0.187952 | 0.494031 | 0.55 |
| 1998 | 127,329 | 140,356 | 1 | 0.187952 | 0.494031 | 0.55 |
| 1999 | 131,723 | 145,200 | 1 | 0.187952 | 0.494031 | 0.55 |

# Gas Generation Curve

| | | | | | | |
|---|---|---|---|---|---|---|
| 2000 | 140,418 | 154,784 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2001 | 149,789 | 165,114 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2002 | 155,874 | 171,822 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2003 | 170,110 | 187,514 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2004 | 178,582 | 196,853 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2005 | 195,572 | 215,581 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2006 | 228,320 | 251,680 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2007 | 222,475 | 245,237 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2008 | 204,433 | 225,349 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2009 | 176,284 | 194,320 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2010 | 179,175 | 197,507 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2011 | 169,137 | 186,442 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2012 | 178,124 | 196,348 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2013 | 188,611 | 207,908 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2014 | 211,955 | 233,640 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2015 | 215,134 | 237,145 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2016 | 218,361 | 240,702 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2017 | 221,637 | 244,313 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2018 | 224,961 | 247,977 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2019 | 228,336 | 251,697 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2020 | 231,761 | 255,473 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2021 | 235,237 | 259,305 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2022 | 238,766 | 263,194 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2023 | 242,347 | 267,142 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2024 | 245,982 | 271,149 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2025 | 249,672 | 275,216 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2026 | 253,417 | 279,345 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2027 | 257,219 | 283,535 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2028 | 261,077 | 287,788 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2029 | 264,993 | 292,105 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2030 | 268,968 | 296,486 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2031 | 273,002 | 300,934 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2032 | 277,097 | 305,448 | 1 | 0.187952 | 0.494031 | 0.55 |
| 2033 | 281,254 | 310,029 | 1 | 0.187952 | 0.494031 | 0.55 |

| Key | |
| --- | --- |
| Required User Input | |

| Year | Waste Tonnage (Short Tons) | Waste Tonnage (Metric Tons) | % CH4 |
| --- | --- | --- | --- |
| 1983 | 18,478 | 20,369 | 55.00% |
| 1984 | 39,503 | 43,545 | 55.00% |
| 1985 | 42,206 | 46,524 | 55.00% |
| 1986 | 45,074 | 49,686 | 55.00% |
| 1987 | 48,117 | 53,040 | 55.00% |
| 1988 | 51,345 | 56,598 | 55.00% |
| 1989 | 54,770 | 60,374 | 55.00% |
| 1990 | 68,472 | 75,477 | 55.00% |
| 1991 | 72,649 | 80,082 | 55.00% |
| 1992 | 77,081 | 84,967 | 55.00% |
| 1993 | 81,980 | 90,367 | 55.00% |
| 1994 | 108,065 | 119,121 | 55.00% |
| 1995 | 113,424 | 125,029 | 55.00% |
| 1996 | 119,707 | 131,954 | 55.00% |
| 1997 | 125,389 | 138,218 | 55.00% |
| 1998 | 127,329 | 140,356 | 55.00% |
| 1999 | 131,723 | 145,200 | 55.00% |
| 2000 | 140,418 | 154,784 | 55.00% |
| 2001 | 149,789 | 165,114 | 55.00% |
| 2002 | 155,874 | 171,822 | 55.00% |
| 2003 | 170,110 | 187,514 | 55.00% |
| 2004 | 178,582 | 196,853 | 55.00% |
| 2005 | 195,572 | 215,581 | 55.00% |
| 2006 | 228,320 | 251,680 | 55.00% |
| 2007 | 222,475 | 245,237 | 55.00% |
| 2008 | 204,433 | 225,349 | 55.00% |
| 2009 | 176,284 | 194,320 | 55.00% |
| 2010 | 179,175 | 197,507 | 55.00% |
| 2011 | 169,137 | 186,442 | 55.00% |
| 2012 | 178,124 | 196,348 | 55.00% |
| 2013 | 188,611 | 207,908 | 55.00% |
| 2014 | 211,955 | 233,640 | 55.00% |
| 2015 | 215,134 | 237,145 | 55.00% |
| 2016 | 218,361 | 240,702 | 55.00% |
| 2017 | 221,637 | 244,313 | 55.00% |
| 2018 | 224,961 | 247,977 | 55.00% |
| 2019 | 228,336 | 251,697 | 55.00% |
| 2020 | 231,761 | 255,473 | 55.00% |
| 2021 | 235,237 | 259,305 | 55.00% |

| Key | |
|---|---|
| Required User Input | |

| | | Year | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion |
| | | Type of Waste | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt |
| 1 | | Dry Recoverable Fiber | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% |
| 2 | | PET UBC's | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% |
| 3 | | HDPE | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% |
| 4 | | Film Plastics | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% |
| 5 | | Mixed plastics | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% |
| 6 | | Glass | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% |
| 7 | | Aluminum UBC's | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% |
| 8 | | Mixed Ferrous (Tin & Salvage) | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% |
| 9 | | Mixed Non-Ferrous (Salvage) | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% |
| 10 | | Inerts | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% |
| 11 | | Hazardous Waste | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% |
| 12 | | E-Waste | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% |
| 13 | | Textiles | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% |
| 14 | | Organics | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% |
| | a | Yard Waste | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% |
| | b | Food Waste | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% |
| | c | Clean Wood | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% |
| | d | Treated/Painted Wood | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% |
| | e | Wet/Contaminated Fiber | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% |
| | f | Rubber | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% |
| | g | Allocated Organics | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% |
| 15 | | Fines (<2" Items) | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% |
| 16 | | Other | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% |
| | | Total | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% |

| Calculated | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Methane Correction Factor (MCF) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Degradable Organic Carbon (DOC) | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 |
| Fraction of DOC Dissimilated ($DOC_F$) | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 |

| | | Type of Waste | MCF | DOC | DOCF |
|---|---|---|---|---|---|
| 1 | | Dry Recoverable Fiber | 100.00% | 41.83% | 40.70% |
| 2 | | PET UBC's | 100.00% | 0.00% | 50.00% |
| 3 | | HDPE | 100.00% | 0.00% | 50.00% |
| 4 | | Film Plastics | 100.00% | 0.00% | 50.00% |
| 5 | | Mixed plastics | 100.00% | 0.00% | 50.00% |
| 6 | | Glass | 100.00% | 0.00% | 50.00% |
| 7 | | Aluminum UBC's | 100.00% | 1.00% | 50.00% |
| 8 | | Mixed Ferrous (Tin & Salvage) | 100.00% | 1.00% | 50.00% |
| 9 | | Mixed Non-Ferrous (Salvage) | 100.00% | 1.00% | 50.00% |
| 10 | | Inerts | 100.00% | 1.00% | 50.00% |
| 11 | | Hazardous Waste | 100.00% | 0.00% | 50.00% |
| 12 | | E-Waste | 100.00% | 1.00% | 50.00% |
| 13 | | Textiles | 100.00% | 24.00% | 50.00% |
| 14 | | Organics | | | |
| | a | Yard Waste | 100.00% | 19.20% | 32.20% |
| | b | Food Waste | 100.00% | 11.70% | 82.80% |
| | c | Clean Wood | 100.00% | 43.00% | 23.30% |
| | d | Treated/Painted Wood | 100.00% | 43.00% | 23.30% |
| | e | Wet/Contaminated Fiber | 100.00% | 27.90% | 17.60% |
| | f | Rubber | 100.00% | 39.00% | 50.00% |
| | g | Allocated Organics | 100.00% | 40.00% | 50.00% |
| 15 | | Fines (<2" Items) | 100.00% | 1.00% | 50.00% |
| 16 | | Other | 100.00% | 1.00% | 50.00% |

| References |
|---|
| EPA Default Value Used |
| Landfill Emissions Tool Version 1.2 |
| "Staff Report: Initial Statement of Reasons for Proposed Rulemaking" from State of CaliforniaAir Resources Board. Appendix C, May 8, 2009 http://www.arb.ca.gov/regact/2009/landfills09/landfills09.htm |
| "2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 5 Waste" Chapter 2 Table 2.5 |

| | |
|---|---|
| Methane Correction Factor<br>(Fraction with Default Value of 1) | |
| | |
| Degradable Organic Carbon (DOC)<br>(Fraction From Table of Factors) | |
| | |
| Degradable Organic Carbon Dissimilated<br>(Fraction with Default Value of 0.5) | |
| | |
| Fraction by volume of methane in LFG<br>(Fraction with Default Value of 0.5) | |
| | |
| Rate Constant "k" (year^-1)<br>(From Table of Factors Tab) | |
| 0.02 | |
| Starting Year | |
| 1983 | |
| Landfill Name or Identifier | |
| Canyon County Pickles Butte Landfill | |
| Collection Efficiency | |
| 95.00% | |

## Table of Factors

| Waste | DOC Weight Fraction (Wet Basis) | k year^-1 low | k year^-1 high |
|---|---|---|---|
| Food Waste | 0.15 | 0.06 | 0.185 |
| Garden | 0.2 | 0.05 | 0.1 |
| Paper | 0.4 | 0.04 | 0.06 |
| Wood and Straw | 0.43 | 0.02 | 0.03 |
| Textiles | 0.24 | 0.04 | 0.06 |
| Diapers | 0.24 | 0.05 | 0.01 |
| Sewage Sludge | 0.05 | 0.06 | 0.185 |
| Bulk Waste | 0.2 | ND | ND |

From Federal Register/Vol .74, No. 209/ Friday, October, 2009/ Rules and Regulations

| Year | Generated Landfill Gas | | | | | | | | Collected Landfill Gas | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Landfill Gas | | | | Methane | | | | Total Landfill Gas | | | | Methane | | | |
| | Mg/year | $m^3$/year | $ft^3$/year | ave scfm | Mg/year | $m^3$/year | $ft^3$/year | ave scfm | Mg/year | $m^3$/year | $ft^3$/year | ave scfm | Mg/year | $m^3$/year | $ft^3$/year | ave scfm |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 89 | 73,744 | 2,604,262 | 5 | 27 | 40,559 | 1,432,344 | 3 | 85 | 70,057 | 2,474,049 | 5 | 26 | 38,531 | 1,360,727 | 3 |
| 1985 | 278 | 229,938 | 8,120,190 | 15 | 86 | 126,466 | 4,466,105 | 8 | 264 | 218,441 | 7,714,181 | 15 | 81 | 120,143 | 4,242,799 | 8 |
| 1986 | 476 | 393,826 | 13,907,852 | 26 | 147 | 216,604 | 7,649,319 | 15 | 452 | 374,135 | 13,212,459 | 25 | 139 | 205,774 | 7,266,853 | 14 |
| 1987 | 684 | 565,915 | 19,985,122 | 38 | 211 | 311,253 | 10,991,817 | 21 | 650 | 537,619 | 18,985,866 | 36 | 200 | 295,691 | 10,442,226 | 20 |
| 1988 | 902 | 746,741 | 26,370,930 | 50 | 278 | 410,707 | 14,504,012 | 28 | 857 | 709,404 | 25,052,384 | 48 | 264 | 390,172 | 13,778,811 | 26 |
| 1989 | 1,132 | 936,869 | 33,085,241 | 63 | 349 | 515,278 | 18,196,882 | 35 | 1,076 | 890,025 | 31,430,978 | 60 | 331 | 489,514 | 17,287,038 | 33 |
| 1990 | 1,374 | 1,136,901 | 40,149,313 | 76 | 423 | 625,295 | 22,082,122 | 42 | 1,305 | 1,080,056 | 38,141,847 | 73 | 402 | 594,031 | 20,978,016 | 40 |
| 1991 | 1,677 | 1,387,656 | 49,004,648 | 93 | 517 | 763,211 | 26,952,556 | 51 | 1,593 | 1,318,273 | 46,554,415 | 89 | 491 | 725,050 | 25,604,928 | 49 |
| 1992 | 1,994 | 1,650,116 | 58,273,335 | 111 | 615 | 907,564 | 32,050,334 | 61 | 1,894 | 1,567,610 | 55,359,668 | 105 | 584 | 862,185 | 30,447,818 | 58 |
| 1993 | 2,326 | 1,925,066 | 67,983,130 | 129 | 717 | 1,058,786 | 37,390,721 | 71 | 2,210 | 1,828,813 | 64,583,973 | 123 | 681 | 1,005,847 | 35,521,185 | 68 |
| 1994 | 2,676 | 2,214,124 | 78,191,116 | 149 | 825 | 1,217,768 | 43,005,114 | 82 | 2,542 | 2,103,418 | 74,281,560 | 141 | 783 | 1,156,880 | 40,854,858 | 78 |
| 1995 | 3,144 | 2,601,561 | 91,873,352 | 175 | 969 | 1,430,859 | 50,530,344 | 96 | 2,987 | 2,471,483 | 87,279,685 | 166 | 920 | 1,359,316 | 48,003,827 | 91 |
| 1996 | 3,629 | 3,002,714 | 106,039,952 | 202 | 1,118 | 1,651,493 | 58,321,973 | 111 | 3,447 | 2,852,579 | 100,737,954 | 192 | 1,062 | 1,568,918 | 55,405,875 | 105 |
| 1997 | 4,134 | 3,420,999 | 120,811,551 | 230 | 1,274 | 1,881,549 | 66,446,353 | 126 | 3,927 | 3,249,949 | 114,770,973 | 218 | 1,210 | 1,787,472 | 63,124,035 | 120 |
| 1998 | 4,657 | 3,853,678 | 136,091,465 | 259 | 1,435 | 2,119,523 | 74,850,306 | 142 | 4,424 | 3,660,994 | 129,286,892 | 246 | 1,363 | 2,013,547 | 71,107,791 | 135 |
| 1999 | 5,179 | 4,285,531 | 151,342,238 | 288 | 1,596 | 2,357,042 | 83,238,231 | 158 | 4,920 | 4,071,254 | 143,775,126 | 274 | 1,516 | 2,239,190 | 79,076,319 | 150 |
| 2000 | 5,712 | 4,726,369 | 166,910,309 | 318 | 1,760 | 2,599,503 | 91,800,670 | 175 | 5,426 | 4,490,051 | 158,564,794 | 302 | 1,672 | 2,469,528 | 87,210,637 | 166 |
| 2001 | 6,276 | 5,193,179 | 183,395,573 | 349 | 1,934 | 2,856,249 | 100,867,565 | 192 | 5,962 | 4,933,520 | 174,225,794 | 331 | 1,837 | 2,713,436 | 95,824,187 | 182 |
| 2002 | 6,874 | 5,688,145 | 200,875,141 | 382 | 2,118 | 3,128,480 | 110,481,328 | 210 | 6,530 | 5,403,738 | 190,831,384 | 363 | 2,012 | 2,972,056 | 104,957,261 | 200 |
| 2003 | 7,489 | 6,197,595 | 218,866,202 | 416 | 2,308 | 3,408,677 | 120,376,411 | 229 | 7,115 | 5,887,715 | 207,922,892 | 396 | 2,193 | 3,238,243 | 114,357,590 | 218 |
| 2004 | 8,162 | 6,753,772 | 238,507,417 | 454 | 2,515 | 3,714,574 | 131,179,079 | 250 | 7,754 | 6,416,083 | 226,582,046 | 431 | 2,389 | 3,528,846 | 124,620,125 | 237 |
| 2005 | 8,861 | 7,332,746 | 258,953,741 | 493 | 2,731 | 4,033,011 | 142,424,558 | 271 | 8,418 | 6,966,109 | 246,006,054 | 468 | 2,594 | 3,831,360 | 135,303,330 | 257 |
| 2006 | 9,629 | 7,968,063 | 281,389,747 | 535 | 2,967 | 4,382,435 | 154,764,361 | 294 | 9,148 | 7,569,660 | 267,320,260 | 509 | 2,819 | 4,163,313 | 147,026,143 | 280 |
| 2007 | 10,539 | 8,721,494 | 307,996,946 | 586 | 3,248 | 4,796,822 | 169,398,320 | 322 | 10,013 | 8,285,419 | 292,597,099 | 557 | 3,086 | 4,556,981 | 160,928,404 | 306 |
| 2008 | 11,404 | 9,436,679 | 333,253,501 | 634 | 3,514 | 5,190,174 | 183,289,426 | 349 | 10,834 | 8,964,845 | 316,590,826 | 602 | 3,339 | 4,930,665 | 174,124,954 | 331 |
| 2009 | 12,164 | 10,065,699 | 355,467,130 | 676 | 3,749 | 5,536,134 | 195,506,921 | 372 | 11,556 | 9,562,414 | 337,693,773 | 642 | 3,561 | 5,259,328 | 185,731,575 | 353 |
| 2010 | 12,773 | 10,569,922 | 373,273,620 | 710 | 3,936 | 5,813,457 | 205,300,491 | 391 | 12,135 | 10,041,426 | 354,609,939 | 675 | 3,740 | 5,522,784 | 195,035,467 | 371 |
| 2011 | 13,384 | 11,075,699 | 391,134,971 | 744 | 4,125 | 6,091,634 | 215,124,234 | 409 | 12,715 | 10,521,914 | 371,578,223 | 707 | 3,919 | 5,787,052 | 204,368,023 | 389 |
| 2012 | 13,935 | 11,531,399 | 407,227,903 | 775 | 4,294 | 6,342,270 | 223,975,347 | 426 | 13,238 | 10,954,829 | 386,866,508 | 736 | 4,080 | 6,025,156 | 212,776,579 | 405 |
| 2013 | 14,518 | 12,013,943 | 424,268,788 | 807 | 4,474 | 6,607,669 | 233,347,834 | 444 | 13,792 | 11,413,246 | 403,055,349 | 767 | 4,250 | 6,277,285 | 221,680,442 | 422 |
| 2014 | 15,140 | 12,528,784 | 442,450,264 | 842 | 4,666 | 6,890,831 | 243,347,645 | 463 | 14,383 | 11,902,345 | 420,327,751 | 800 | 4,433 | 6,546,290 | 231,180,263 | 440 |
| 2015 | 15,863 | 13,126,596 | 463,561,791 | 882 | 4,889 | 7,219,628 | 254,958,985 | 485 | 15,070 | 12,470,266 | 440,383,702 | 838 | 4,644 | 6,858,646 | 242,211,036 | 461 |
| 2016 | 16,586 | 13,725,258 | 484,703,372 | 922 | 5,111 | 7,548,892 | 266,586,855 | 507 | 15,757 | 13,038,995 | 460,468,204 | 876 | 4,856 | 7,171,447 | 253,257,512 | 482 |
| 2017 | 17,311 | 14,324,945 | 505,881,132 | 962 | 5,335 | 7,878,720 | 278,234,623 | 529 | 16,445 | 13,608,698 | 480,587,076 | 914 | 5,068 | 7,484,784 | 264,322,892 | 503 |
| 2018 | 18,037 | 14,925,829 | 527,101,178 | 1,003 | 5,559 | 8,209,206 | 289,905,648 | 552 | 17,135 | 14,179,538 | 500,746,119 | 953 | 5,281 | 7,798,746 | 275,410,365 | 524 |
| 2019 | 18,765 | 15,528,083 | 548,369,596 | 1,043 | 5,783 | 8,540,446 | 301,603,278 | 574 | 17,827 | 14,751,679 | 520,951,116 | 991 | 5,494 | 8,113,423 | 286,523,114 | 545 |
| 2020 | 19,495 | 16,131,879 | 569,692,456 | 1,084 | 6,008 | 8,872,533 | 313,330,851 | 596 | 18,520 | 15,325,285 | 541,207,834 | 1,030 | 5,707 | 8,428,907 | 297,664,308 | 566 |
| 2021 | 20,226 | 16,737,387 | 591,075,816 | 1,125 | 6,233 | 9,205,563 | 325,091,699 | 619 | 19,215 | 15,900,518 | 561,522,025 | 1,068 | 5,922 | 8,745,285 | 308,837,114 | 588 |
| 2022 | 20,960 | 17,344,780 | 612,525,717 | 1,165 | 6,459 | 9,539,629 | 336,889,144 | 641 | 19,912 | 16,477,541 | 581,899,431 | 1,107 | 6,136 | 9,062,648 | 320,044,687 | 609 |
| 2023 | 21,697 | 17,954,228 | 634,048,191 | 1,206 | 6,686 | 9,874,826 | 348,726,505 | 663 | 20,612 | 17,056,517 | 602,345,781 | 1,146 | 6,352 | 9,381,084 | 331,290,180 | 630 |
| 2024 | 22,436 | 18,565,902 | 655,649,261 | 1,247 | 6,914 | 10,211,246 | 360,607,094 | 686 | 21,314 | 17,637,607 | 622,866,798 | 1,185 | 6,569 | 9,700,684 | 342,576,739 | 652 |
| 2025 | 23,178 | 19,179,972 | 677,334,942 | 1,289 | 7,143 | 10,548,984 | 372,534,218 | 709 | 22,019 | 18,220,973 | 643,468,195 | 1,224 | 6,786 | 10,021,535 | 353,907,507 | 673 |
| 2026 | 23,923 | 19,796,607 | 699,111,244 | 1,330 | 7,373 | 10,888,134 | 384,511,184 | 732 | 22,727 | 18,806,777 | 664,155,682 | 1,264 | 7,004 | 10,343,727 | 365,285,625 | 695 |
| 2027 | 24,672 | 20,415,979 | 720,984,173 | 1,372 | 7,603 | 11,228,788 | 396,541,295 | 754 | 23,438 | 19,395,180 | 684,934,965 | 1,303 | 7,223 | 10,667,349 | 376,714,231 | 717 |
| 2028 | 25,424 | 21,038,257 | 742,959,733 | 1,414 | 7,835 | 11,571,041 | 408,627,853 | 777 | 24,152 | 19,986,344 | 705,811,746 | 1,343 | 7,443 | 10,992,489 | 388,196,461 | 739 |
| 2029 | 26,179 | 21,663,611 | 765,043,928 | 1,456 | 8,068 | 11,914,986 | 420,774,160 | 801 | 24,870 | 20,580,431 | 726,791,731 | 1,383 | 7,664 | 11,319,237 | 399,735,452 | 761 |
| 2030 | 26,939 | 22,292,212 | 787,242,763 | 1,498 | 8,302 | 12,260,716 | 432,983,519 | 824 | 25,592 | 21,177,601 | 747,880,624 | 1,423 | 7,887 | 11,647,681 | 411,334,343 | 783 |
| 2031 | 27,703 | 22,924,228 | 809,562,247 | 1,540 | 8,537 | 12,608,326 | 445,259,236 | 847 | 26,318 | 21,778,017 | 769,084,135 | 1,463 | 8,110 | 11,977,909 | 422,996,274 | 805 |
| 2032 | 28,471 | 23,559,832 | 832,008,395 | 1,583 | 8,774 | 12,957,908 | 457,604,617 | 871 | 27,047 | 22,381,840 | 790,407,975 | 1,504 | 8,335 | 12,310,012 | 434,724,386 | 827 |
| 2033 | 29,243 | 24,199,193 | 854,587,228 | 1,626 | 9,012 | 13,309,556 | 470,022,975 | 894 | 27,781 | 22,989,233 | 811,857,866 | 1,545 | 8,562 | 12,644,078 | 446,521,827 | 850 |
| 2034 | 30,021 | 24,842,481 | 877,304,775 | 1,669 | 9,252 | 13,663,365 | 482,517,626 | 918 | 28,520 | 23,600,357 | 833,439,537 | 1,586 | 8,789 | 12,980,196 | 458,391,745 | 872 |
| 2035 | 30,803 | 25,489,869 | 900,167,078 | 1,713 | 9,493 | 14,019,428 | 495,091,893 | 942 | 29,263 | 24,215,376 | 855,158,724 | 1,627 | 9,018 | 13,318,457 | 470,337,298 | 895 |
| 2036 | 31,591 | 26,141,527 | 923,180,188 | 1,756 | 9,735 | 14,377,840 | 507,749,103 | 966 | 30,011 | 24,834,451 | 877,021,179 | 1,669 | 9,249 | 13,658,948 | 482,361,648 | 918 |
| 2037 | 32,384 | 26,797,627 | 946,350,172 | 1,801 | 9,980 | 14,738,695 | 520,492,595 | 990 | 30,764 | 25,457,746 | 899,032,664 | 1,710 | 9,481 | 14,001,760 | 494,467,965 | 941 |
| 2038 | 33,182 | 27,458,342 | 969,683,113 | 1,845 | 10,226 | 15,102,088 | 533,325,712 | 1,015 | 31,523 | 26,085,425 | 921,198,957 | 1,753 | 9,715 | 14,346,984 | 506,659,426 | 964 |
| 2039 | 33,986 | 28,123,844 | 993,185,109 | 1,890 | 10,474 | 15,468,114 | 546,251,810 | 1,039 | 32,287 | 26,717,652 | 943,525,854 | 1,795 | 9,950 | 14,694,708 | 518,939,219 | 987 |
| 2040 | 34,796 | 28,794,306 | 1,016,862,280 | 1,935 | 10,723 | 15,836,868 | 559,274,254 | 1,064 | 33,057 | 27,354,591 | 966,019,166 | 1,838 | 10,187 | 15,045,025 | 531,310,541 | 1,011 |
| 2041 | 35,613 | 29,469,902 | 1,040,720,764 | 1,980 | 10,975 | 16,208,446 | 572,396,420 | 1,089 | 33,832 | 27,996,407 | 988,684,726 | 1,881 | 10,426 | 15,398,024 | 543,776,599 | 1,035 |
| 2042 | 36,413 | 30,132,121 | 1,064,106,819 | 2,025 | 11,222 | 16,572,667 | 585,258,750 | 1,114 | 34,592 | 28,625,515 | 1,010,901,478 | 1,923 | 10,661 | 15,744,033 | 555,995,813 | 1,058 |
| 2043 | 37,198 | 30,781,227 | 1,087,029,799 | 2,068 | 11,463 | 16,929,675 | 597,866,389 | 1,137 | 35,338 | 29,242,166 | 1,032,678,309 | 1,965 | 10,890 | 16,083,191 | 567,973,070 | 1,081 |
| 2044 | 37,966 | 31,417,480 | 1,109,498,874 | 2,111 | 11,700 | 17,279,614 | 610,224,380 | 1,161 | 36,068 | 29,846,606 | 1,054,023,930 | 2,005 | 11,115 | 16,415,633 | 579,713,161 | 1,103 |
| 2045 | 38,720 | 32,041,134 | 1,131,523,031 | 2,153 | 11,933 | 17,622,624 | 622,337,667 | 1,184 | 36,784 | 30,439,077 | 1,074,946,879 | 2,045 | 11,336 | 16,741,492 | 591,220,784 | 1,125 |
| 2046 | 39,459 | 32,652,439 | 1,153,111,080 | 2,194 | 12,160 | 17,958,841 | 634,211,094 | 1,207 | 37,486 | 31,019,817 | 1,095,455,526 | 2,084 | 11,552 | 17,060,899 | 602,500,539 | 1,146 |
| 2047 | 40,183 | 33,251,639 | 1,174,271,658 | 2,234 | 12,383 | 18,288,401 | 645,849,412 | 1,229 | 38,174 | 31,589,057 | 1,115,558,075 | 2,122 | 11,764 | 17,373,981 | 613,556,941 | 1,167 |
| 2048 | 40,893 | 33,838,974 | 1,195,013,228 | 2,274 | 12,602 | 18,611,436 | 657,257,275 | 1,250 | 38,848 | 32,147,026 | 1,135,262,566 | 2,160 | 11,972 | 17,680,864 | 624,394,412 | 1,188 |
| 2049 | 41,588 | 34,414,680 | 1,215,344,087 | 2,312 | 12,817 | 18,928,074 | 668,439,248 | 1,272 | 39,509 | 32,693,946 | 1,154,576,883 | 2,197 | 12,176 | 17,981,670 | 635,017,286 | 1,208 |
| 2050 | 42,270 | 34,978,985 | 1,235,272,369 | 2,350 | 13,027 | 19,238,442 | 679,399,803 | 1,293 | 40,157 | 33,230,036 | 1,173,508,750 | 2,233 | 12,375 | 18,276,520 | 645,429,813 | 1,228 |

# APPENDIX 4-F
# ESTIMATED METHANE GENERATION RATES BASED ON CARB WITH BIOSOLIDS, 2015

Pickles Butte Sanitary Landfill Assumed Waste Composition with Additional Organics

| | | | Compostion |
|---|---|---|---|
| | | Type of Waste | % by wt |
| 1 | | Dry Recoverable Fiber | 17.60% |
| 2 | | PET UBC's | 0.60% |
| 3 | | HDPE | 0.80% |
| 4 | | Film Plastics | 3.30% |
| 5 | | Mixed plastics | 3.40% |
| 6 | | Glass | 0.90% |
| 7 | | Aluminum UBC's | 0.20% |
| 8 | | Mixed Ferrous (Tin & Salvage) | 1.70% |
| 9 | | Mixed Non-Ferrous (Salvage) | 0.10% |
| 10 | | Inerts | 2.30% |
| 11 | | Hazardous Waste | 0.30% |
| 12 | | E-Waste | 1.00% |
| 13 | | Textiles | 7.00% |
| 14 | | Organics | 55.00% |
| | a | Yard Waste | 8.20% |
| | b | Food Waste | 19.10% |
| | c | Clean Wood | 3.40% |
| | d | Treated/Painted Wood | 3.30% |
| | e | Wet/Contaminated Fiber | 6.10% |
| | f | Rubber | 0.90% |
| | g | Allocated Organics | 14.00% |
| 15 | | Fines (<2" Items) | 1.30% |
| 16 | | Other | 4.50% |
| | | Total | 100.00% |
| | | Calculated | |
| | | Methane Correction Factor (MCF) | 1 |
| | | Degradable Organic Carbon (DOC) | 0.234952 |
| | | Fraction of DOC Dissimilated ($DOC_F$) | 0.494031 |

| Key | |
|---|---|
| Required User Input | |

| | | Year | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion |
| | | Type of Waste | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt |
| 1 | | Dry Recoverable Fiber | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% |
| 2 | | PET UBC's | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% |
| 3 | | HDPE | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% |
| 4 | | Film Plastics | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% |
| 5 | | Mixed plastics | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% |
| 6 | | Glass | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% |
| 7 | | Aluminum UBC's | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% |
| 8 | | Mixed Ferrous (Tin & Salvage) | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% |
| 9 | | Mixed Non-Ferrous (Salvage) | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% |
| 10 | | Inerts | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% |
| 11 | | Hazardous Waste | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% |
| 12 | | E-Waste | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% |
| 13 | | Textiles | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% |
| 14 | | Organics | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% |
| | a | Yard Waste | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% |
| | b | Food Waste | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% |
| | c | Clean Wood | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% |
| | d | Treated/Painted Wood | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% |
| | e | Wet/Contaminated Fiber | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% |
| | f | Rubber | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% |
| | g | Allocated Organics | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% |
| 15 | | Fines (<2" Items) | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% |
| 16 | | Other | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% |
| | | Total | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% |

| Calculated | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Methane Correction Factor (MCF) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Degradable Organic Carbon (DOC) | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 |
| Fraction of DOC Dissimilated ($DOC_F$) | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 |

| 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion |
| % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt |
| 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% |
| 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% |
| 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% |
| 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% | 5.30% |
| 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% |
| 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% |
| 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% |
| 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% |
| 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% |
| 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% | 7.30% |
| 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% |
| 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% |
| 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% |
| 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% | 43.00% |
| 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% |
| 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% |
| 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% |
| 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% |
| 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% |
| 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% |
| 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% |
| 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% |
| 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% |
| 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 | 0.187952 |
| 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 |

| 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion |
| % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt |
| 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% |
| 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% |
| 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% |
| 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% |
| 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% |
| 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% |
| 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% |
| 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% |
| 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% |
| 2.30% | 2.30% | 2.30% | 2.30% | 2.30% | 2.30% | 2.30% | 2.30% | 2.30% | 2.30% | 2.30% | 2.30% | 2.30% | 2.30% | 2.30% | 2.30% | 2.30% | 2.30% |
| 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% |
| 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% |
| 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% |
| 55.00% | 55.00% | 55.00% | 55.00% | 55.00% | 55.00% | 55.00% | 55.00% | 55.00% | 55.00% | 55.00% | 55.00% | 55.00% | 55.00% | 55.00% | 55.00% | 55.00% | 55.00% |
| 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% |
| 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% |
| 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% |
| 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% |
| 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% |
| 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% |
| 14.00% | 14.00% | 14.00% | 14.00% | 14.00% | 14.00% | 14.00% | 14.00% | 14.00% | 14.00% | 14.00% | 14.00% | 14.00% | 14.00% | 14.00% | 14.00% | 14.00% | 14.00% |
| 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% |
| 4.50% | 4.50% | 4.50% | 4.50% | 4.50% | 4.50% | 4.50% | 4.50% | 4.50% | 4.50% | 4.50% | 4.50% | 4.50% | 4.50% | 4.50% | 4.50% | 4.50% | 4.50% |
| 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% |

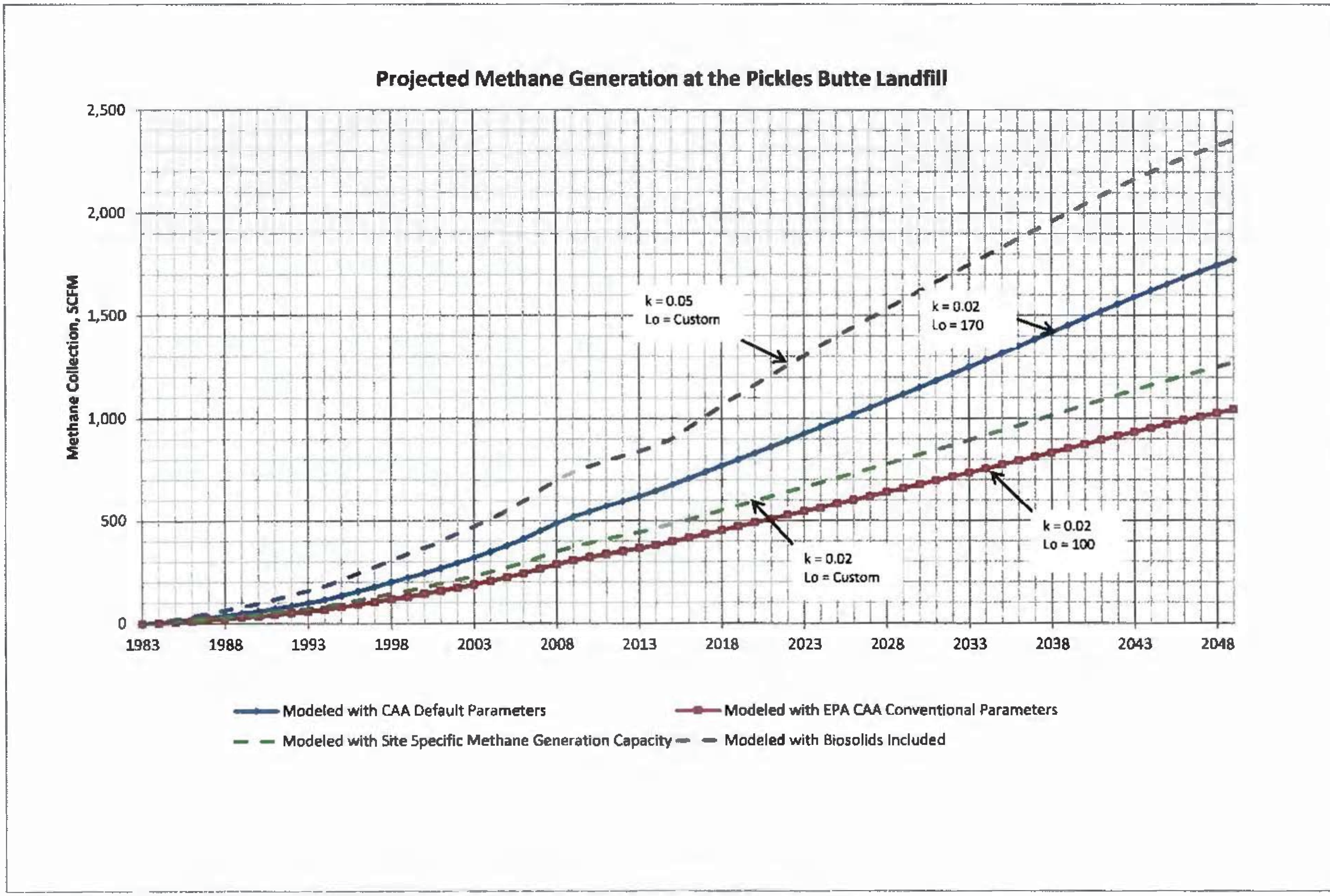
| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 |
| 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 |

| 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion | Compostion |
| % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt | % by wt |
| 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% | 17.60% |
| 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% | 0.60% |
| 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% | 0.80% |
| 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% |
| 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% |
| 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% |
| 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% |
| 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% | 1.70% |
| 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% |
| 2.30% | 2.30% | 2.30% | 2.30% | 2.30% | 2.30% | 2.30% | 2.30% | 2.30% | 2.30% | 2.30% | 2.30% | 2.30% | 2.30% | 2.30% | 2.30% | 2.30% |
| 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% | 0.30% |
| 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% |
| 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% | 7.00% |
| 55.00% | 55.00% | 55.00% | 55.00% | 55.00% | 55.00% | 55.00% | 55.00% | 55.00% | 55.00% | 55.00% | 55.00% | 55.00% | 55.00% | 55.00% | 55.00% | 55.00% |
| 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% | 8.20% |
| 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% | 19.10% |
| 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% | 3.40% |
| 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% | 3.30% |
| 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% | 6.10% |
| 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% | 0.90% |
| 14.00% | 14.00% | 14.00% | 14.00% | 14.00% | 14.00% | 14.00% | 14.00% | 14.00% | 14.00% | 14.00% | 14.00% | 14.00% | 14.00% | 14.00% | 14.00% | 14.00% |
| 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% | 1.30% |
| 4.50% | 4.50% | 4.50% | 4.50% | 4.50% | 4.50% | 4.50% | 4.50% | 4.50% | 4.50% | 4.50% | 4.50% | 4.50% | 4.50% | 4.50% | 4.50% | 4.50% |
| 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% |

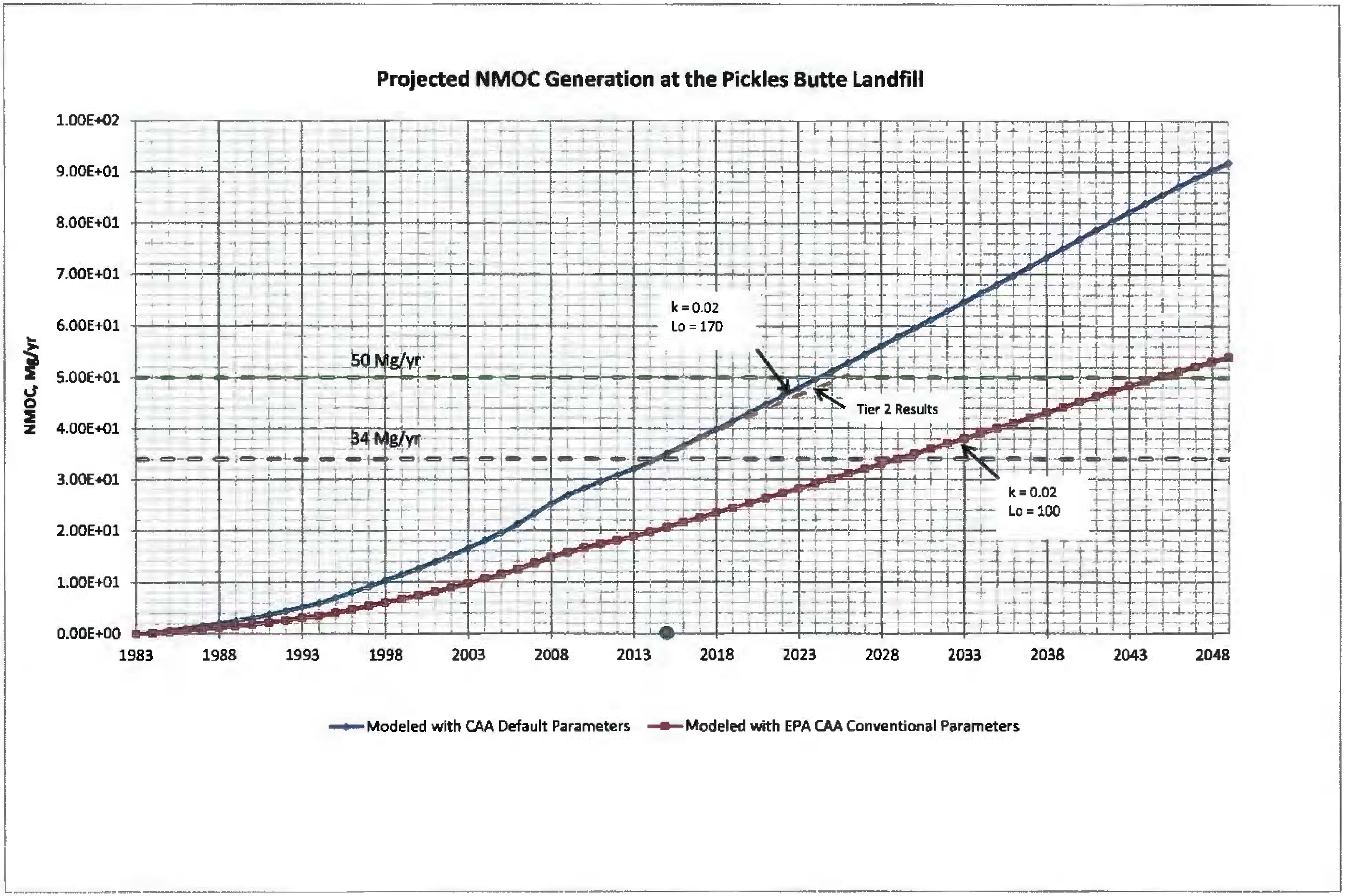
| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 | 0.234952 |
| 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 | 0.494031 |

| Year | Generated Landfill Gas | | | | | | | | Collected Landfill Gas | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Landfill Gas | | | | Methane | | | | Total Landfill Gas | | | | Methane | | | |
| | Mg/year | $m^3$/year | $ft^3$/year | ave scfm | Mg/year | $m^3$/year | $ft^3$/year | ave scfm | Mg/year | $m^3$/year | $ft^3$/year | ave scfm | Mg/year | $m^3$/year | $ft^3$/year | ave scfm |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 219 | 181,632 | 6,414,286 | 12 | 68 | 99,898 | 3,527,858 | 7 | 209 | 172,551 | 6,093,572 | 12 | 64 | 94,903 | 3,351,465 | 6 |
| 1985 | 678 | 561,074 | 19,814,173 | 38 | 209 | 308,591 | 10,897,795 | 21 | 644 | 533,021 | 18,823,465 | 36 | 199 | 293,161 | 10,352,906 | 20 |
| 1986 | 1,146 | 948,580 | 33,498,835 | 64 | 353 | 521,719 | 18,424,359 | 35 | 1,089 | 901,151 | 31,823,893 | 61 | 336 | 495,633 | 17,503,141 | 33 |
| 1987 | 1,626 | 1,345,379 | 47,511,660 | 90 | 501 | 739,959 | 26,131,413 | 50 | 1,545 | 1,278,110 | 45,136,077 | 86 | 476 | 702,961 | 24,824,842 | 47 |
| 1988 | 2,118 | 1,752,737 | 61,897,390 | 118 | 653 | 964,005 | 34,043,565 | 65 | 2,012 | 1,665,100 | 58,802,521 | 112 | 620 | 915,805 | 32,341,386 | 62 |
| 1989 | 2,625 | 2,171,958 | 76,702,060 | 146 | 809 | 1,194,577 | 42,186,133 | 80 | 2,493 | 2,063,360 | 72,866,957 | 139 | 768 | 1,134,848 | 40,076,826 | 76 |
| 1990 | 3,147 | 2,604,400 | 91,973,620 | 175 | 970 | 1,432,420 | 50,585,491 | 96 | 2,990 | 2,474,180 | 87,374,939 | 166 | 921 | 1,360,799 | 48,056,216 | 91 |
| 1991 | 3,807 | 3,150,438 | 111,256,767 | 212 | 1,173 | 1,732,741 | 61,191,222 | 116 | 3,617 | 2,992,916 | 105,693,928 | 201 | 1,115 | 1,646,104 | 58,131,661 | 111 |
| 1992 | 4,484 | 3,710,903 | 131,049,429 | 249 | 1,382 | 2,040,997 | 72,077,186 | 137 | 4,260 | 3,525,358 | 124,496,958 | 237 | 1,313 | 1,938,947 | 68,473,327 | 130 |
| 1993 | 5,181 | 4,287,599 | 151,415,277 | 288 | 1,597 | 2,358,180 | 83,278,402 | 158 | 4,922 | 4,073,219 | 143,844,513 | 274 | 1,517 | 2,240,271 | 79,114,482 | 151 |
| 1994 | 5,902 | 4,884,325 | 172,488,465 | 328 | 1,819 | 2,686,379 | 94,868,656 | 180 | 5,607 | 4,640,109 | 163,864,041 | 312 | 1,728 | 2,552,060 | 90,125,223 | 171 |
| 1995 | 6,898 | 5,708,354 | 201,588,813 | 384 | 2,126 | 3,139,595 | 110,873,847 | 211 | 6,553 | 5,422,936 | 191,509,372 | 364 | 2,020 | 2,982,615 | 105,330,155 | 200 |
| 1996 | 7,909 | 6,544,872 | 231,130,196 | 440 | 2,437 | 3,599,680 | 127,121,608 | 242 | 7,514 | 6,217,629 | 219,573,686 | 418 | 2,316 | 3,419,696 | 120,765,527 | 230 |
| 1997 | 8,945 | 7,402,352 | 261,411,852 | 497 | 2,757 | 4,071,294 | 143,776,519 | 274 | 8,498 | 7,032,235 | 248,341,259 | 472 | 2,619 | 3,867,729 | 136,587,693 | 260 |
| 1998 | 9,999 | 8,273,865 | 292,189,053 | 556 | 3,081 | 4,550,626 | 160,703,979 | 306 | 9,499 | 7,860,172 | 277,579,600 | 528 | 2,927 | 4,323,094 | 152,668,780 | 290 |
| 1999 | 11,023 | 9,121,943 | 322,138,666 | 613 | 3,397 | 5,017,068 | 177,176,266 | 337 | 10,472 | 8,665,845 | 306,031,733 | 582 | 3,227 | 4,766,215 | 168,317,453 | 320 |
| 2000 | 12,050 | 9,971,851 | 352,152,913 | 670 | 3,714 | 5,484,518 | 193,684,102 | 369 | 11,448 | 9,473,258 | 334,545,267 | 637 | 3,528 | 5,210,292 | 183,999,897 | 350 |
| 2001 | 13,131 | 10,865,777 | 383,721,651 | 730 | 4,047 | 5,976,177 | 211,046,908 | 402 | 12,474 | 10,322,488 | 364,535,569 | 694 | 3,844 | 5,677,368 | 200,494,563 | 381 |
| 2002 | 14,270 | 11,808,219 | 417,003,729 | 793 | 4,398 | 6,494,521 | 229,352,051 | 436 | 13,556 | 11,217,809 | 396,153,542 | 754 | 4,178 | 6,169,795 | 217,884,448 | 415 |
| 2003 | 15,425 | 12,764,512 | 450,774,912 | 858 | 4,754 | 7,020,482 | 247,926,202 | 472 | 14,654 | 12,126,286 | 428,236,167 | 815 | 4,516 | 6,669,458 | 235,529,892 | 448 |
| 2004 | 16,694 | 13,814,100 | 487,840,813 | 928 | 5,145 | 7,597,755 | 268,312,447 | 510 | 15,859 | 13,123,395 | 463,448,772 | 882 | 4,887 | 7,217,867 | 254,896,825 | 485 |
| 2005 | 18,001 | 14,895,777 | 526,039,881 | 1,001 | 5,547 | 8,192,677 | 289,321,935 | 550 | 17,101 | 14,150,988 | 499,737,887 | 951 | 5,270 | 7,783,043 | 274,855,838 | 523 |
| 2006 | 19,446 | 16,091,704 | 568,273,715 | 1,081 | 5,993 | 8,850,437 | 312,550,543 | 595 | 18,474 | 15,287,119 | 539,860,029 | 1,027 | 5,693 | 8,407,916 | 296,923,016 | 565 |
| 2007 | 21,210 | 17,551,207 | 619,815,626 | 1,179 | 6,536 | 9,653,164 | 340,898,594 | 649 | 20,149 | 16,673,647 | 588,824,844 | 1,120 | 6,210 | 9,170,506 | 323,853,664 | 616 |
| 2008 | 22,818 | 18,882,075 | 666,814,827 | 1,269 | 7,032 | 10,385,141 | 366,748,155 | 698 | 21,677 | 17,937,972 | 633,474,086 | 1,205 | 6,680 | 9,865,884 | 348,410,747 | 663 |
| 2009 | 24,134 | 19,970,690 | 705,258,913 | 1,342 | 7,437 | 10,983,879 | 387,892,402 | 738 | 22,927 | 18,972,155 | 669,995,967 | 1,275 | 7,066 | 10,434,685 | 368,497,782 | 701 |
| 2010 | 25,051 | 20,729,517 | 732,056,669 | 1,393 | 7,720 | 11,401,234 | 402,631,168 | 766 | 23,798 | 19,693,041 | 695,453,835 | 1,323 | 7,334 | 10,831,173 | 382,499,609 | 728 |
| 2011 | 25,957 | 21,479,753 | 758,551,038 | 1,443 | 7,999 | 11,813,864 | 417,203,071 | 794 | 24,659 | 20,405,765 | 720,623,486 | 1,371 | 7,599 | 11,223,171 | 396,342,917 | 754 |
| 2012 | 26,700 | 22,094,730 | 780,268,761 | 1,485 | 8,228 | 12,152,101 | 429,147,819 | 816 | 25,365 | 20,989,993 | 741,255,323 | 1,410 | 7,817 | 11,544,496 | 407,690,428 | 776 |
| 2013 | 27,514 | 22,768,053 | 804,046,965 | 1,530 | 8,479 | 12,522,429 | 442,225,830 | 841 | 26,138 | 21,629,650 | 763,844,616 | 1,453 | 8,055 | 11,896,308 | 420,114,539 | 799 |
| 2014 | 28,413 | 23,511,621 | 830,305,854 | 1,580 | 8,756 | 12,931,392 | 456,668,220 | 869 | 26,992 | 22,336,040 | 788,790,561 | 1,501 | 8,318 | 12,284,822 | 433,834,809 | 825 |
| 2015 | 29,545 | 24,448,389 | 863,387,508 | 1,643 | 9,105 | 13,446,614 | 474,863,129 | 903 | 28,067 | 23,225,969 | 820,218,132 | 1,561 | 8,650 | 12,774,283 | 451,119,973 | 858 |
| 2016 | 31,298 | 25,899,529 | 914,634,108 | 1,740 | 9,645 | 14,244,741 | 503,048,760 | 957 | 29,733 | 24,604,553 | 868,902,403 | 1,653 | 9,163 | 13,532,504 | 477,896,322 | 909 |
| 2017 | 33,014 | 27,319,550 | 964,781,700 | 1,836 | 10,174 | 15,025,752 | 530,629,935 | 1,010 | 31,364 | 25,953,572 | 916,542,615 | 1,744 | 9,665 | 14,274,465 | 504,098,438 | 959 |
| 2018 | 34,695 | 28,710,562 | 1,013,904,887 | 1,929 | 10,692 | 15,790,809 | 557,647,688 | 1,061 | 32,960 | 27,275,034 | 963,209,643 | 1,833 | 10,158 | 15,001,269 | 529,765,304 | 1,008 |
| 2019 | 36,344 | 30,074,585 | 1,062,074,951 | 2,021 | 11,200 | 16,541,022 | 584,141,223 | 1,111 | 34,526 | 28,570,856 | 1,008,971,203 | 1,920 | 10,640 | 15,713,971 | 554,934,162 | 1,056 |
| 2020 | 37,962 | 31,413,548 | 1,109,360,014 | 2,111 | 11,699 | 17,277,451 | 610,148,008 | 1,161 | 36,064 | 29,842,870 | 1,053,892,013 | 2,005 | 11,114 | 16,413,579 | 579,640,607 | 1,103 |
| 2021 | 39,552 | 32,729,294 | 1,155,825,204 | 2,199 | 12,189 | 18,001,112 | 635,703,862 | 1,209 | 37,574 | 31,092,829 | 1,098,033,944 | 2,089 | 11,579 | 17,101,056 | 603,918,669 | 1,149 |
| 2022 | 41,116 | 34,023,588 | 1,201,532,799 | 2,286 | 12,671 | 18,712,973 | 660,843,040 | 1,257 | 39,060 | 32,322,408 | 1,141,456,159 | 2,172 | 12,037 | 17,777,325 | 627,800,888 | 1,194 |
| 2023 | 42,656 | 35,298,116 | 1,246,542,377 | 2,372 | 13,146 | 19,413,964 | 685,598,307 | 1,304 | 40,523 | 33,533,210 | 1,184,215,258 | 2,253 | 12,488 | 18,443,266 | 651,318,392 | 1,239 |
| 2024 | 44,174 | 36,554,493 | 1,290,910,947 | 2,456 | 13,613 | 20,104,971 | 710,001,021 | 1,351 | 41,966 | 34,726,768 | 1,226,365,400 | 2,333 | 12,933 | 19,099,722 | 674,500,970 | 1,283 |
| 2025 | 45,672 | 37,794,264 | 1,334,693,083 | 2,539 | 14,075 | 20,786,845 | 734,081,196 | 1,397 | 43,389 | 35,904,550 | 1,267,958,429 | 2,412 | 13,371 | 19,747,503 | 697,377,136 | 1,327 |
| 2026 | 47,152 | 39,018,909 | 1,377,941,049 | 2,622 | 14,531 | 21,460,400 | 757,867,577 | 1,442 | 44,795 | 37,067,963 | 1,309,043,997 | 2,491 | 13,806 | 20,387,380 | 719,974,198 | 1,370 |
| 2027 | 48,616 | 40,229,845 | 1,420,704,912 | 2,703 | 14,982 | 22,126,415 | 781,387,702 | 1,487 | 46,185 | 38,218,353 | 1,349,669,667 | 2,568 | 14,233 | 21,020,094 | 742,318,317 | 1,412 |
| 2028 | 50,064 | 41,428,432 | 1,463,032,660 | 2,784 | 15,429 | 22,785,638 | 804,667,963 | 1,531 | 47,561 | 39,357,011 | 1,389,881,027 | 2,644 | 14,657 | 21,646,356 | 764,434,565 | 1,454 |
| 2029 | 51,499 | 42,615,973 | 1,504,970,304 | 2,863 | 15,871 | 23,438,785 | 827,733,667 | 1,575 | 48,924 | 40,485,174 | 1,429,721,789 | 2,720 | 15,077 | 22,266,846 | 786,346,984 | 1,496 |
| 2030 | 52,922 | 43,793,717 | 1,546,561,984 | 2,942 | 16,309 | 24,086,544 | 850,609,091 | 1,618 | 50,276 | 41,604,031 | 1,469,233,885 | 2,795 | 15,494 | 22,882,217 | 808,078,637 | 1,537 |
| 2031 | 54,335 | 44,962,864 | 1,587,850,063 | 3,021 | 16,745 | 24,729,575 | 873,317,535 | 1,662 | 51,619 | 42,714,721 | 1,508,457,560 | 2,870 | 15,908 | 23,493,097 | 829,651,658 | 1,578 |
| 2032 | 55,739 | 46,124,566 | 1,628,875,221 | 3,099 | 17,177 | 25,368,511 | 895,881,372 | 1,704 | 52,952 | 43,818,338 | 1,547,431,460 | 2,944 | 16,319 | 24,100,086 | 851,087,303 | 1,619 |
| 2033 | 57,135 | 47,279,930 | 1,669,676,541 | 3,177 | 17,608 | 26,003,961 | 918,322,097 | 1,747 | 54,279 | 44,915,933 | 1,586,192,714 | 3,018 | 16,727 | 24,703,763 | 872,405,993 | 1,660 |
| 2034 | 58,525 | 48,430,019 | 1,710,291,594 | 3,254 | 18,036 | 26,636,510 | 940,660,377 | 1,790 | 55,599 | 46,008,518 | 1,624,777,015 | 3,091 | 17,134 | 25,304,685 | 893,627,358 | 1,700 |
| 2035 | 59,910 | 49,575,857 | 1,750,756,521 | 3,331 | 18,463 | 27,266,721 | 962,916,086 | 1,832 | 56,914 | 47,097,064 | 1,663,218,695 | 3,164 | 17,540 | 25,903,385 | 914,770,282 | 1,740 |
| 2036 | 61,291 | 50,718,429 | 1,791,106,101 | 3,408 | 18,888 | 27,895,136 | 985,108,356 | 1,874 | 58,226 | 48,182,507 | 1,701,550,796 | 3,237 | 17,944 | 26,500,379 | 935,852,938 | 1,781 |
| 2037 | 62,669 | 51,858,683 | 1,831,373,835 | 3,484 | 19,313 | 28,522,276 | 1,007,255,609 | 1,916 | 59,535 | 49,265,749 | 1,739,805,143 | 3,310 | 18,347 | 27,096,162 | 956,892,829 | 1,821 |
| 2038 | 64,045 | 52,997,534 | 1,871,592,003 | 3,561 | 19,737 | 29,148,644 | 1,029,375,601 | 1,958 | 60,843 | 50,347,657 | 1,778,012,402 | 3,383 | 18,750 | 27,691,211 | 977,906,821 | 1,861 |
| 2039 | 65,420 | 54,135,862 | 1,911,791,737 | 3,637 | 20,161 | 29,774,724 | 1,051,485,455 | 2,001 | 62,149 | 51,429,069 | 1,816,202,150 | 3,455 | 19,153 | 28,285,988 | 998,911,183 | 1,901 |
| 2040 | 66,796 | 55,274,520 | 1,952,003,083 | 3,714 | 20,585 | 30,400,986 | 1,073,601,696 | 2,043 | 63,457 | 52,510,794 | 1,854,402,929 | 3,528 | 19,556 | 28,880,937 | 1,019,921,611 | 1,940 |
| 2041 | 68,174 | 56,414,328 | 1,992,255,056 | 3,790 | 21,010 | 31,027,880 | 1,095,740,281 | 2,085 | 64,765 | 53,593,611 | 1,892,642,303 | 3,601 | 19,959 | 29,476,486 | 1,040,953,267 | 1,981 |
| 2042 | 69,484 | 57,498,546 | 2,030,543,917 | 3,863 | 21,413 | 31,624,201 | 1,116,799,155 | 2,125 | 66,010 | 54,623,619 | 1,929,016,721 | 3,670 | 20,343 | 30,042,991 | 1,060,959,197 | 2,019 |
| 2043 | 70,730 | 58,529,887 | 2,066,965,409 | 3,933 | 21,797 | 32,191,438 | 1,136,830,975 | 2,163 | 67,194 | 55,603,393 | 1,963,617,138 | 3,736 | 20,708 | 30,581,866 | 1,079,989,426 | 2,055 |
| 2044 | 71,916 | 59,510,929 | 2,101,610,603 | 3,998 | 22,163 | 32,731,011 | 1,155,885,832 | 2,199 | 68,320 | 56,535,383 | 1,996,530,073 | 3,799 | 21,055 | 31,094,460 | 1,098,091,540 | 2,089 |
| 2045 | 73,044 | 60,444,125 | 2,134,566,131 | 4,061 | 22,510 | 33,244,269 | 1,174,011,372 | 2,234 | 69,391 | 57,421,918 | 2,027,837,825 | 3,858 | 21,385 | 31,582,055 | 1,115,310,804 | 2,122 |
| 2046 | 74,116 | 61,331,808 | 2,165,914,400 | 4,121 | 22,841 | 33,732,494 | 1,191,252,920 | 2,266 | 70,411 | 58,265,218 | 2,057,618,680 | 3,915 | 21,699 | 32,045,870 | 1,131,690,274 | 2,153 |
| 2047 | 75,137 | 62,176,198 | 2,195,733,795 | 4,178 | 23,155 | 34,196,909 | 1,207,653,587 | 2,298 | 71,380 | 59,067,389 | 2,085,947,105 | 3,969 | 21,998 | 32,487,064 | 1,147,270,908 | 2,183 |
| 2048 | 76,107 | 62,979,407 | 2,224,098,881 | 4,232 | 23,454 | 34,638,674 | 1,223,254,384 | 2,327 | 72,302 | 59,830,437 | 2,112,893,937 | 4,020 | 22,282 | 32,906,740 | 1,162,091,665 | 2,211 |
| 2049 | 77,031 | 63,743,444 | 2,251,080,585 | 4,283 | 23,739 | 35,058,894 | 1,238,094,322 | 2,356 | 73,179 | 60,556,271 | 2,138,526,556 | 4,069 | 22,552 | 33,305,949 | 1,176,189,606 | 2,238 |
| 2050 | 77,909 | 64,470,217 | 2,276,746,377 | 4,332 | 24,010 | 35,458,619 | 1,252,210,507 | 2,382 | 74,013 | 61,246,706 | 2,162,909,058 | 4,115 | 22,809 | 33,685,688 | 1,189,599,982 | 2,263 |

# APPENDIX 4-G
# GAS GENERATION GRAPHS

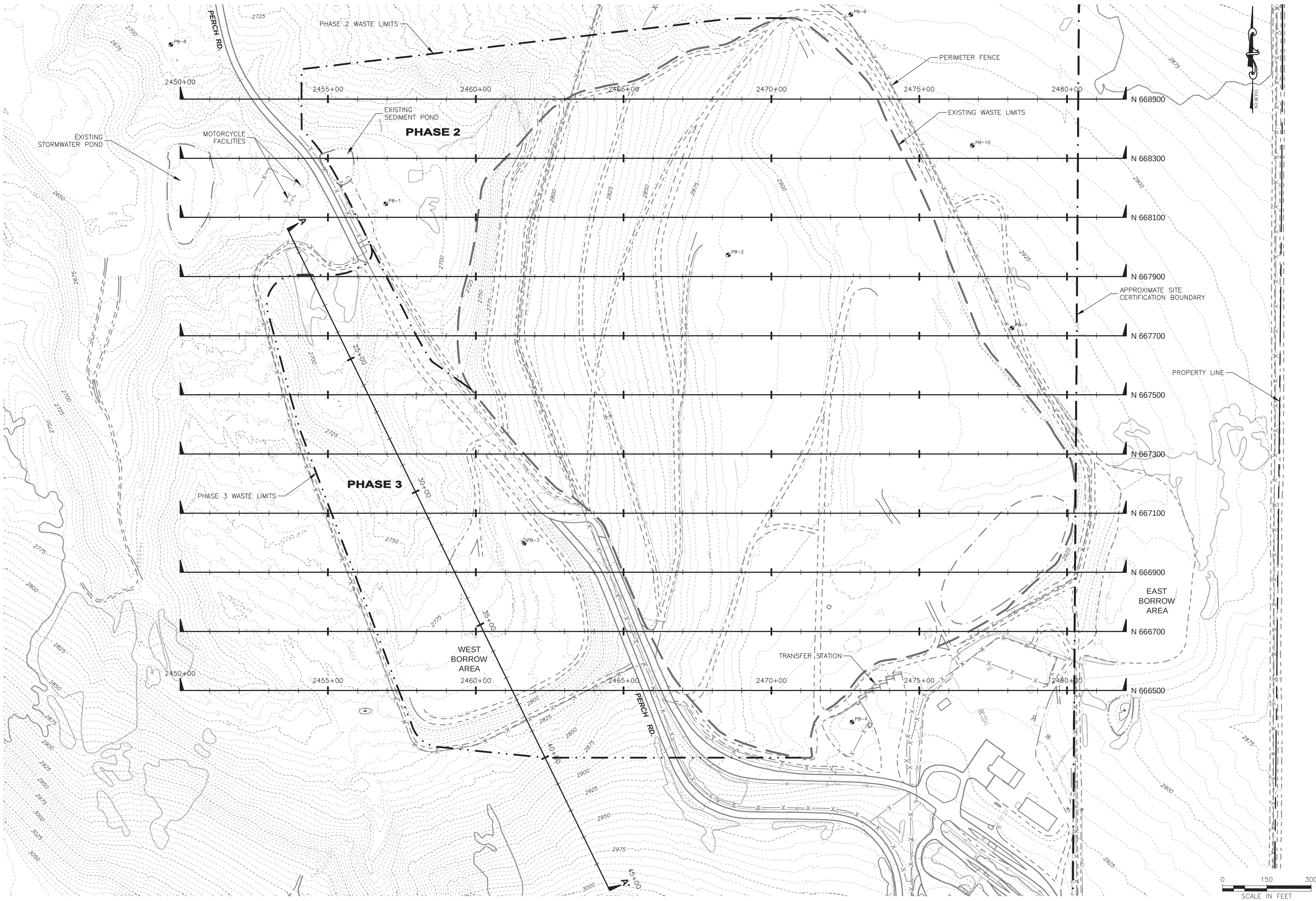



H:\Pickles Butte\Methane-Curves_Tt-BAS-May-2013_8_SR-85




H:\Pickles Butte\NMOC-Curves_Tt-BAS-May-2013_8_SR-85

# APPENDIX 6-A
# CONCEPTUAL FILL PLAN CROSS SECTIONS

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| MARK | DATE | DESCRIPTION | BY |
|---|---|---|---|
| | 9-14-2015 | EXHIBITS | |

# PICKLES BUTTE LANDFILL - CANYON COUNTY, ID

CONCEPTUAL FILL PLAN

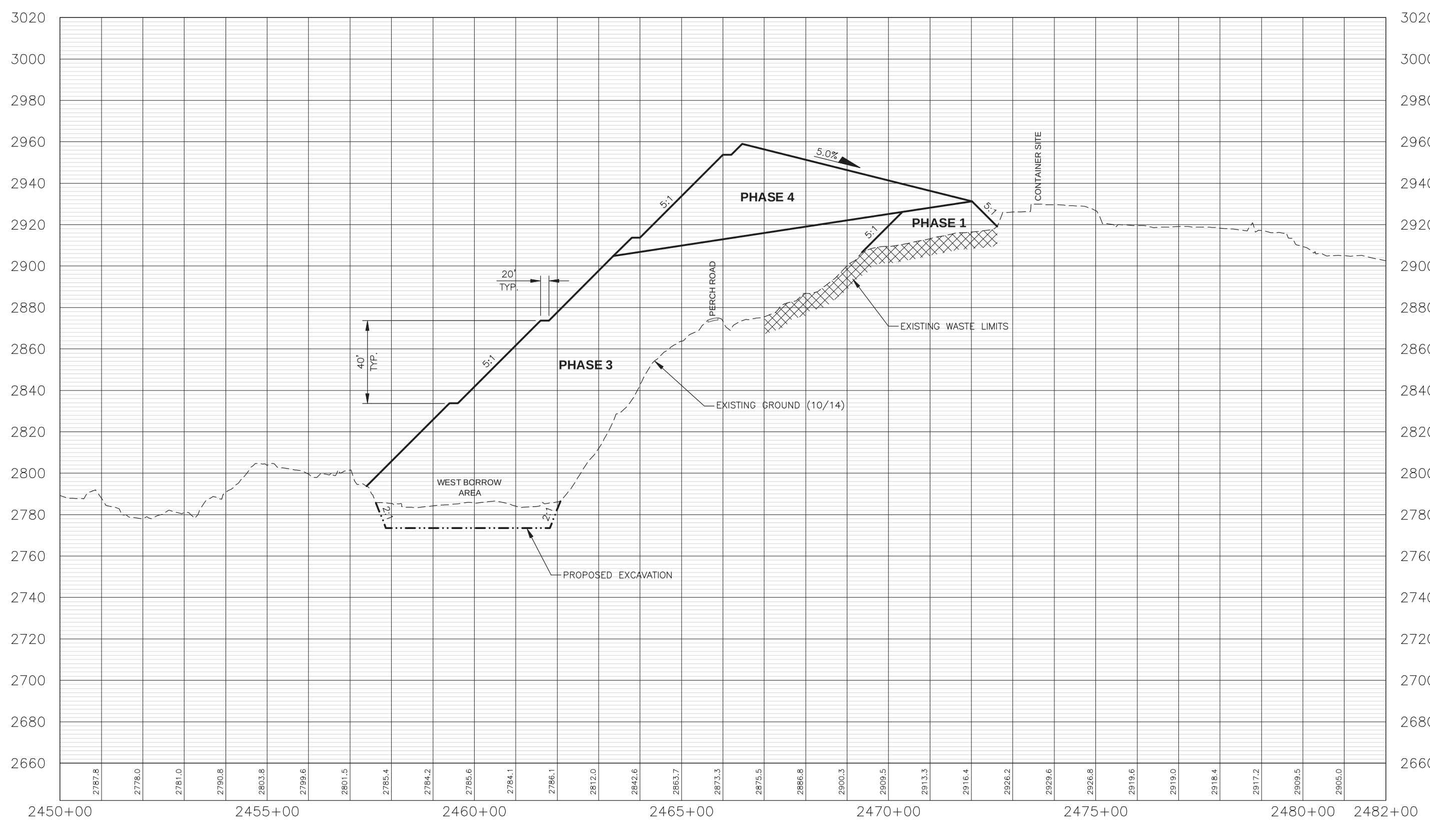
SITE PLAN

| | |
|---|---|
| Project No.: | 1-15170 |
| Designed By: | REC / BAA |
| Drawn By: | BAA |
| Checked By: | REC |

FIGURE NO.
1



9/14/2015 3:05:04 PM – F:\1-15170-PICKLES BUTTE LANDFILL\CADD 1-15170\EXHIBITS\CONCEPTUAL FILL PLAN\1-15170-CFP-FG01.DWG – BRET ANDERSON




**N 666500**

HORIZONTAL SCALE: 1" = 300'
VERTICAL SCALE: 1" = 60'

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PICKLES BUTTE LANDFILL - CANYON COUNTY, ID

CONCEPTUAL FILL PLAN

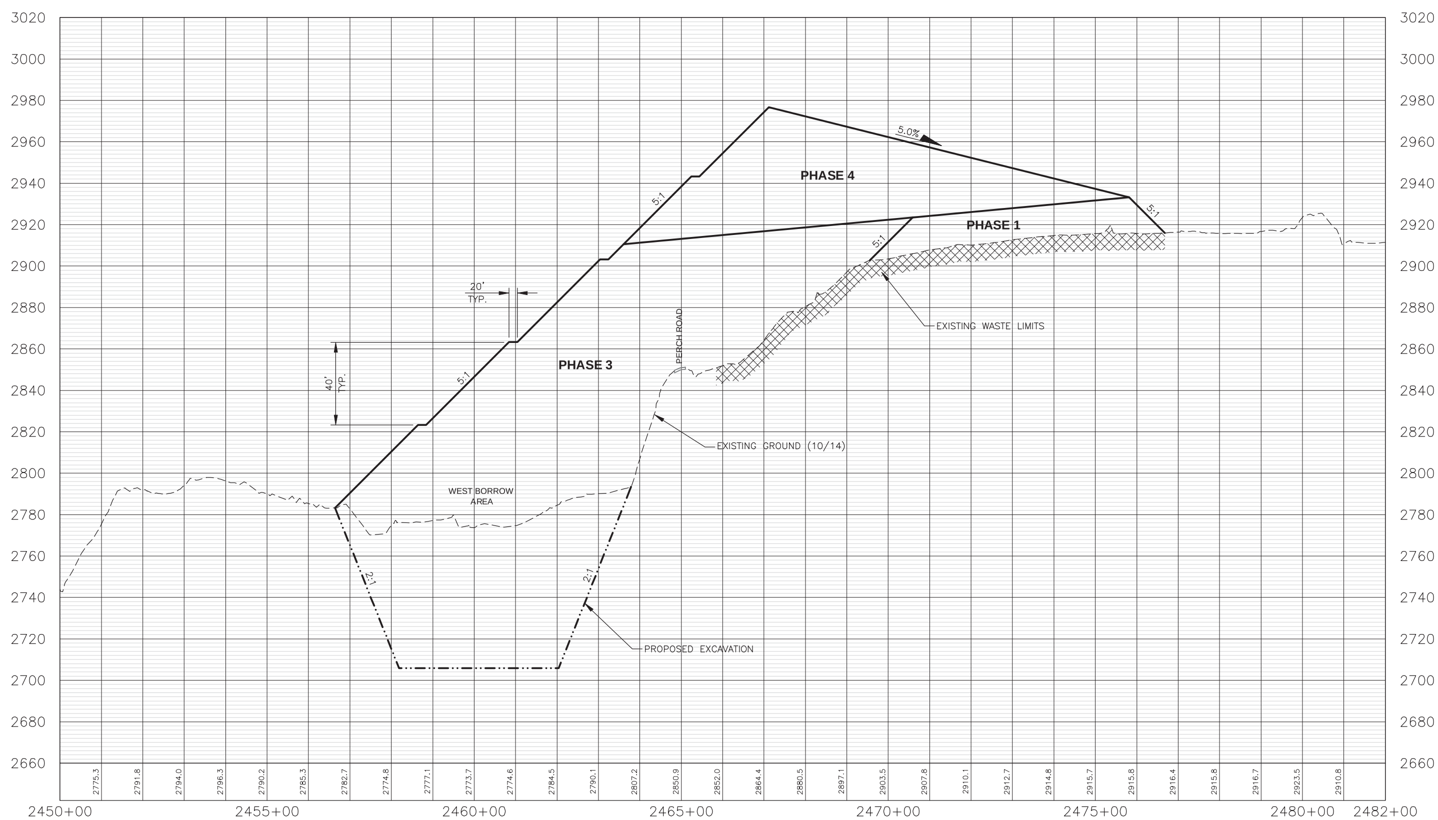
N 666500 SECTION

| | |
|---|---|
| Project No.: | 1-15170 |
| Designed By: | REC / BAA |
| Drawn By: | BAA |
| Checked By: | REC |

FIGURE NO.
**2**



9/14/2015 3:05:36 PM - F:\1-15170-PICKLES BUTTE LANDFILL\CADD 1-15170\EXHIBITS\CONCEPTUAL FILL PLAN\1-15170-CFP-FG02.DWG - BRET ANDERSON




**N 666700**

HORIZONTAL SCALE: 1" = 300'
VERTICAL SCALE: 1" = 60'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| MARK | DATE | DESCRIPTION | BY |
|---|---|---|---|
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PICKLES BUTTE LANDFILL - CANYON COUNTY, ID

CONCEPTUAL FILL PLAN

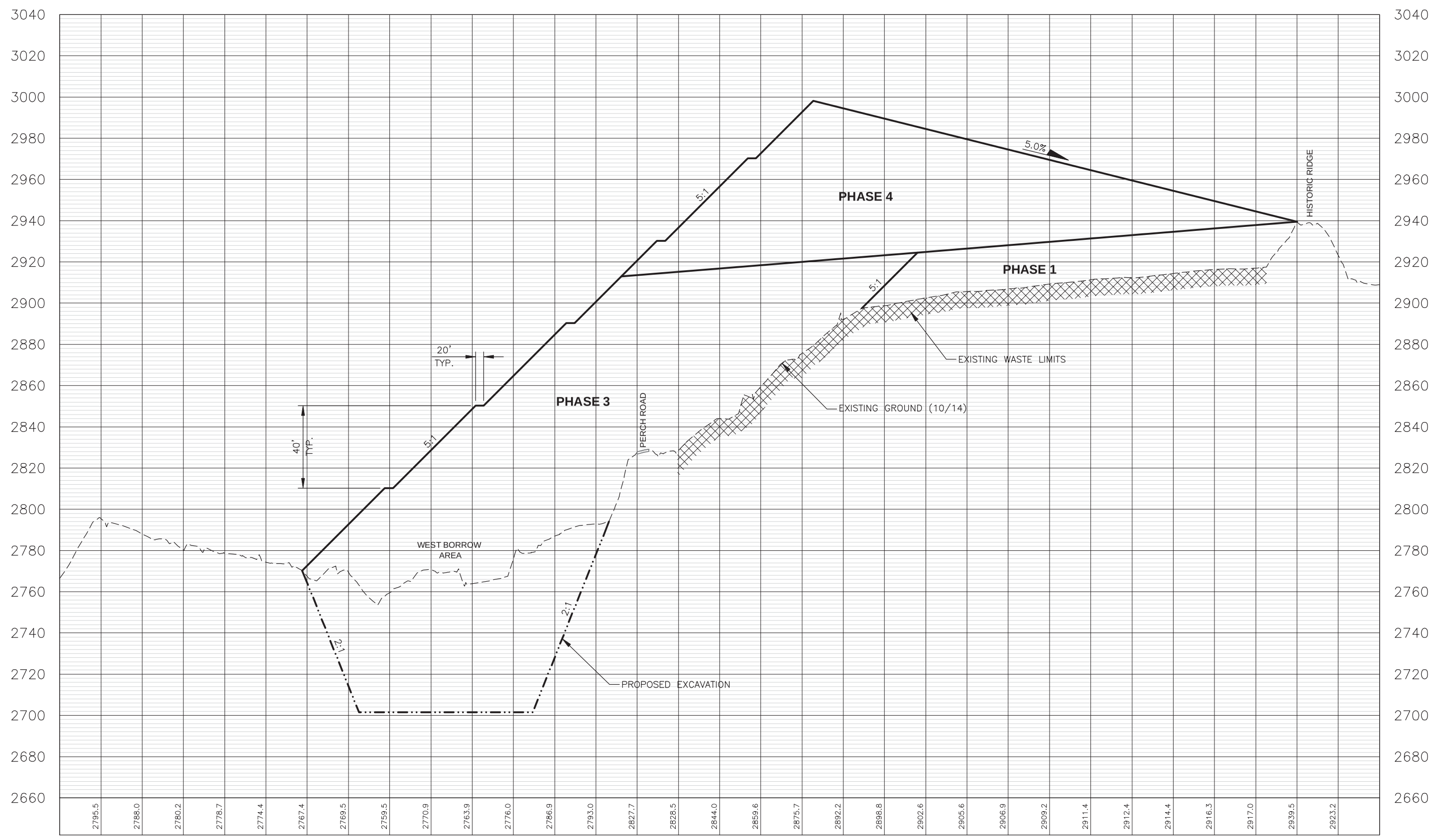
N 666700 SECTION

| | |
|---|---|
| Project No.: | 1-15170 |
| Designed By: | REC / BAA |
| Drawn By: | BAA |
| Checked By: | REC |

FIGURE NO.
**3**



9/14/2015 3:06:11 PM - F:\1-15170-PICKLES BUTTE LANDFILL\CADD 1-15170\EXHIBITS\CONCEPTUAL FILL PLAN\1-15170-CFP-FG03.DWG - BRET ANDERSON




**N 666900**

HORIZONTAL SCALE: 1" = 300'
VERTICAL SCALE: 1" = 60'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|---|---|---|---|
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PICKLES BUTTE LANDFILL - CANYON COUNTY, ID

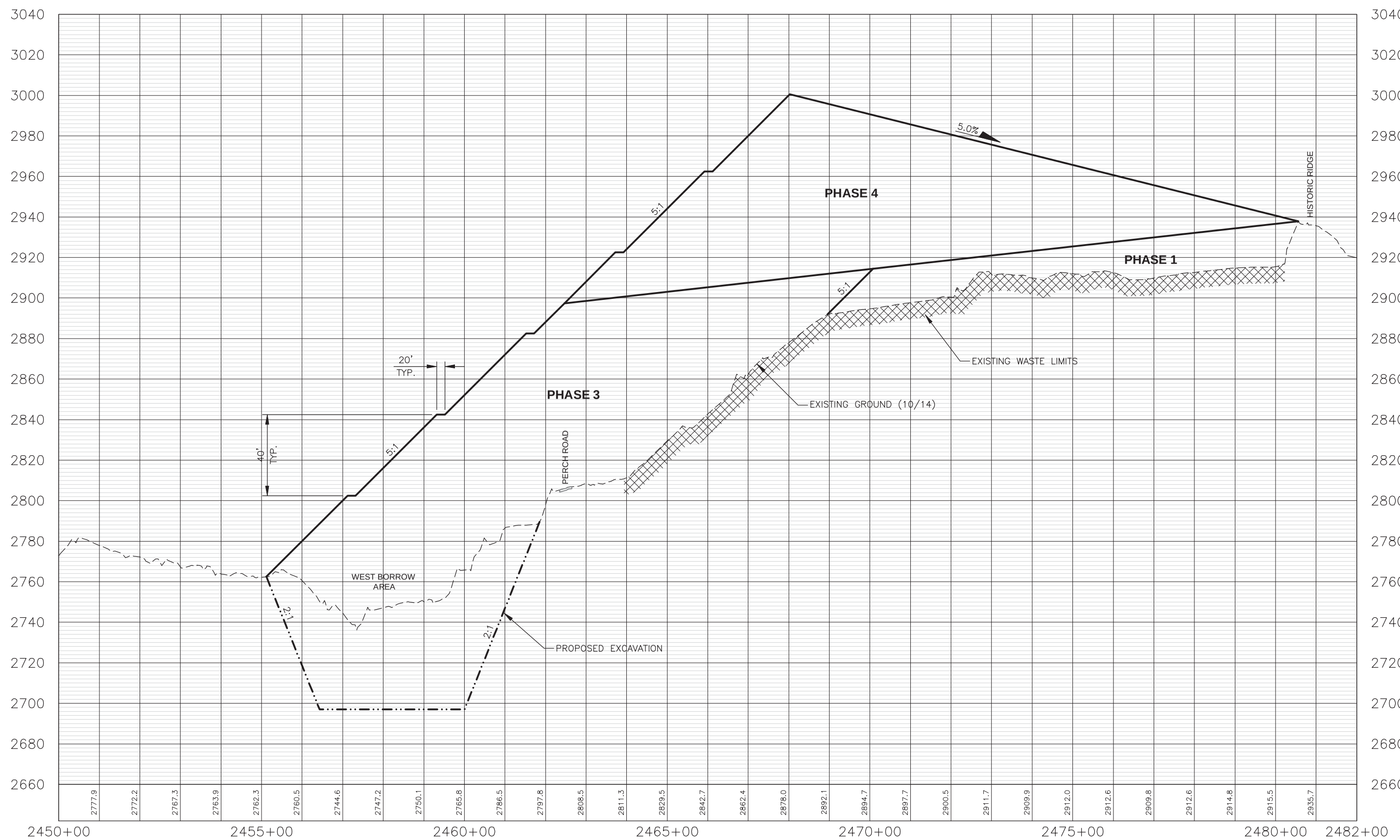
CONCEPTUAL FILL PLAN

N 666900 SECTION

| | |
|---|---|
| Project No.: | 1-15170 |
| Designed By: | REC / BAA |
| Drawn By: | BAA |
| Checked By: | REC |

FIGURE NO.

4




## N 667100

HORIZONTAL SCALE: 1" = 300'
VERTICAL SCALE: 1" = 60'

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|---|---|---|---|
| 9-14-2015 | | EXHIBITS | |

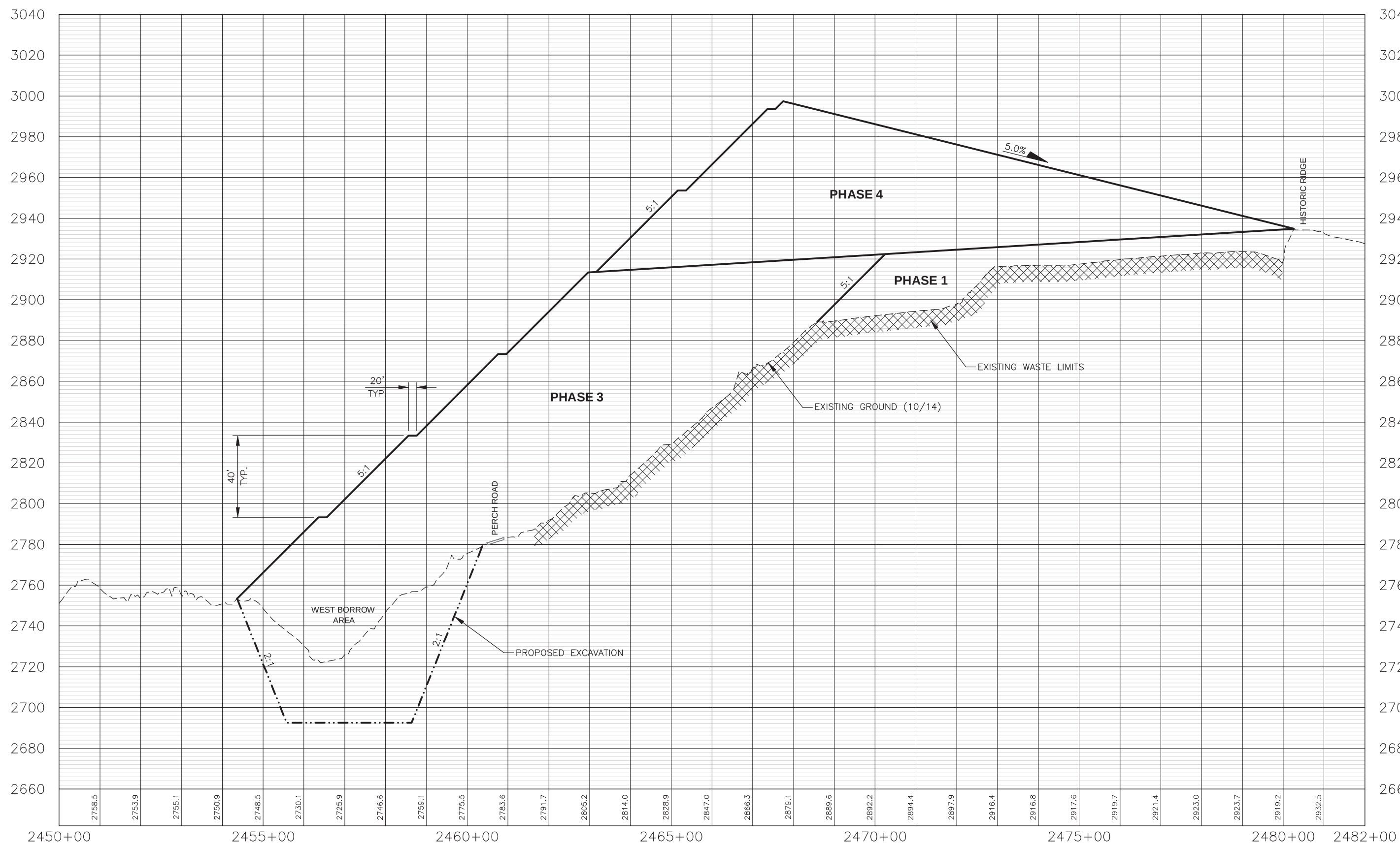
PICKLES BUTTE LANDFILL - CANYON COUNTY, ID

CONCEPTUAL FILL PLAN

N 667100 SECTION

| | |
|---|---|
| Project No.: | 1-15170 |
| Designed By: | REC / BAA |
| Drawn By: | BAA |
| Checked By: | REC |

FIGURE NO.
5




**N 667300**

HORIZONTAL SCALE: 1" = 300'
VERTICAL SCALE: 1" = 60'

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| MARK | DATE | DESCRIPTION | BY |
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PICKLES BUTTE LANDFILL - CANYON COUNTY, ID

CONCEPTUAL FILL PLAN

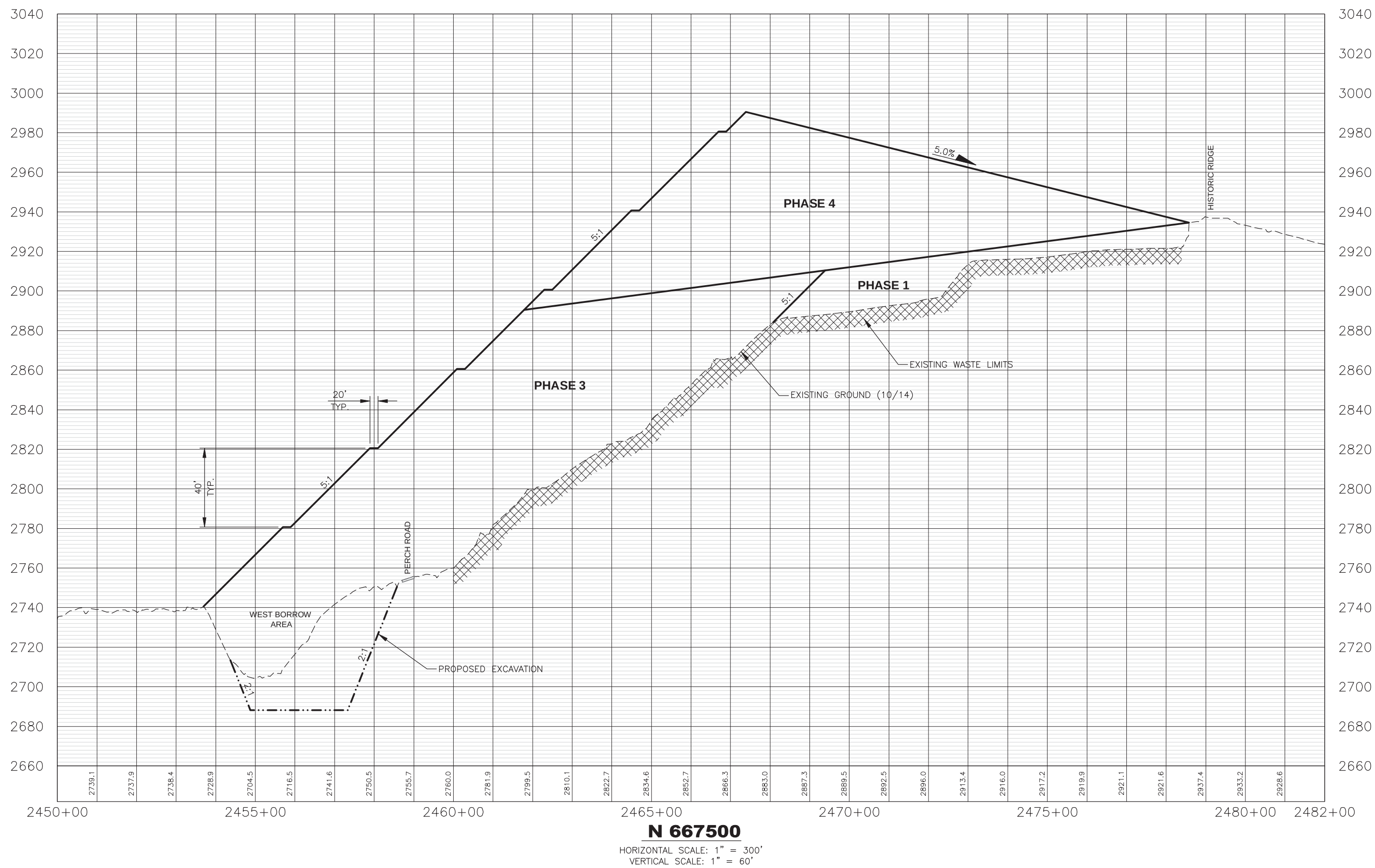
N 667300 SECTION

| | |
|---|---|
| Project No.: | 1-15170 |
| Designed By: | REC / BAA |
| Drawn By: | BAA |
| Checked By: | REC |

FIGURE NO.
6



9/14/2015 3:07:46 PM - F:\1-15170-PICKLES BUTTE LANDFILL\CADD 1-15170\EXHIBITS\CONCEPTUAL FILL PLAN\1-15170-CFP-FG06.DWG - BRET ANDERSON




**N 667500**

HORIZONTAL SCALE: 1" = 300'
VERTICAL SCALE: 1" = 60'

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PICKLES BUTTE LANDFILL - CANYON COUNTY, ID

CONCEPTUAL FILL PLAN

N 667500 SECTION

| | |
|---|---|
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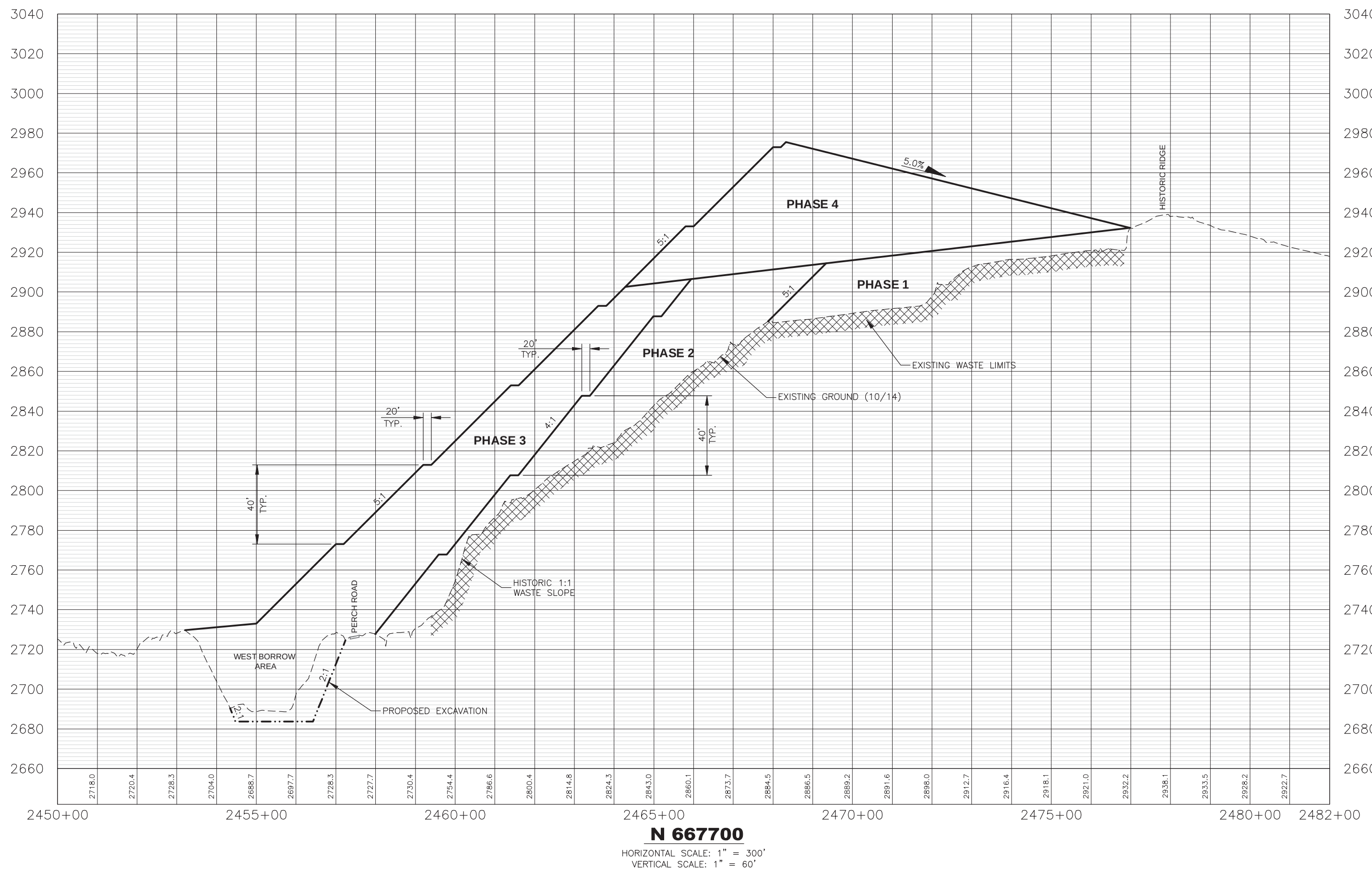
| Drawn By: | BAA |
| Checked By: | REC |

FIGURE NO.
**7**



9/14/2015 3:08:14 PM - F:\1-15170-PICKLES BUTTE LANDFILL\CADD 1-15170\EXHIBITS\CONCEPTUAL FILL PLAN\1-15170-CFP-FG07.DWG - BRET ANDERSON





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# PICKLES BUTTE LANDFILL - CANYON COUNTY, ID

CONCEPTUAL FILL PLAN

N 667700 SECTION

| | |
|---|---|
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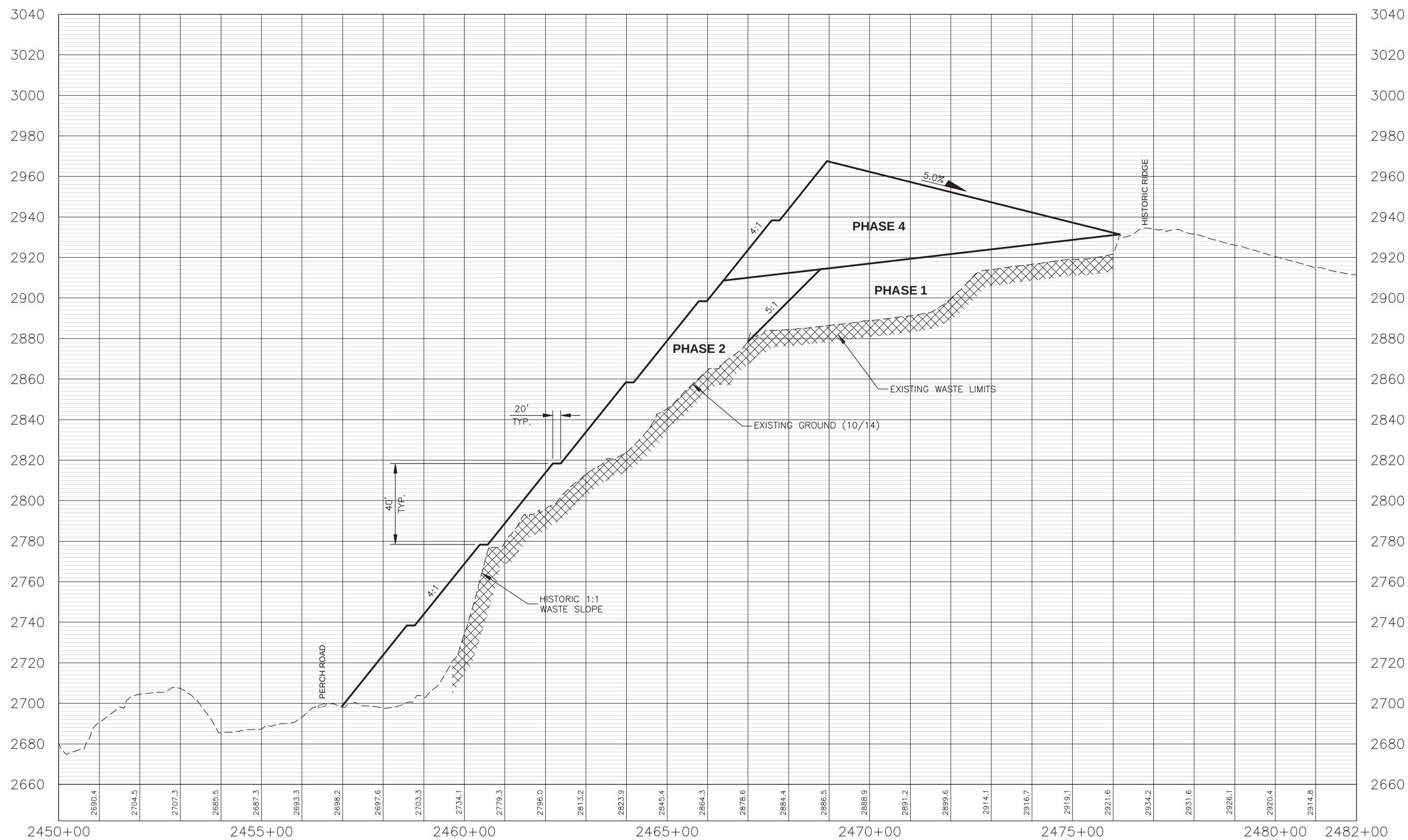
| Drawn By: | BAA |
| Checked By: | REC |

FIGURE NO.
**8**




**N 667900**

HORIZONTAL SCALE: 1" = 300'
VERTICAL SCALE: 1" = 60'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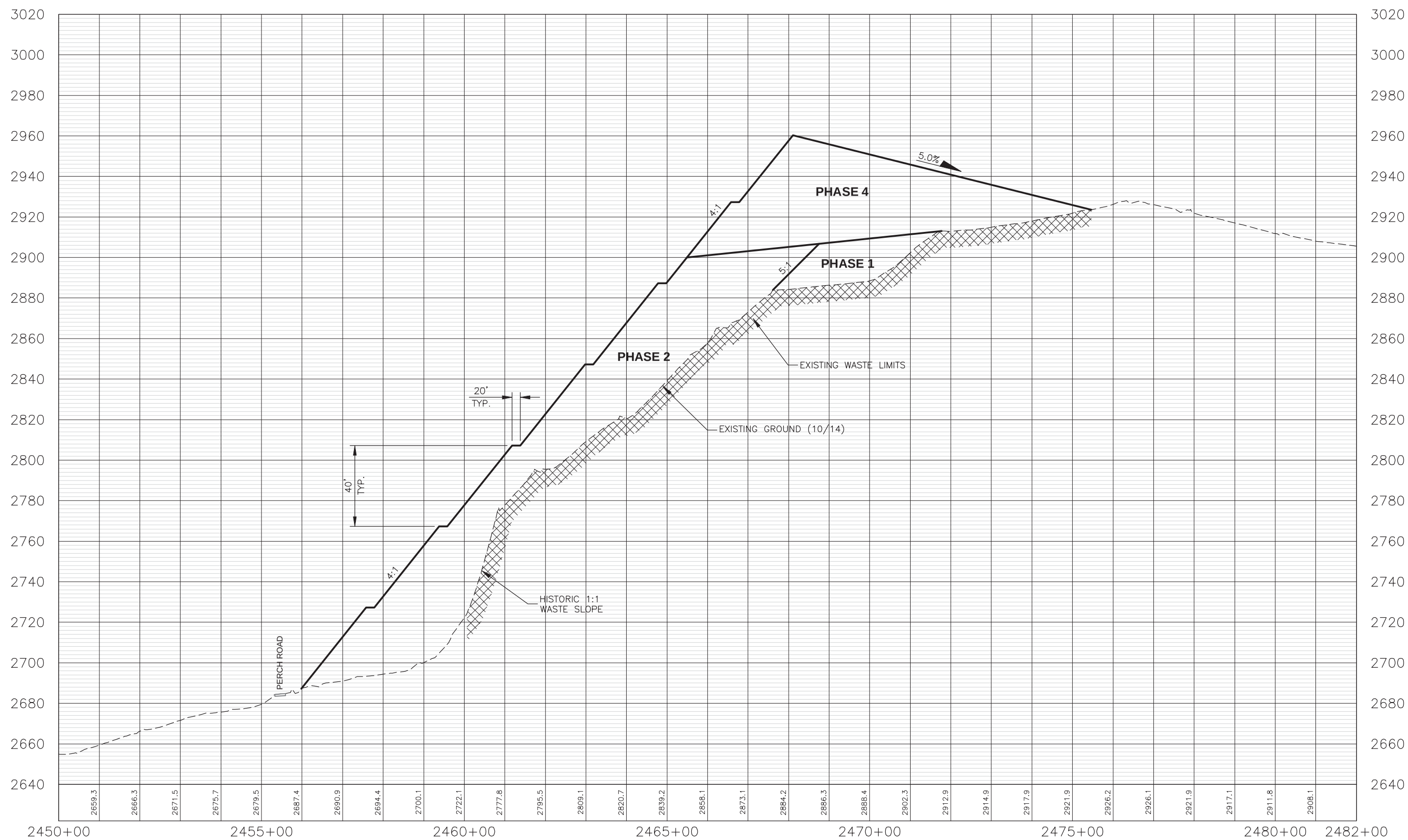
PICKLES BUTTE LANDFILL - CANYON COUNTY, ID

CONCEPTUAL FILL PLAN

N 667900 SECTION

| | |
|---|---|
| Project No.: | 1-15170 |
| Designed By: | REC / BAA |
| Drawn By: | BAA |
| Checked By: | REC |

FIGURE NO.
**9**




**N 668100**

HORIZONTAL SCALE: 1" = 300'
VERTICAL SCALE: 1" = 60'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PICKLES BUTTE LANDFILL - CANYON COUNTY, ID

CONCEPTUAL FILL PLAN

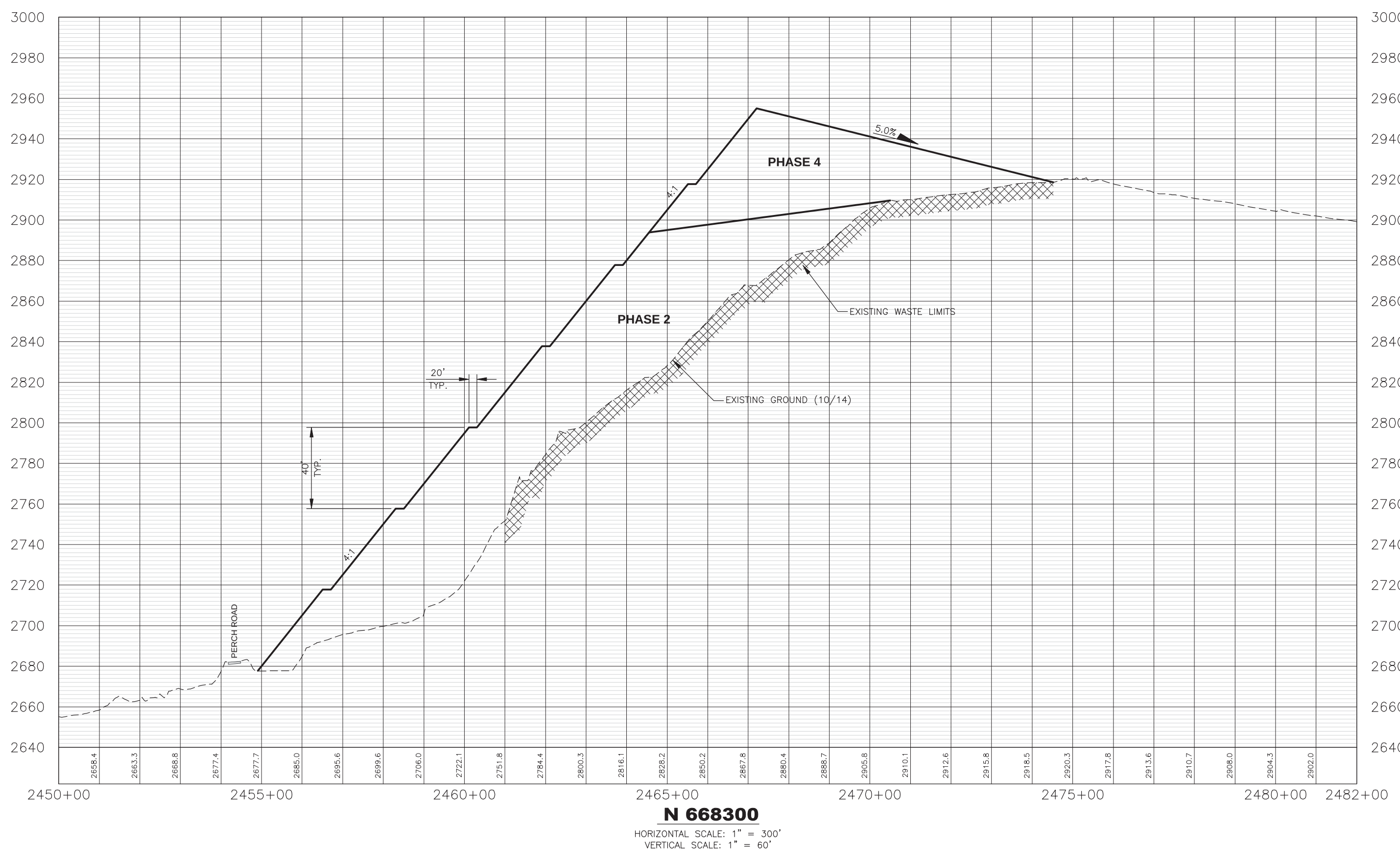
N 668100 SECTION

Project No.: 1-15170
Designed By: REC / BAA
Drawn By: BAA
Checked By: REC

FIGURE NO.
**10**



9/14/2015 3:09:52 PM - F:\1-15170-PICKLES BUTTE LANDFILL\CADD 1-15170\EXHIBITS\CONCEPTUAL FILL PLAN\1-15170-CFP-FG10.DWG - BRET ANDERSON




**N 668300**

HORIZONTAL SCALE: 1" = 300'
VERTICAL SCALE: 1" = 60'

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CONCEPTUAL FILL PLAN

N 668300 SECTION

| | |
|---|---|
| Project No.: | 1-15170 |
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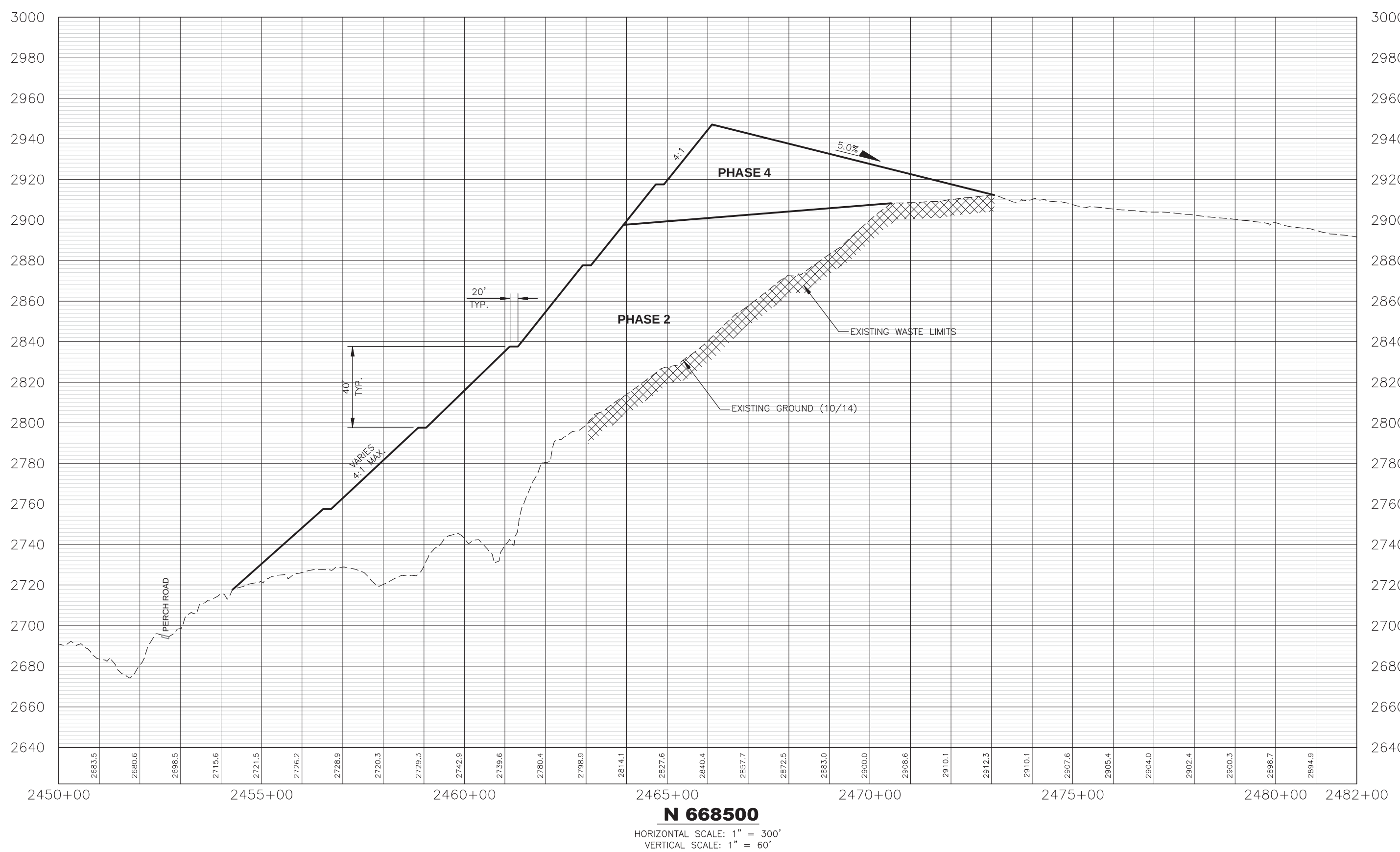
| Checked By: | REC |

FIGURE NO.
**11**




**N 668500**

HORIZONTAL SCALE: 1" = 300'
VERTICAL SCALE: 1" = 60'

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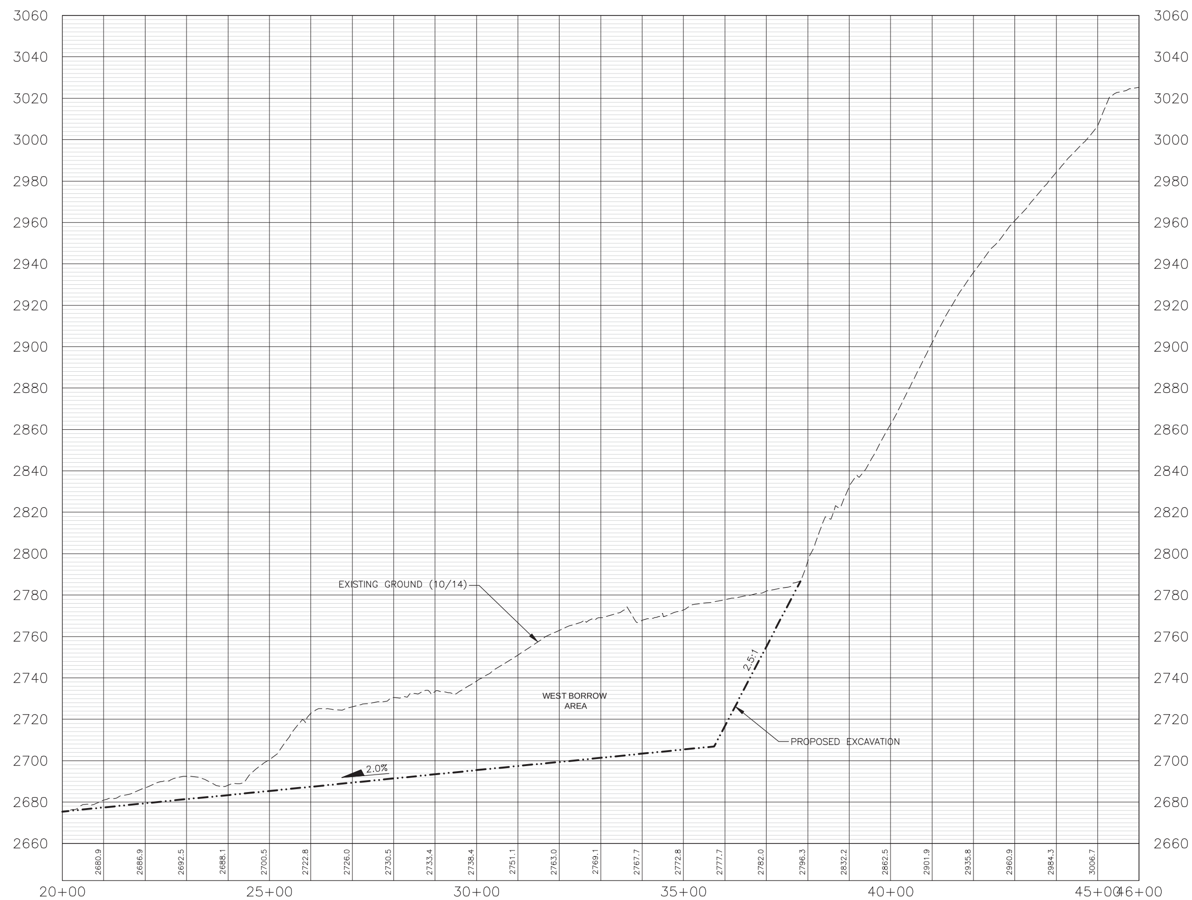
PICKLES BUTTE LANDFILL - CANYON COUNTY, ID
CONCEPTUAL FILL PLAN
N 668500 SECTION

| | |
|---|---|
| Project No.: | 1-15170 |
| Designed By: | REC / BAA |
| Drawn By: | BAA |
| Checked By: | REC |

FIGURE NO.
12



9/14/2015 3:11:01 PM – F:\1-15170-PICKLES BUTTE LANDFILL\CADD 1-15170\EXHIBITS\CONCEPTUAL FILL PLAN\1-15170-CFP-FG12.DWG – BRET ANDERSON




## WEST BORROW AREA SECTION A-A'

HORIZONTAL SCALE: 1" = 300'
VERTICAL SCALE: 1" = 60'

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PICKLES BUTTE LANDFILL - CANYON COUNTY, ID

CONCEPTUAL FILL PLAN

WEST BORROW AREA SECTION A-A'

| | |
|---|---|
| Project No.: | 1-15170 |
| Designed By: | REC / BAA |
| Drawn By: | BAA |
| Checked By: | REC |

FIGURE NO.
13

# APPENDIX 7 –A
# ISOPLUVIAL MAP

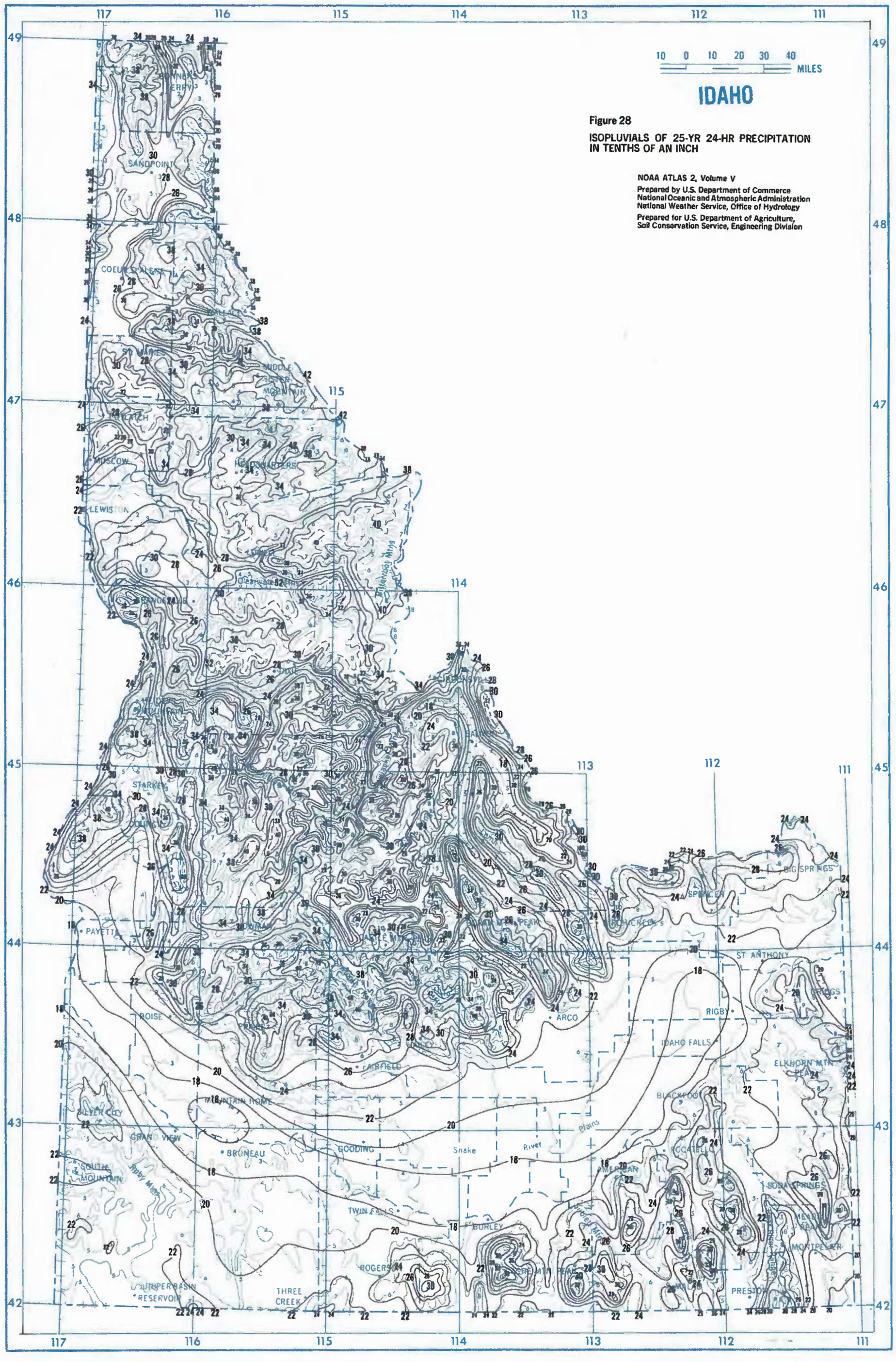



Figure 28

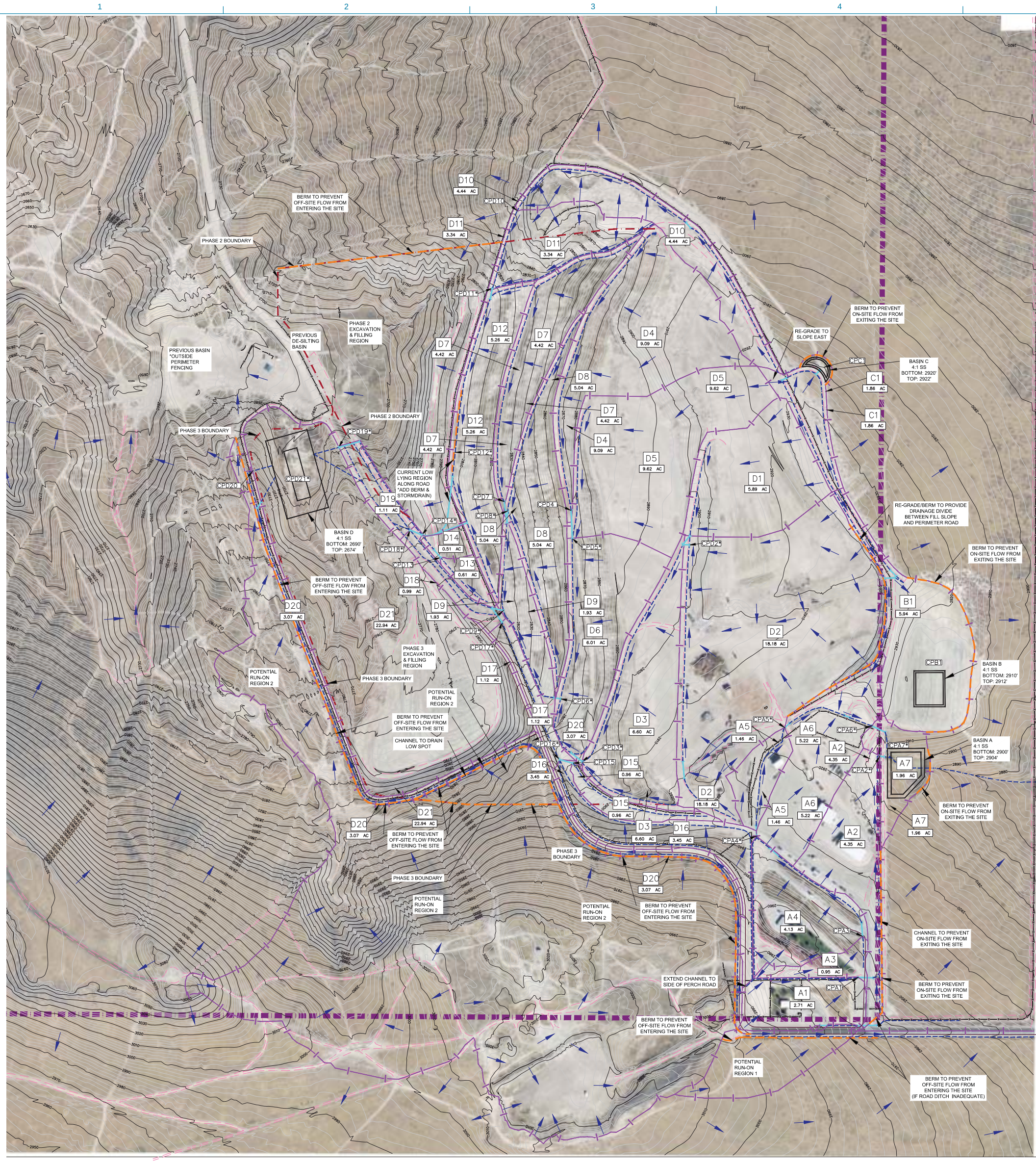
ISOPLUVIALS OF 25-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume V

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

# APPENDIX 7-B
# STORMWATER PLANS




## 25 - YEAR, 24 - HOUR RUNOFF SUMMARY TABLE

| CONC. POINT | CONTRIBUTING AREA(S) | AREA [AC] | RUNOFF [CFS] | Σ AREA [AC] | Σ RUNOFF [CFS] | DISCHARGES TO |
|---|---|---|---|---|---|---|
| A1 | A1 | 2.71 | 4.0 | 2.71 | 4.0 | A2 |
| A2 | A2 | 4.35 | 2.0 | 4.35 | 2.0 | BASIN A |
| A2* | A1+A2 | – | – | 7.06 | 5.0 | BASIN A |
| A3 | A3 | 0.95 | 1.0 | 0.95 | 1.0 | A4 |
| A4 | A4 | 4.13 | 6.0 | 4.13 | 6.0 | A5 |
| A4* | A3+A4 | – | – | 5.08 | 6.4 | A5 |
| A5 | A5 | 1.46 | 2.0 | 1.46 | 2.0 | A6 |
| A5* | A3+A4+A5 | – | – | 6.54 | 7.4 | A6 |
| A6 | A6 | 5.22 | 8.0 | 5.22 | 8.0 | BASIN A |
| A6* | A3+A4+A5+A6 | – | – | 15.38 | 9.7 | BASIN A |
| A7 | A7 | 1.96 | 3.0 | 1.96 | 3.0 | BASIN A |
| A7* | A1+A2+A3+A4+A5+A6+A7 | – | – | 20.78 | 16.6 | BASIN A |
| B1 | B1 | 5.94 | 9.0 | 5.94 | 9.0 | BASIN B |
| C1 | C1 | 1.86 | 3.0 | 1.86 | 3.0 | BASIN C |
| D1 | D1 | 5.89 | 9.0 | 5.89 | 9.0 | D3 |
| D2 | D2 | 18.18 | 28.0 | 18.18 | 28.0 | D3 |
| D2* | D1+D2 | – | – | 24.07 | 37.1 | D3 |
| D3 | D3 | 6.60 | 10.0 | 6.60 | 10.0 | D6 |
| D3* | D1+D2+D3 | – | – | 30.67 | 41.9 | D6 |
| D4 | D4 | 9.09 | 14.0 | 9.09 | 14.0 | D6 |
| D5 | D5 | 9.62 | 15.0 | 9.62 | 15.0 | D6 |
| D5* | D4+D5 | – | – | 18.71 | 29.0 | D6 |
| D6 | D6 | 6.01 | 9.0 | 6.01 | 9.0 | D9 |
| D6* | D1+D2+D3+D4+D5+D6 | – | – | 55.39 | 61.5 | D9 |
| D7 | D7 | 4.42 | 7.0 | 4.42 | 7.0 | D9 |
| D8 | D8 | 5.04 | 8.0 | 5.04 | 8.0 | D9 |
| D8* | D7+D8 | – | – | 9.46 | 15.0 | D9 |
| D9 | D9 | 1.89 | 3.0 | 1.89 | 3.0 | D18 |
| D9* | D1+D2+D3+D4+D5+D6+D7 +D8+D9 | – | – | 66.74 | 66.8 | D18 |
| D10 | D10 | 4.44 | 7.0 | 4.44 | 7.0 | D11 |
| D11 | D11 | 3.34 | 5.0 | 3.34 | 5.0 | D12 |
| D11* | D10+D11 | – | – | 7.78 | 9.6 | D12 |
| D12 | D12 | 5.26 | 8.0 | 5.26 | 8.0 | D19 |
| D12* | D10+D11+D12 | – | – | 13.04 | 11.7 | D19 |
| D13 | D13 | 0.61 | 1.0 | 0.61 | 1.0 | D14 |
| D14 | D14 | 0.51 | 1.0 | 0.51 | 1.0 | D19 |
| D14* | D10+D11+D12+D13+D14 | – | – | 14.17 | 12.7 | D19 |
| D15 | D15 | 0.96 | 2.0 | 0.96 | 2.0 | D17 |
| D16 | D16 | 3.45 | 5.0 | 3.45 | 5.0 | D17 |
| D16* | D15+D16 | – | – | 4.42 | 7.0 | D17 |
| D17 | D17 | 1.12 | 2.0 | 1.12 | 2.0 | D18 |
| D17* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D15+D16+D17 | – | – | 72.29 | 68.3 | D18 |
| D18 | D18 | 0.99 | 2.0 | 0.99 | 2.0 | D19 |
| D18* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D10+D11+D12+D13 +D14+D15+D16+D17+D18 | – | – | 87.44 | 79.0 | D19 |
| D19 | D19 | 1.11 | 2.0 | 1.11 | 2.0 | BASIN D |
| D19* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D10+D11+D12+D13 +D14+D15+D16+D17+D18 +D19 | – | – | 88.55 | 79.2 | BASIN D |
| D20 | D20 | 3.07 | 5.0 | 3.07 | 5.0 | BASIN D |
| D21 | D21 | 22.94 | 36.1 | 22.94 | 36.1 | BASIN D |
| D21* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D10+D11+D12+D13 +D14+D15+D16+D17+D18 +D19+D20+D21 | – | – | 114.57 | 82.1 | BASIN D |

## LEGEND

- 2810 — 2014 10–FOOT CONTOUR
- 2014 2–FOOT CONTOUR
- DRAINAGE FLOW DIRECTION
- DRAINAGE TRIBUTARY AREA
- DRAINAGE FLOW LINE
- D10 — DRAINAGE AREA ID
- 4.44 AC — DRAINAGE AREA IN ACRES
- CPD11* — CONC. POINT (* = JUNCTION)
- CULVERT
- BERM
- FUTURE PHASE BOUNDARY

N

GRAPHIC SCALE
250 125 0 250 500
( IN FEET )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LANDFILL STATUS REPORT UPDATE PROJECT

STORMWATER RUN-ON / RUN-OFF PLAN

Project No.: 197-2015-0100-150
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Checked By: KAJ

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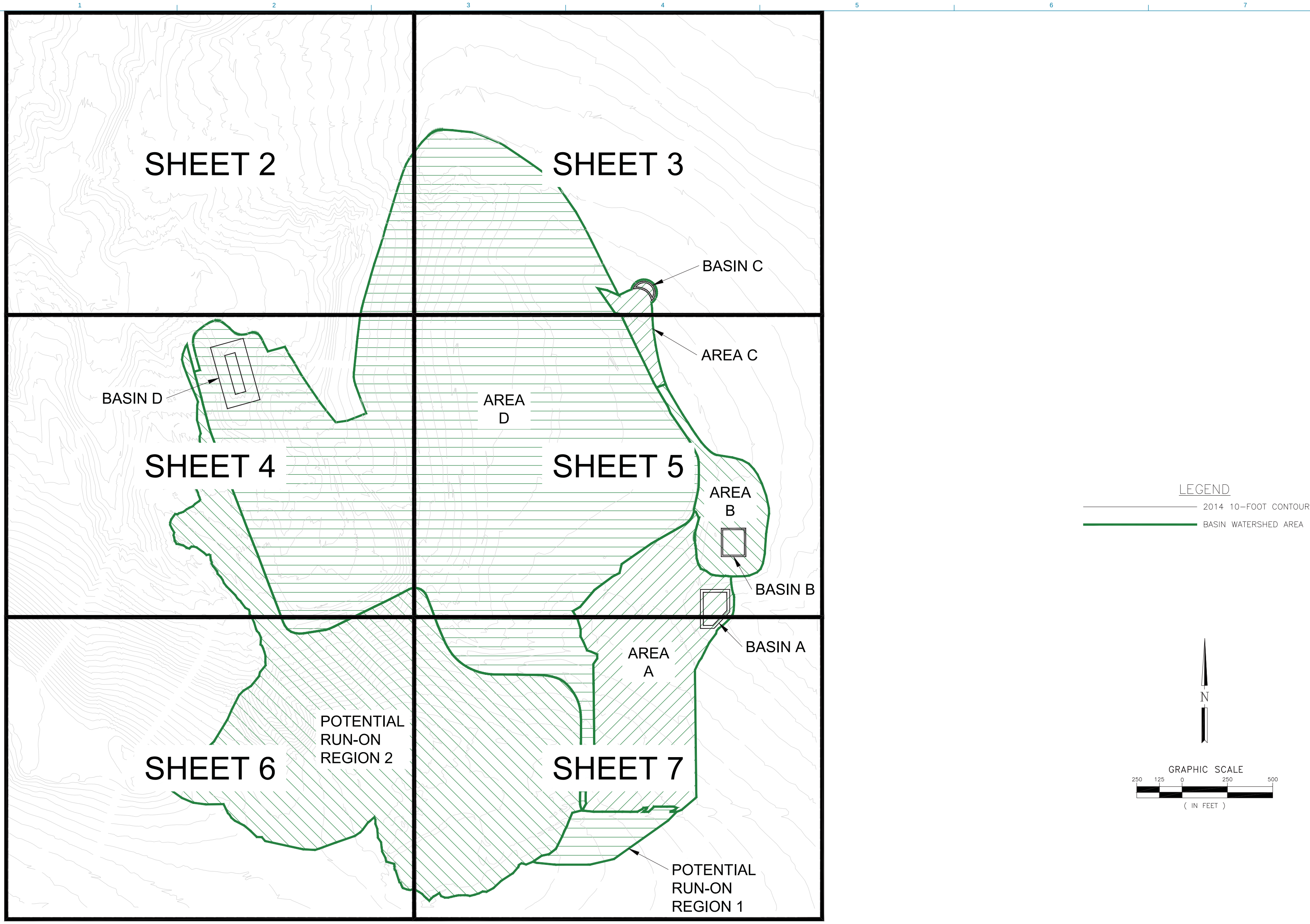


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INDEX



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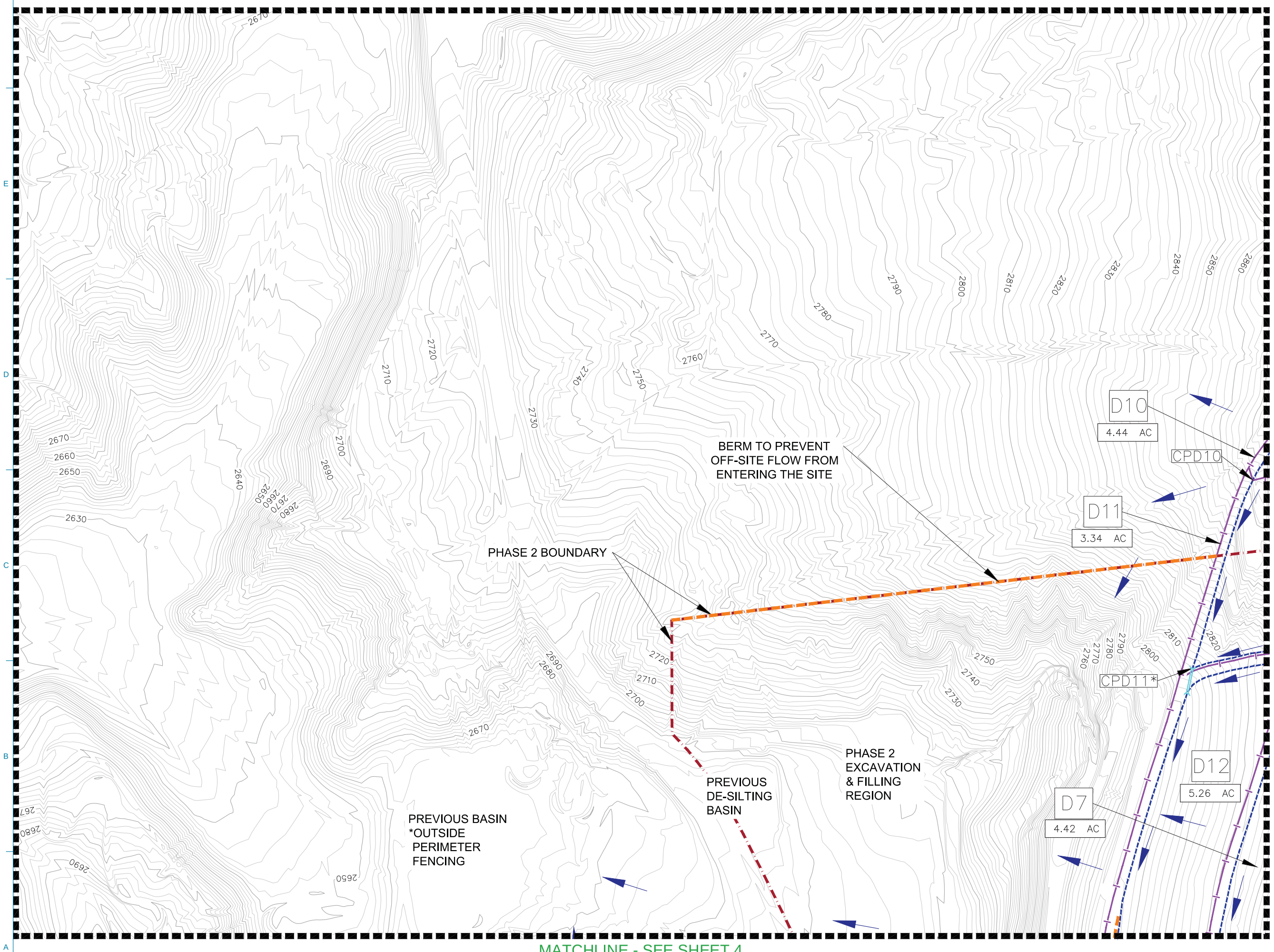


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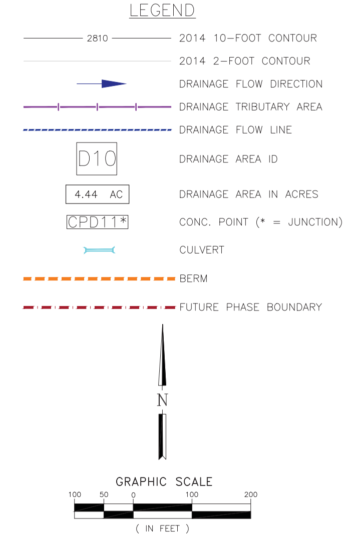
| A2 | A2 | 4.35 | 2.0 | 4.35 | 2.0 | BASIN A |
| A2* | A1+A2 | – | – | 7.06 | 5.0 | BASIN A |
| A3 | A3 | 0.95 | 1.0 | 0.95 | 1.0 | A4 |
| A4 | A4 | 4.13 | 6.0 | 4.13 | 6.0 | A5 |
| A4* | A3+A4 | – | – | 5.08 | 6.4 | A5 |
| A5 | A5 | 1.46 | 2.0 | 1.46 | 2.0 | A6 |
| A5* | A3+A4+A5 | – | – | 6.54 | 7.4 | A6 |
| A6 | A6 | 5.22 | 8.0 | 5.22 | 8.0 | BASIN A |
| A6* | A3+A4+A5+A6 | – | – | 15.38 | 9.7 | BASIN A |
| A7 | A7 | 1.96 | 3.0 | 1.96 | 3.0 | BASIN A |
| A7* | A1+A2+A3+A4+A5+A6+A7 | – | – | 20.78 | 16.6 | BASIN A |
| B1 | B1 | 5.94 | 9.0 | 5.94 | 9.0 | BASIN B |
| C1 | C1 | 1.86 | 3.0 | 1.86 | 3.0 | BASIN C |
| D1 | D1 | 5.89 | 9.0 | 5.89 | 9.0 | D3 |
| D2 | D2 | 18.18 | 28.0 | 18.18 | 28.0 | D3 |
| D2* | D1+D2 | – | – | 24.07 | 37.1 | D3 |
| D3 | D3 | 6.60 | 10.0 | 6.60 | 10.0 | D6 |
| D3* | D1+D2+D3 | – | – | 30.67 | 41.9 | D6 |
| D4 | D4 | 9.09 | 14.0 | 9.09 | 14.0 | D6 |
| D5 | D5 | 9.62 | 15.0 | 9.62 | 15.0 | D6 |
| D5* | D4+D5 | – | – | 18.71 | 29.0 | D6 |
| D6 | D6 | 6.01 | 9.0 | 6.01 | 9.0 | D9 |
| D6* | D1+D2+D3+D4+D5+D6 | – | – | 55.39 | 61.5 | D9 |
| D7 | D7 | 4.42 | 7.0 | 4.42 | 7.0 | D9 |
| D8 | D8 | 5.04 | 8.0 | 5.04 | 8.0 | D9 |
| D8* | D7+D8 | – | – | 9.46 | 15.0 | D9 |
| D9 | D9 | 1.89 | 3.0 | 1.89 | 3.0 | D18 |
| D9* | D1+D2+D3+D4+D5+D6+D7 +D8+D9 | – | – | 66.74 | 66.8 | D18 |
| D10 | D10 | 4.44 | 7.0 | 4.44 | 7.0 | D11 |
| D11 | D11 | 3.34 | 5.0 | 3.34 | 5.0 | D12 |
| D11* | D10+D11 | – | – | 7.78 | 9.6 | D12 |
| D12 | D12 | 5.26 | 8.0 | 5.26 | 8.0 | D19 |
| D12* | D10+D11+D12 | – | – | 13.04 | 11.7 | D19 |
| D13 | D13 | 0.61 | 1.0 | 0.61 | 1.0 | D14 |
| D14 | D14 | 0.51 | 1.0 | 0.51 | 1.0 | D19 |
| D14* | D10+D11+D12+D13+D14 | – | – | 14.17 | 12.7 | D19 |
| D15 | D15 | 0.96 | 2.0 | 0.96 | 2.0 | D17 |
| D16 | D16 | 3.45 | 5.0 | 3.45 | 5.0 | D17 |
| D16* | D15+D16 | – | – | 4.42 | 7.0 | D17 |
| D17 | D17 | 1.12 | 2.0 | 1.12 | 2.0 | D18 |
| D17* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D15+D16+D17 | – | – | 72.29 | 68.3 | D18 |
| D18 | D18 | 0.99 | 2.0 | 0.99 | 2.0 | D19 |
| D18* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D10+D11+D12+D13 +D14+D15+D16+D17+D18 | – | – | 87.44 | 79.0 | D19 |
| D19 | D19 | 1.11 | 2.0 | 1.11 | 2.0 | BASIN D |
| D19* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D10+D11+D12+D13 +D14+D15+D16+D17+D18 +D19 | – | – | 88.55 | 79.2 | BASIN D |
| D20 | D20 | 3.07 | 5.0 | 3.07 | 5.0 | BASIN D |
| D21 | D21 | 22.94 | 36.1 | 22.94 | 36.1 | BASIN D |
| D21* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D10+D11+D12+D13 +D14+D15+D16+D17+D18 +D19+D20+D21 | – | – | 114.57 | 82.1 | BASIN D |

## LEGEND

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| 10-2015 | | EXHIBITS | |

# PICKLES BUTTE LANDFILL - CANYON COUNTY, ID

LANDFILL STATUS REPORT UPDATE PROJECT

STORMWATER RUN-ON / RUN-OFF PLAN

Project No.: 197-2015-0100-150
Designed By: RTL / KAJ
Drawn By: RTL
Checked By: KAJ

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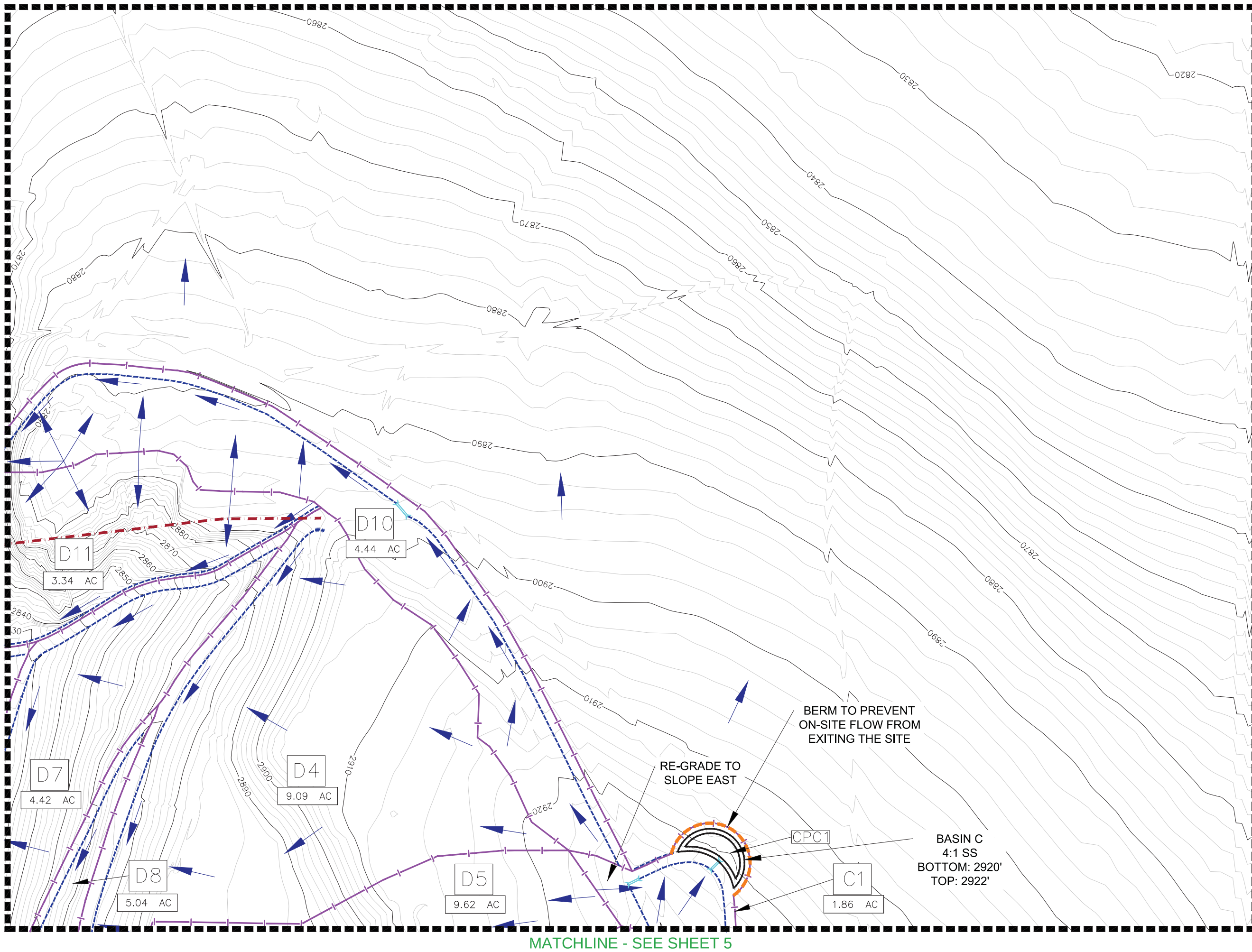


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| A3 | A3 | 0.95 | 1.0 | 0.95 | 1.0 | A4 |
| A4 | A4 | 4.13 | 6.0 | 4.13 | 6.0 | A5 |
| A4* | A3+A4 | – | – | 5.08 | 6.4 | A5 |
| A5 | A5 | 1.46 | 2.0 | 1.46 | 2.0 | A6 |
| A5* | A3+A4+A5 | – | – | 6.54 | 7.4 | A6 |
| A6 | A6 | 5.22 | 8.0 | 5.22 | 8.0 | BASIN A |
| A6* | A3+A4+A5+A6 | – | – | 15.38 | 9.7 | BASIN A |
| A7 | A7 | 1.96 | 3.0 | 1.96 | 3.0 | BASIN A |
| A7* | A1+A2+A3+A4+A5+A6+A7 | – | – | 20.78 | 16.6 | BASIN A |
| B1 | B1 | 5.94 | 9.0 | 5.94 | 9.0 | BASIN B |
| C1 | C1 | 1.86 | 3.0 | 1.86 | 3.0 | BASIN C |
| D1 | D1 | 5.89 | 9.0 | 5.89 | 9.0 | D3 |
| D2 | D2 | 18.18 | 28.0 | 18.18 | 28.0 | D3 |
| D2* | D1+D2 | – | – | 24.07 | 37.1 | D3 |
| D3 | D3 | 6.60 | 10.0 | 6.60 | 10.0 | D6 |
| D3* | D1+D2+D3 | – | – | 30.67 | 41.9 | D6 |
| D4 | D4 | 9.09 | 14.0 | 9.09 | 14.0 | D6 |
| D5 | D5 | 9.62 | 15.0 | 9.62 | 15.0 | D6 |
| D5* | D4+D5 | – | – | 18.71 | 29.0 | D6 |
| D6 | D6 | 6.01 | 9.0 | 6.01 | 9.0 | D9 |
| D6* | D1+D2+D3+D4+D5+D6 | – | – | 55.39 | 61.5 | D9 |
| D7 | D7 | 4.42 | 7.0 | 4.42 | 7.0 | D9 |
| D8 | D8 | 5.04 | 8.0 | 5.04 | 8.0 | D9 |
| D8* | D7+D8 | – | – | 9.46 | 15.0 | D9 |
| D9 | D9 | 1.89 | 3.0 | 1.89 | 3.0 | D18 |
| D9* | D1+D2+D3+D4+D5+D6+D7 +D8+D9 | – | – | 66.74 | 66.8 | D18 |
| D10 | D10 | 4.44 | 7.0 | 4.44 | 7.0 | D11 |
| D11 | D11 | 3.34 | 5.0 | 3.34 | 5.0 | D12 |
| D11* | D10+D11 | – | – | 7.78 | 9.6 | D12 |
| D12 | D12 | 5.26 | 8.0 | 5.26 | 8.0 | D19 |
| D12* | D10+D11+D12 | – | – | 13.04 | 11.7 | D19 |
| D13 | D13 | 0.61 | 1.0 | 0.61 | 1.0 | D14 |
| D14 | D14 | 0.51 | 1.0 | 0.51 | 1.0 | D19 |
| D14* | D10+D11+D12+D13+D14 | – | – | 14.17 | 12.7 | D19 |
| D15 | D15 | 0.96 | 2.0 | 0.96 | 2.0 | D17 |
| D16 | D16 | 3.45 | 5.0 | 3.45 | 5.0 | D17 |
| D16* | D15+D16 | – | – | 4.42 | 7.0 | D17 |
| D17 | D17 | 1.12 | 2.0 | 1.12 | 2.0 | D18 |
| D17* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D15+D16+D17 | – | – | 72.29 | 68.3 | D18 |
| D18 | D18 | 0.99 | 2.0 | 0.99 | 2.0 | D19 |
| D18* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D10+D11+D12+D13 +D14+D15+D16+D17+D18 | – | – | 87.44 | 79.0 | D19 |
| D19 | D19 | 1.11 | 2.0 | 1.11 | 2.0 | BASIN D |
| D19* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D10+D11+D12+D13 +D14+D15+D16+D17+D18 +D19 | – | – | 88.55 | 79.2 | BASIN D |
| D20 | D20 | 3.07 | 5.0 | 3.07 | 5.0 | BASIN D |
| D21 | D21 | 22.94 | 36.1 | 22.94 | 36.1 | BASIN D |
| D21* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D10+D11+D12+D13 +D14+D15+D16+D17+D18 +D19+D20+D21 | – | – | 114.57 | 82.1 | BASIN D |

## LEGEND

2810 — 2014 10–FOOT CONTOUR
2014 2–FOOT CONTOUR
DRAINAGE FLOW DIRECTION
DRAINAGE TRIBUTARY AREA
DRAINAGE FLOW LINE
D10 — DRAINAGE AREA ID
4.44 AC — DRAINAGE AREA IN ACRES
CPD11* — CONC. POINT (* = JUNCTION)
CULVERT
BERM
FUTURE PHASE BOUNDARY

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| MARK | DATE | DESCRIPTION | BY |
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| | 10-2015 | EXHIBITS | |

# PICKLES BUTTE LANDFILL - CANYON COUNTY, ID

LANDFILL STATUS REPORT UPDATE PROJECT

STORMWATER RUN-ON / RUN-OFF PLAN

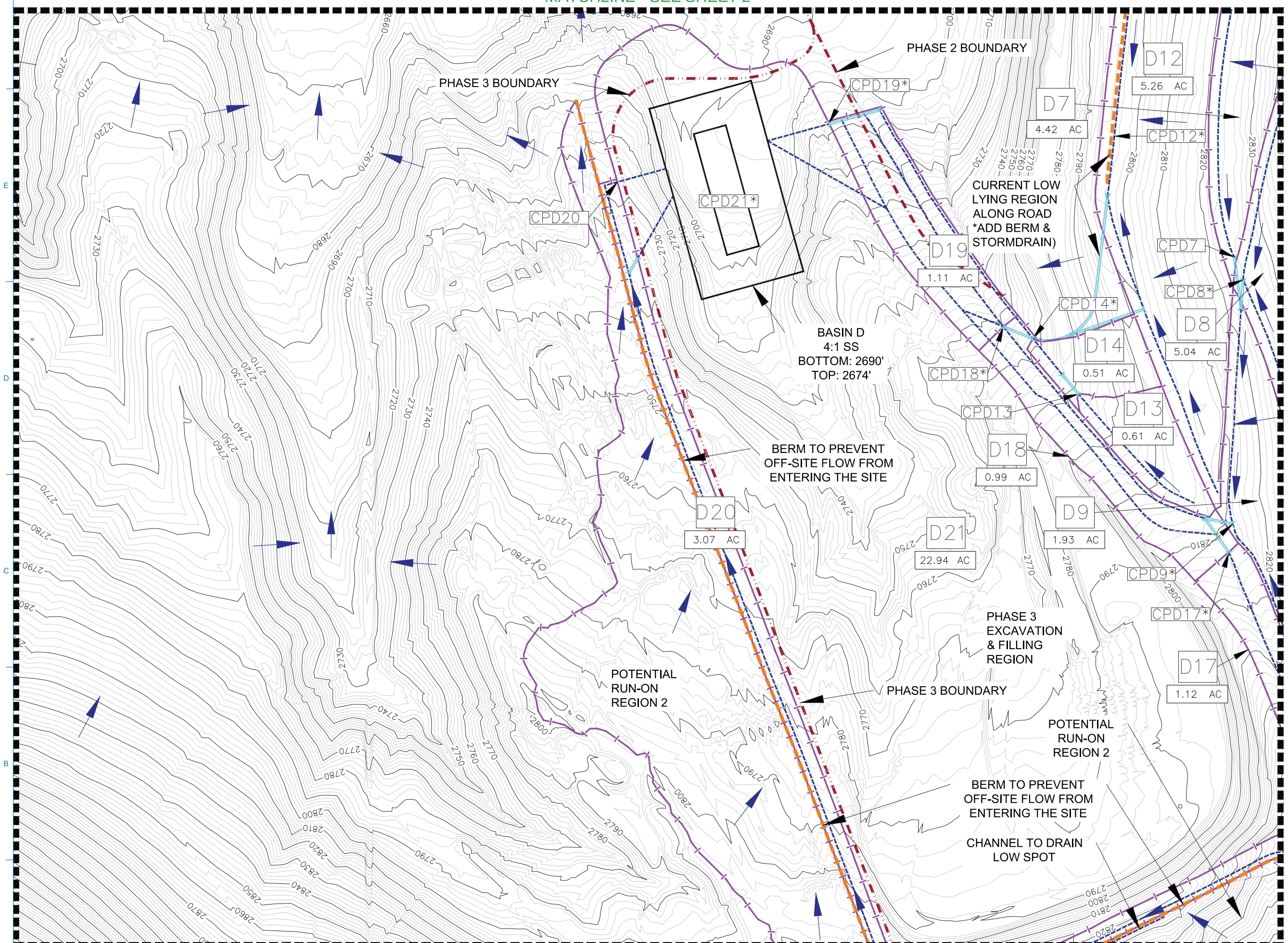
Project No.: 197-2015-0100-150
Designed By: RTL / KAJ
Drawn By: RTL
Checked By: KAJ

SHEET NO.
3



10/26/2015 10:18:25 AM – F:\DATA\CLIENTS\TETRATECH\PICKLES BUTTE LANDFILL\STORMWATER\PICKLES-BUTTE-STORMWATER_X.DWG – LIVERMORE, TODD

MATCHLINE - SEE SHEET 2



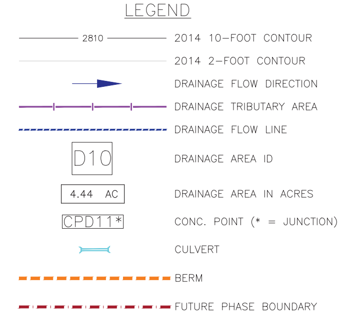

MATCHLINE - SEE SHEET 5

MATCHLINE - SEE SHEET 6

**25 - YEAR, 24 - HOUR RUNOFF SUMMARY TABLE**

| CONC. POINT | CONTRIBUTING AREA(S) | AREA [AC] | RUNOFF [CFS] | Σ AREA [AC] | Σ RUNOFF [CFS] | DISCHARGES TO |
|---|---|---|---|---|---|---|
| A1 | A1 | 2.71 | 4.0 | 2.71 | 4.0 | A2 |
| A2 | A2 | 4.35 | 2.0 | 4.35 | 2.0 | BASIN A |
| A2* | A1+A2 | – | – | 7.06 | 5.0 | BASIN A |
| A3 | A3 | 0.95 | 1.0 | 0.95 | 1.0 | A4 |
| A4 | A4 | 4.13 | 6.0 | 4.13 | 6.0 | A5 |
| A4* | A3+A4 | – | – | 5.08 | 6.4 | A5 |
| A5 | A5 | 1.46 | 2.0 | 1.46 | 2.0 | A6 |
| A5* | A3+A4+A5 | – | – | 6.54 | 7.4 | A6 |
| A6 | A6 | 5.22 | 8.0 | 5.22 | 8.0 | BASIN A |
| A6* | A3+A4+A5+A6 | – | – | 15.38 | 9.7 | BASIN A |
| A7 | A7 | 1.96 | 3.0 | 1.96 | 3.0 | BASIN A |
| A7* | A1+A2+A3+A4+A5+A6+A7 | – | – | 20.78 | 16.6 | BASIN A |
| B1 | B1 | 5.94 | 9.0 | 5.94 | 9.0 | BASIN B |
| C1 | C1 | 1.86 | 3.0 | 1.86 | 3.0 | BASIN C |
| D1 | D1 | 5.89 | 9.0 | 5.89 | 9.0 | D3 |
| D2 | D2 | 18.18 | 28.0 | 18.18 | 28.0 | D3 |
| D2* | D1+D2 | – | – | 24.07 | 37.1 | D3 |
| D3 | D3 | 6.60 | 10.0 | 6.60 | 10.0 | D6 |
| D3* | D1+D2+D3 | – | – | 30.67 | 41.9 | D6 |
| D4 | D4 | 9.09 | 14.0 | 9.09 | 14.0 | D6 |
| D5 | D5 | 9.62 | 15.0 | 9.62 | 15.0 | D6 |
| D5* | D4+D5 | – | – | 18.71 | 29.0 | D6 |
| D6 | D6 | 6.01 | 9.0 | 6.01 | 9.0 | D9 |
| D6* | D1+D2+D3+D4+D5+D6 | – | – | 55.39 | 61.5 | D9 |
| D7 | D7 | 4.42 | 7.0 | 4.42 | 7.0 | D9 |
| D8 | D8 | 5.04 | 8.0 | 5.04 | 8.0 | D9 |
| D8* | D7+D8 | – | – | 9.46 | 15.0 | D9 |
| D9 | D9 | 1.89 | 3.0 | 1.89 | 3.0 | D18 |
| D9* | D1+D2+D3+D4+D5+D6+D7 +D8+D9 | – | – | 66.74 | 66.8 | D18 |
| D10 | D10 | 4.44 | 7.0 | 4.44 | 7.0 | D11 |
| D11 | D11 | 3.34 | 5.0 | 3.34 | 5.0 | D12 |
| D11* | D10+D11 | – | – | 7.78 | 9.6 | D12 |
| D12 | D12 | 5.26 | 8.0 | 5.26 | 8.0 | D19 |
| D12* | D10+D11+D12 | – | – | 13.04 | 11.7 | D19 |
| D13 | D13 | 0.61 | 1.0 | 0.61 | 1.0 | D14 |
| D14 | D14 | 0.51 | 1.0 | 0.51 | 1.0 | D19 |
| D14* | D10+D11+D12+D13+D14 | – | – | 14.17 | 12.7 | D19 |
| D15 | D15 | 0.96 | 2.0 | 0.96 | 2.0 | D17 |
| D16 | D16 | 3.45 | 5.0 | 3.45 | 5.0 | D17 |
| D16* | D15+D16 | – | – | 4.42 | 7.0 | D17 |
| D17 | D17 | 1.12 | 2.0 | 1.12 | 2.0 | D18 |
| D17* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D15+D16+D17 | – | – | 72.29 | 68.3 | D18 |
| D18 | D18 | 0.99 | 2.0 | 0.99 | 2.0 | D19 |
| D18* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D10+D11+D12+D13 +D14+D15+D16+D17+D18 | – | – | 87.44 | 79.0 | D19 |
| D19 | D19 | 1.11 | 2.0 | 1.11 | 2.0 | BASIN D |
| D19* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D10+D11+D12+D13 +D14+D15+D16+D17+D18 +D19 | – | – | 88.55 | 79.2 | BASIN D |
| D20 | D20 | 3.07 | 5.0 | 3.07 | 5.0 | BASIN D |
| D21 | D21 | 22.94 | 36.1 | 22.94 | 36.1 | BASIN D |
| D21* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D10+D11+D12+D13 +D14+D15+D16+D17+D18 +D19+D20+D21 | – | – | 114.57 | 82.1 | BASIN D |

## LEGEND

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| MARK | DATE | DESCRIPTION | BY |
|---|---|---|---|
| | 10-2015 | EXHIBITS | |

# PICKLES BUTTE LANDFILL - CANYON COUNTY, ID

LANDFILL STATUS REPORT UPDATE PROJECT

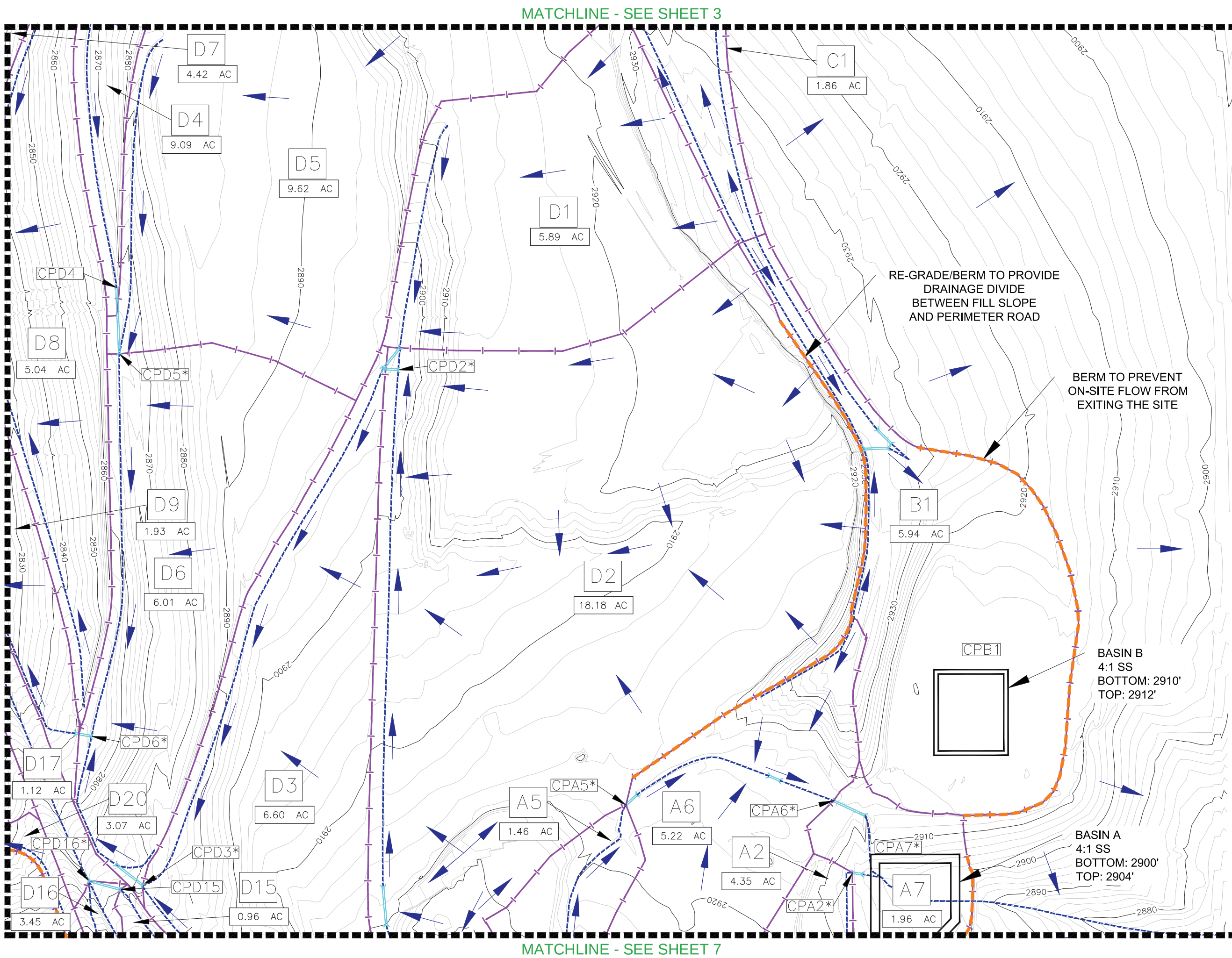
STORMWATER RUN-ON / RUN-OFF PLAN

Project No.: 197-2015-0100-150
Designed By: RTL / KAJ
Drawn By: RTL
Checked By: KAJ

SHEET NO.
4



10/26/2015 10:18:50 AM – F:\DATA\CLIENTS\TETRATECH\PICKLES BUTTE LANDFILL\STORMWATER\PICKLES-BUTTE-STORMWATER_X.DWG – LIVERMORE, TODD




## 25 - YEAR, 24 - HOUR RUNOFF SUMMARY TABLE

| CONC. POINT | CONTRIBUTING AREA(S) | AREA [AC] | RUNOFF [CFS] | Σ AREA [AC] | Σ RUNOFF [CFS] | DISCHARGES TO |
|---|---|---|---|---|---|---|
| A1 | A1 | 2.71 | 4.0 | 2.71 | 4.0 | A2 |
| A2 | A2 | 4.35 | 2.0 | 4.35 | 2.0 | BASIN A |
| A2* | A1+A2 | – | – | 7.06 | 5.0 | BASIN A |
| A3 | A3 | 0.95 | 1.0 | 0.95 | 1.0 | A4 |
| A4 | A4 | 4.13 | 6.0 | 4.13 | 6.0 | A5 |
| A4* | A3+A4 | – | – | 5.08 | 6.4 | A5 |
| A5 | A5 | 1.46 | 2.0 | 1.46 | 2.0 | A6 |
| A5* | A3+A4+A5 | – | – | 6.54 | 7.4 | A6 |
| A6 | A6 | 5.22 | 8.0 | 5.22 | 8.0 | BASIN A |
| A6* | A3+A4+A5+A6 | – | – | 15.38 | 9.7 | BASIN A |
| A7 | A7 | 1.96 | 3.0 | 1.96 | 3.0 | BASIN A |
| A7* | A1+A2+A3+A4+A5+A6+A7 | – | – | 20.78 | 16.6 | BASIN A |
| B1 | B1 | 5.94 | 9.0 | 5.94 | 9.0 | BASIN B |
| C1 | C1 | 1.86 | 3.0 | 1.86 | 3.0 | BASIN C |
| D1 | D1 | 5.89 | 9.0 | 5.89 | 9.0 | D3 |
| D2 | D2 | 18.18 | 28.0 | 18.18 | 28.0 | D3 |
| D2* | D1+D2 | – | – | 24.07 | 37.1 | D3 |
| D3 | D3 | 6.60 | 10.0 | 6.60 | 10.0 | D6 |
| D3* | D1+D2+D3 | – | – | 30.67 | 41.9 | D6 |
| D4 | D4 | 9.09 | 14.0 | 9.09 | 14.0 | D6 |
| D5 | D5 | 9.62 | 15.0 | 9.62 | 15.0 | D6 |
| D5* | D4+D5 | – | – | 18.71 | 29.0 | D6 |
| D6 | D6 | 6.01 | 9.0 | 6.01 | 9.0 | D9 |
| D6* | D1+D2+D3+D4+D5+D6 | – | – | 55.39 | 61.5 | D9 |
| D7 | D7 | 4.42 | 7.0 | 4.42 | 7.0 | D9 |
| D8 | D8 | 5.04 | 8.0 | 5.04 | 8.0 | D9 |
| D8* | D7+D8 | – | – | 9.46 | 15.0 | D9 |
| D9 | D9 | 1.89 | 3.0 | 1.89 | 3.0 | D18 |
| D9* | D1+D2+D3+D4+D5+D6+D7 +D8+D9 | – | – | 66.74 | 66.8 | D18 |
| D10 | D10 | 4.44 | 7.0 | 4.44 | 7.0 | D11 |
| D11 | D11 | 3.34 | 5.0 | 3.34 | 5.0 | D12 |
| D11* | D10+D11 | – | – | 7.78 | 9.6 | D12 |
| D12 | D12 | 5.26 | 8.0 | 5.26 | 8.0 | D19 |
| D12* | D10+D11+D12 | – | – | 13.04 | 11.7 | D19 |
| D13 | D13 | 0.61 | 1.0 | 0.61 | 1.0 | D14 |
| D14 | D14 | 0.51 | 1.0 | 0.51 | 1.0 | D19 |
| D14* | D10+D11+D12+D13+D14 | – | – | 14.17 | 12.7 | D19 |
| D15 | D15 | 0.96 | 2.0 | 0.96 | 2.0 | D17 |
| D16 | D16 | 3.45 | 5.0 | 3.45 | 5.0 | D17 |
| D16* | D15+D16 | – | – | 4.42 | 7.0 | D17 |
| D17 | D17 | 1.12 | 2.0 | 1.12 | 2.0 | D18 |
| D17* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D15+D16+D17 | – | – | 72.29 | 68.3 | D18 |
| D18 | D18 | 0.99 | 2.0 | 0.99 | 2.0 | D19 |
| D18* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D10+D11+D12+D13 +D14+D15+D16+D17+D18 | – | – | 87.44 | 79.0 | D19 |
| D19 | D19 | 1.11 | 2.0 | 1.11 | 2.0 | BASIN D |
| D19* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D10+D11+D12+D13 +D14+D15+D16+D17+D18 +D19 | – | – | 88.55 | 79.2 | BASIN D |
| D20 | D20 | 3.07 | 5.0 | 3.07 | 5.0 | BASIN D |
| D21 | D21 | 22.94 | 36.1 | 22.94 | 36.1 | BASIN D |
| D21* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D10+D11+D12+D13 +D14+D15+D16+D17+D18 +D19+D20+D21 | – | – | 114.57 | 82.1 | BASIN D |

## LEGEND

2810 — 2014 10-FOOT CONTOUR
2014 2-FOOT CONTOUR
DRAINAGE FLOW DIRECTION
DRAINAGE TRIBUTARY AREA
DRAINAGE FLOW LINE
D10 — DRAINAGE AREA ID
4.44 AC — DRAINAGE AREA IN ACRES
CPD11* — CONC. POINT (* = JUNCTION)
CULVERT
BERM
FUTURE PHASE BOUNDARY

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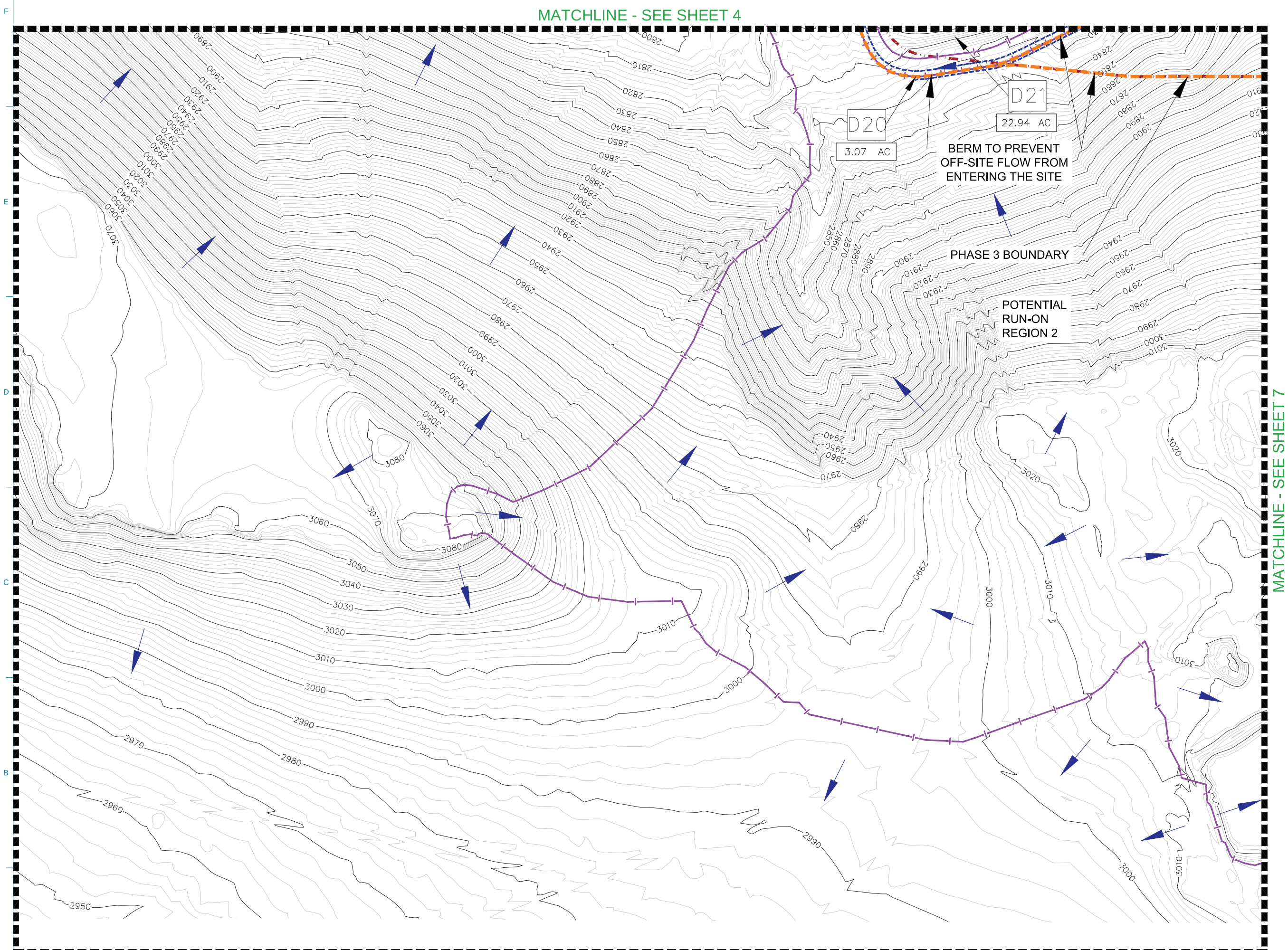
|---|---|---|---|
| | 10-2015 | EXHIBITS | |

PICKLES BUTTE LANDFILL - CANYON COUNTY, ID
LANDFILL STATUS REPORT UPDATE PROJECT
STORMWATER RUN-ON / RUN-OFF PLAN

Project No.: 197-2015-0100-150
Designed By: RTL / KAJ
Drawn By: RTL
Checked By: KAJ
SHEET NO. 5



10/26/2015 10:19:08 AM – F:\DATA\CLIENTS\TETRATECH\PICKLES BUTTE LANDFILL\STORMWATER\PICKLES-BUTTE-STORMWATER_X.DWG – LIVERMORE, TODD




**25 - YEAR, 24 - HOUR RUNOFF SUMMARY TABLE**

| CONC. POINT | CONTRIBUTING AREA(S) | AREA [AC] | RUNOFF [CFS] | Σ AREA [AC] | Σ RUNOFF [CFS] | DISCHARGES TO |
|---|---|---|---|---|---|---|
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| A2 | A2 | 4.35 | 2.0 | 4.35 | 2.0 | BASIN A |
| A2* | A1+A2 | – | – | 7.06 | 5.0 | BASIN A |
| A3 | A3 | 0.95 | 1.0 | 0.95 | 1.0 | A4 |
| A4 | A4 | 4.13 | 6.0 | 4.13 | 6.0 | A5 |
| A4* | A3+A4 | – | – | 5.08 | 6.4 | A5 |
| A5 | A5 | 1.46 | 2.0 | 1.46 | 2.0 | A6 |
| A5* | A3+A4+A5 | – | – | 6.54 | 7.4 | A6 |
| A6 | A6 | 5.22 | 8.0 | 5.22 | 8.0 | BASIN A |
| A6* | A3+A4+A5+A6 | – | – | 15.38 | 9.7 | BASIN A |
| A7 | A7 | 1.96 | 3.0 | 1.96 | 3.0 | BASIN A |
| A7* | A1+A2+A3+A4+A5+A6+A7 | – | – | 20.78 | 16.6 | BASIN A |
| B1 | B1 | 5.94 | 9.0 | 5.94 | 9.0 | BASIN B |
| C1 | C1 | 1.86 | 3.0 | 1.86 | 3.0 | BASIN C |
| D1 | D1 | 5.89 | 9.0 | 5.89 | 9.0 | D3 |
| D2 | D2 | 18.18 | 28.0 | 18.18 | 28.0 | D3 |
| D2* | D1+D2 | – | – | 24.07 | 37.1 | D3 |
| D3 | D3 | 6.60 | 10.0 | 6.60 | 10.0 | D6 |
| D3* | D1+D2+D3 | – | – | 30.67 | 41.9 | D6 |
| D4 | D4 | 9.09 | 14.0 | 9.09 | 14.0 | D6 |
| D5 | D5 | 9.62 | 15.0 | 9.62 | 15.0 | D6 |
| D5* | D4+D5 | – | – | 18.71 | 29.0 | D6 |
| D6 | D6 | 6.01 | 9.0 | 6.01 | 9.0 | D9 |
| D6* | D1+D2+D3+D4+D5+D6 | – | – | 55.39 | 61.5 | D9 |
| D7 | D7 | 4.42 | 7.0 | 4.42 | 7.0 | D9 |
| D8 | D8 | 5.04 | 8.0 | 5.04 | 8.0 | D9 |
| D8* | D7+D8 | – | – | 9.46 | 15.0 | D9 |
| D9 | D9 | 1.89 | 3.0 | 1.89 | 3.0 | D18 |
| D9* | D1+D2+D3+D4+D5+D6+D7 +D8+D9 | – | – | 66.74 | 66.8 | D18 |
| D10 | D10 | 4.44 | 7.0 | 4.44 | 7.0 | D11 |
| D11 | D11 | 3.34 | 5.0 | 3.34 | 5.0 | D12 |
| D11* | D10+D11 | – | – | 7.78 | 9.6 | D12 |
| D12 | D12 | 5.26 | 8.0 | 5.26 | 8.0 | D19 |
| D12* | D10+D11+D12 | – | – | 13.04 | 11.7 | D19 |
| D13 | D13 | 0.61 | 1.0 | 0.61 | 1.0 | D14 |
| D14 | D14 | 0.51 | 1.0 | 0.51 | 1.0 | D19 |
| D14* | D10+D11+D12+D13+D14 | – | – | 14.17 | 12.7 | D19 |
| D15 | D15 | 0.96 | 2.0 | 0.96 | 2.0 | D17 |
| D16 | D16 | 3.45 | 5.0 | 3.45 | 5.0 | D17 |
| D16* | D15+D16 | – | – | 4.42 | 7.0 | D17 |
| D17 | D17 | 1.12 | 2.0 | 1.12 | 2.0 | D18 |
| D17* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D15+D16+D17 | – | – | 72.29 | 68.3 | D18 |
| D18 | D18 | 0.99 | 2.0 | 0.99 | 2.0 | D19 |
| D18* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D10+D11+D12+D13 +D14+D15+D16+D17+D18 | – | – | 87.44 | 79.0 | D19 |
| D19 | D19 | 1.11 | 2.0 | 1.11 | 2.0 | BASIN D |
| D19* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D10+D11+D12+D13 +D14+D15+D16+D17+D18 +D19 | – | – | 88.55 | 79.2 | BASIN D |
| D20 | D20 | 3.07 | 5.0 | 3.07 | 5.0 | BASIN D |
| D21 | D21 | 22.94 | 36.1 | 22.94 | 36.1 | BASIN D |
| D21* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D10+D11+D12+D13 +D14+D15+D16+D17+D18 +D19+D20+D21 | – | – | 114.57 | 82.1 | BASIN D |

## LEGEND

- 2810 — 2014 10-FOOT CONTOUR
- 2014 2-FOOT CONTOUR
- DRAINAGE FLOW DIRECTION
- DRAINAGE TRIBUTARY AREA
- DRAINAGE FLOW LINE
- D10 — DRAINAGE AREA ID
- 4.44 AC — DRAINAGE AREA IN ACRES
- CPD11* — CONC. POINT (* = JUNCTION)
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- FUTURE PHASE BOUNDARY

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GRAPHIC SCALE
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( IN FEET )

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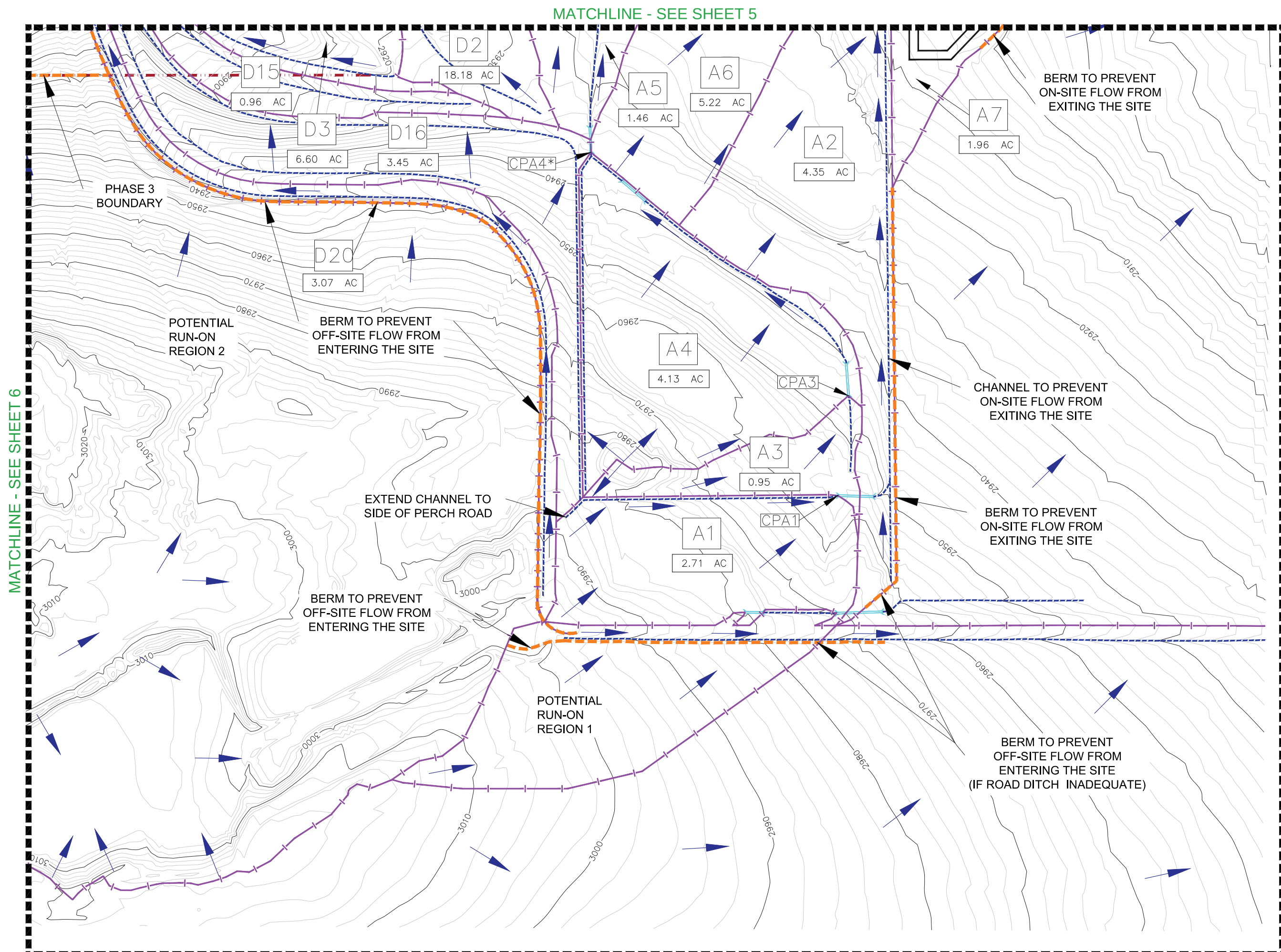
| MARK | DATE | DESCRIPTION | BY |
|---|---|---|---|
| | 10-2015 | EXHIBITS | |

PICKLES BUTTE LANDFILL - CANYON COUNTY, ID
LANDFILL STATUS REPORT UPDATE PROJECT
STORMWATER RUN-ON / RUN-OFF PLAN

Project No.: 197-2015-0100-150
Designed By: RTL / KAJ
Drawn By: RTL
Checked By: KAJ
SHEET NO. 6



10/26/2015 10:19:29 AM – F:\DATA\CLIENTS\TETRATECH\PICKLES BUTTE LANDFILL\STORMWATER\PICKLES-BUTTE-STORMWATER_X.DWG – LIVERMORE, TODD




**25 - YEAR, 24 - HOUR RUNOFF SUMMARY TABLE**

| CONC. POINT | CONTRIBUTING AREA(S) | AREA [AC] | RUNOFF [CFS] | Σ AREA [AC] | Σ RUNOFF [CFS] | DISCHARGES TO |
|---|---|---|---|---|---|---|
| A1 | A1 | 2.71 | 4.0 | 2.71 | 4.0 | A2 |
| A2 | A2 | 4.35 | 2.0 | 4.35 | 2.0 | BASIN A |
| A2* | A1+A2 | – | – | 7.06 | 5.0 | BASIN A |
| A3 | A3 | 0.95 | 1.0 | 0.95 | 1.0 | A4 |
| A4 | A4 | 4.13 | 6.0 | 4.13 | 6.0 | A5 |
| A4* | A3+A4 | – | – | 5.08 | 6.4 | A5 |
| A5 | A5 | 1.46 | 2.0 | 1.46 | 2.0 | A6 |
| A5* | A3+A4+A5 | – | – | 6.54 | 7.4 | A6 |
| A6 | A6 | 5.22 | 8.0 | 5.22 | 8.0 | BASIN A |
| A6* | A3+A4+A5+A6 | – | – | 15.38 | 9.7 | BASIN A |
| A7 | A7 | 1.96 | 3.0 | 1.96 | 3.0 | BASIN A |
| A7* | A1+A2+A3+A4+A5+A6+A7 | – | – | 20.78 | 16.6 | BASIN A |
| B1 | B1 | 5.94 | 9.0 | 5.94 | 9.0 | BASIN B |
| C1 | C1 | 1.86 | 3.0 | 1.86 | 3.0 | BASIN C |
| D1 | D1 | 5.89 | 9.0 | 5.89 | 9.0 | D3 |
| D2 | D2 | 18.18 | 28.0 | 18.18 | 28.0 | D3 |
| D2* | D1+D2 | – | – | 24.07 | 37.1 | D3 |
| D3 | D3 | 6.60 | 10.0 | 6.60 | 10.0 | D6 |
| D3* | D1+D2+D3 | – | – | 30.67 | 41.9 | D6 |
| D4 | D4 | 9.09 | 14.0 | 9.09 | 14.0 | D6 |
| D5 | D5 | 9.62 | 15.0 | 9.62 | 15.0 | D6 |
| D5* | D4+D5 | – | – | 18.71 | 29.0 | D6 |
| D6 | D6 | 6.01 | 9.0 | 6.01 | 9.0 | D9 |
| D6* | D1+D2+D3+D4+D5+D6 | – | – | 55.39 | 61.5 | D9 |
| D7 | D7 | 4.42 | 7.0 | 4.42 | 7.0 | D9 |
| D8 | D8 | 5.04 | 8.0 | 5.04 | 8.0 | D9 |
| D8* | D7+D8 | – | – | 9.46 | 15.0 | D9 |
| D9 | D9 | 1.89 | 3.0 | 1.89 | 3.0 | D18 |
| D9* | D1+D2+D3+D4+D5+D6+D7 +D8+D9 | – | – | 66.74 | 66.8 | D18 |
| D10 | D10 | 4.44 | 7.0 | 4.44 | 7.0 | D11 |
| D11 | D11 | 3.34 | 5.0 | 3.34 | 5.0 | D12 |
| D11* | D10+D11 | – | – | 7.78 | 9.6 | D12 |
| D12 | D12 | 5.26 | 8.0 | 5.26 | 8.0 | D19 |
| D12* | D10+D11+D12 | – | – | 13.04 | 11.7 | D19 |
| D13 | D13 | 0.61 | 1.0 | 0.61 | 1.0 | D14 |
| D14 | D14 | 0.51 | 1.0 | 0.51 | 1.0 | D19 |
| D14* | D10+D11+D12+D13+D14 | – | – | 14.17 | 12.7 | D19 |
| D15 | D15 | 0.96 | 2.0 | 0.96 | 2.0 | D17 |
| D16 | D16 | 3.45 | 5.0 | 3.45 | 5.0 | D17 |
| D16* | D15+D16 | – | – | 4.42 | 7.0 | D17 |
| D17 | D17 | 1.12 | 2.0 | 1.12 | 2.0 | D18 |
| D17* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D15+D16+D17 | – | – | 72.29 | 68.3 | D18 |
| D18 | D18 | 0.99 | 2.0 | 0.99 | 2.0 | D19 |
| D18* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D10+D11+D12+D13 +D14+D15+D16+D17+D18 | – | – | 87.44 | 79.0 | D19 |
| D19 | D19 | 1.11 | 2.0 | 1.11 | 2.0 | BASIN D |
| D19* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D10+D11+D12+D13 +D14+D15+D16+D17+D18 +D19 | – | – | 88.55 | 79.2 | BASIN D |
| D20 | D20 | 3.07 | 5.0 | 3.07 | 5.0 | BASIN D |
| D21 | D21 | 22.94 | 36.1 | 22.94 | 36.1 | BASIN D |
| D21* | D1+D2+D3+D4+D5+D6+D7 +D8+D9+D10+D11+D12+D13 +D14+D15+D16+D17+D18 +D19+D20+D21 | – | – | 114.57 | 82.1 | BASIN D |

## LEGEND

- 2810 — 2014 10–FOOT CONTOUR
- 2014 2–FOOT CONTOUR
- DRAINAGE FLOW DIRECTION
- DRAINAGE TRIBUTARY AREA
- DRAINAGE FLOW LINE
- D10 — DRAINAGE AREA ID
- 4.44 AC — DRAINAGE AREA IN ACRES
- CPD11* — CONC. POINT (* = JUNCTION)
- CULVERT
- BERM
- FUTURE PHASE BOUNDARY

N

GRAPHIC SCALE

100 50 0 100 200

( IN FEET )

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Bozeman, Montana 59715
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GreatWest engineering®
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HELENA, MT 59601
(406)449-8627

| MARK | DATE | DESCRIPTION | BY |
|---|---|---|---|
| | 10-2015 | EXHIBITS | |

PICKLES BUTTE LANDFILL - CANYON COUNTY, ID

LANDFILL STATUS REPORT UPDATE PROJECT

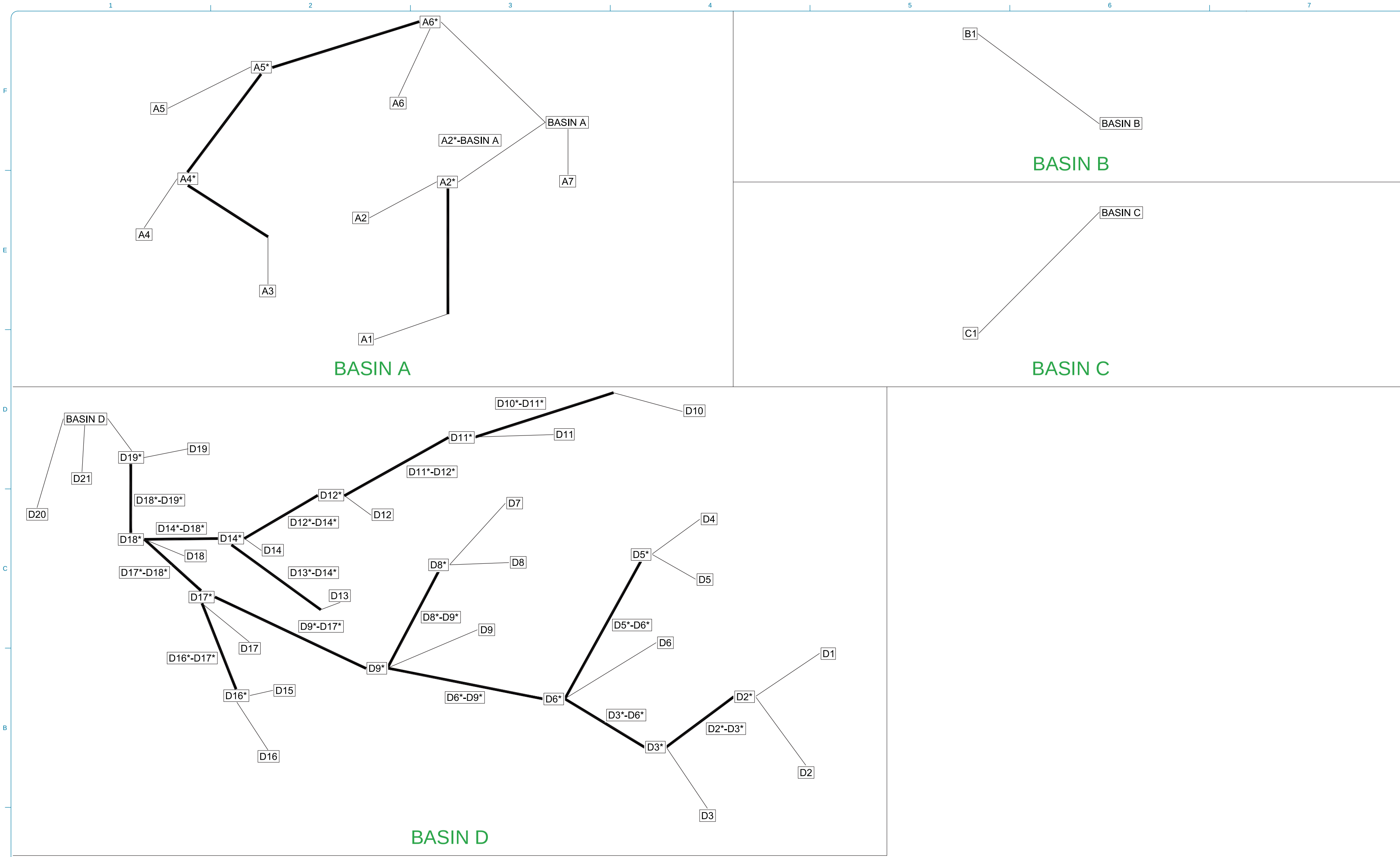
STORMWATER RUN-ON / RUN-OFF PLAN

Project No.: 197-2015-0100-150
Designed By: RTL / KAJ
Drawn By: RTL
Checked By: KAJ

SHEET NO. 7



10/26/2015 10:19:46 AM – F:\DATA\CLIENTS\TETRATECH\PICKLES BUTTE LANDFILL\STORMWATER\PICKLES-BUTTE-STORMWATER_X.DWG – LIVERMORE, TODD




BASIN TRIBUTARIES , JUNCTIONS, & ROUTING SCHEMATIC (NTS)

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(406)449-8627

| MARK | DATE | DESCRIPTION | BY |
|---|---|---|---|
| 10-2015 | | EXHIBITS | |

PICKLES BUTTE LANDFILL - CANYON COUNTY, ID
LANDFILL STATUS REPORT UPDATE PROJECT
STORMWATER RUN-ON / RUN-OFF PLAN

Project No.: 197-2015-0100-150
Designed By: RTL / KAJ
Drawn By: RTL
Checked By: KAJ

SHEET NO.
8



10/26/2015 10:23:17 AM – F:\DATA\CLIENTS\TETRATECH\PICKLES BUTTE LANDFILL\STORMWATER\PICKLES-BUTTE-STORMWATER_X.DWG – LIVERMORE, TODD

# APPENDIX 7-C
# FLOWMASTER CALCULATIONS

# Cross Section for CPA1-CULVERT

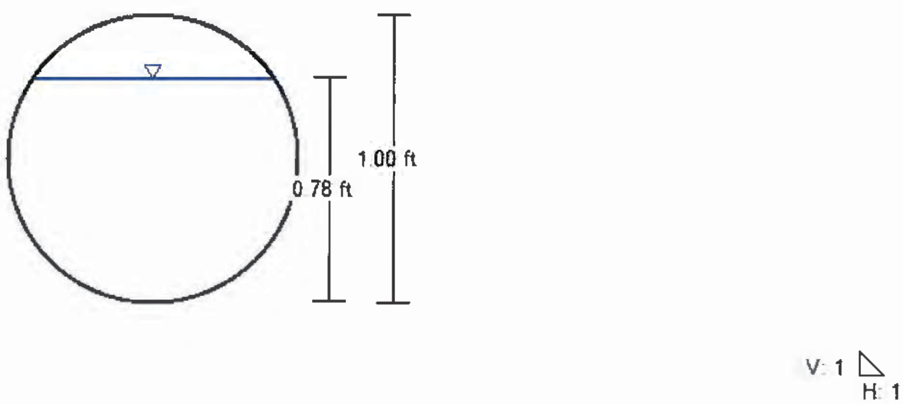
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.04700 | ft/ft |
| Normal Depth | 0.78 | ft |
| Diameter | 1.00 | ft |
| Discharge | 4.00 | $ft^3/s$ |

## Cross Section Image



# Worksheet for CPA1-CULVERT

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.04700 | ft/ft |
| Diameter | 1.00 | ft |
| Discharge | 4.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.78 | ft |
| Flow Area | 0.66 | ft² |
| Wetted Perimeter | 2.17 | ft |
| Hydraulic Radius | 0.30 | ft |
| Top Width | 0.82 | ft |
| Critical Depth | 0.85 | ft |
| Percent Full | 78.3 | % |
| Critical Slope | 0.04064 | ft/ft |
| Velocity | 6.06 | ft/s |
| Velocity Head | 0.57 | ft |
| Specific Energy | 1.35 | ft |
| Froude Number | 1.20 | |
| Maximum Discharge | 4.50 | ft³/s |
| Discharge Full | 4.18 | ft³/s |
| Slope Full | 0.04297 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 78.28 | % |
| Downstream Velocity | Infinity | ft/s |

## Worksheet for CPA1-CULVERT

### GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.78 | ft |
| Critical Depth | 0.85 | ft |
| Channel Slope | 0.04700 | ft/ft |
| Critical Slope | 0.04064 | ft/ft |

# Cross Section for CPA2*-CULVERT

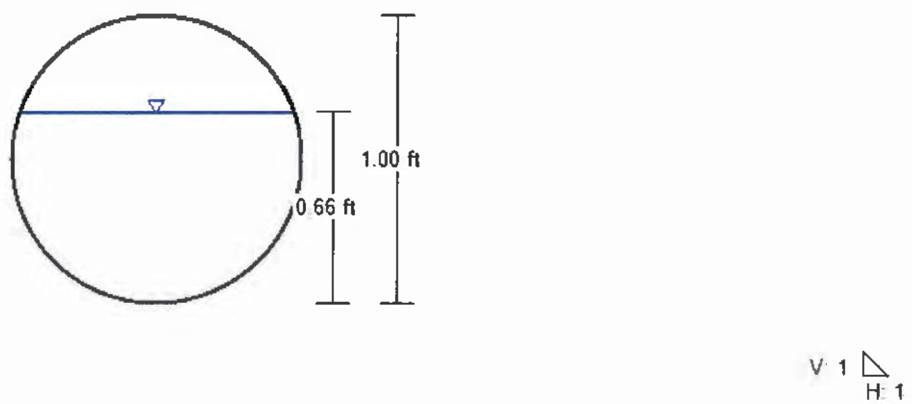
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.11100 | ft/ft |
| Normal Depth | 0.66 | ft |
| Diameter | 1.00 | ft |
| Discharge | 5.00 | ft³/s |

## Cross Section Image



# Worksheet for CPA2*-CULVERT

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.11100 | ft/ft |
| Diameter | 1.00 | ft |
| Discharge | 5.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.66 | ft |
| Flow Area | 0.55 | ft² |
| Wetted Perimeter | 1.90 | ft |
| Hydraulic Radius | 0.29 | ft |
| Top Width | 0.95 | ft |
| Critical Depth | 0.92 | ft |
| Percent Full | 66.3 | % |
| Critical Slope | 0.05837 | ft/ft |
| Velocity | 9.04 | ft/s |
| Velocity Head | 1.27 | ft |
| Specific Energy | 1.93 | ft |
| Froude Number | 2.09 | |
| Maximum Discharge | 6.92 | ft³/s |
| Discharge Full | 6.43 | ft³/s |
| Slope Full | 0.06713 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 66.30 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPA2*-CULVERT

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.66 | ft |
| Critical Depth | 0.92 | ft |
| Channel Slope | 0.11100 | ft/ft |
| Critical Slope | 0.05837 | ft/ft |

# Cross Section for CPA3-CULVERT

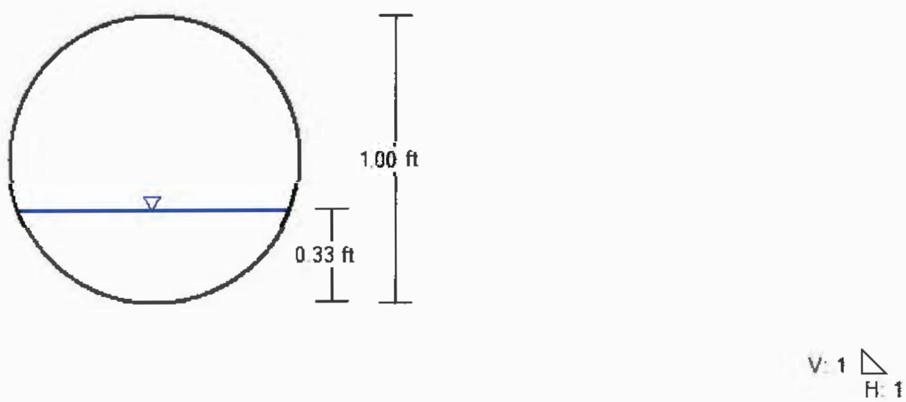
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.05100 | ft/ft |
| Normal Depth | 0.33 | ft |
| Diameter | 1.00 | ft |
| Discharge | 1.00 | ft³/s |

## Cross Section Image



# Worksheet for CPA3-CULVERT

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.05100 | ft/ft |
| Diameter | 1.00 | ft |
| Discharge | 1.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.33 | ft |
| Flow Area | 0.22 | ft² |
| Wetted Perimeter | 1.21 | ft |
| Hydraulic Radius | 0.18 | ft |
| Top Width | 0.94 | ft |
| Critical Depth | 0.42 | ft |
| Percent Full | 32.6 | % |
| Critical Slope | 0.01980 | ft/ft |
| Velocity | 4.51 | ft/s |
| Velocity Head | 0.32 | ft |
| Specific Energy | 0.64 | ft |
| Froude Number | 1.63 | |
| Maximum Discharge | 4.69 | ft³/s |
| Discharge Full | 4.36 | ft³/s |
| Slope Full | 0.00269 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 32.56 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPA3-CULVERT

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.33 | ft |
| Critical Depth | 0.42 | ft |
| Channel Slope | 0.05100 | ft/ft |
| Critical Slope | 0.01980 | ft/ft |

# Cross Section for CPA4*-CULVERT

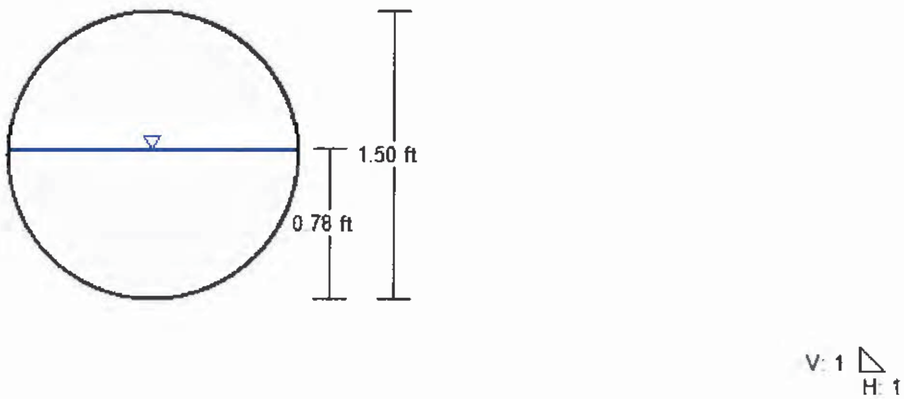
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.04400 | ft/ft |
| Normal Depth | 0.78 | ft |
| Diameter | 1.50 | ft |
| Discharge | 6.40 | ft³/s |

## Cross Section Image



# Worksheet for CPA4*-CULVERT

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.04400 | ft/ft |
| Diameter | 1.50 | ft |
| Discharge | 6.40 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.78 | ft |
| Flow Area | 0.93 | $ft^2$ |
| Wetted Perimeter | 2.42 | ft |
| Hydraulic Radius | 0.38 | ft |
| Top Width | 1.50 | ft |
| Critical Depth | 0.98 | ft |
| Percent Full | 52.1 | % |
| Critical Slope | 0.02189 | ft/ft |
| Velocity | 6.87 | ft/s |
| Velocity Head | 0.73 | ft |
| Specific Energy | 1.52 | ft |
| Froude Number | 1.54 | |
| Maximum Discharge | 12.84 | $ft^3/s$ |
| Discharge Full | 11.93 | $ft^3/s$ |
| Slope Full | 0.01265 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 52.12 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPA4*-CULVERT

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.78 | ft |
| Critical Depth | 0.98 | ft |
| Channel Slope | 0.04400 | ft/ft |
| Critical Slope | 0.02189 | ft/ft |

# Cross Section for CPA5*-CULVERT

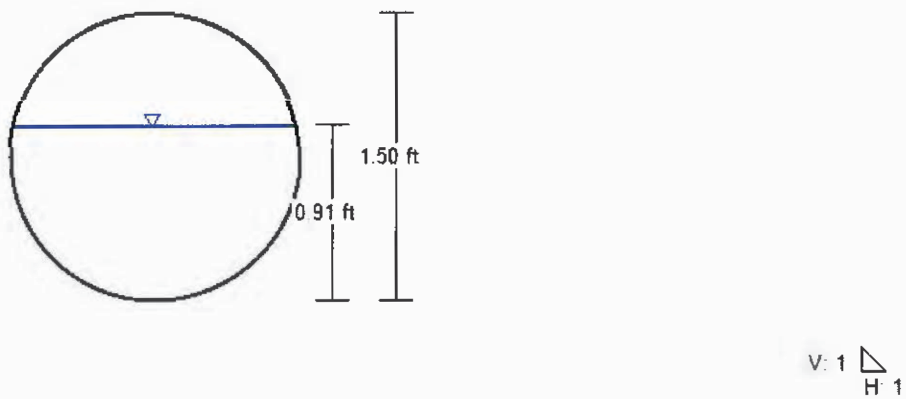
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.03600 | ft/ft |
| Normal Depth | 0.91 | ft |
| Diameter | 1.50 | ft |
| Discharge | 7.40 | ft³/s |

## Cross Section Image



# Worksheet for CPA5*-CULVERT

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.03600 | ft/ft |
| Diameter | 1.50 | ft |
| Discharge | 7.40 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.91 | ft |
| Flow Area | 1.12 | ft² |
| Wetted Perimeter | 2.68 | ft |
| Hydraulic Radius | 0.42 | ft |
| Top Width | 1.46 | ft |
| Critical Depth | 1.05 | ft |
| Percent Full | 60.8 | % |
| Critical Slope | 0.02390 | ft/ft |
| Velocity | 6.58 | ft/s |
| Velocity Head | 0.67 | ft |
| Specific Energy | 1.58 | ft |
| Froude Number | 1.32 | |
| Maximum Discharge | 11.61 | ft³/s |
| Discharge Full | 10.80 | ft³/s |
| Slope Full | 0.01692 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 60.80 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPA5*-CULVERT

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.91 | ft |
| Critical Depth | 1.05 | ft |
| Channel Slope | 0.03600 | ft/ft |
| Critical Slope | 0.02390 | ft/ft |

# Cross Section for CPA6*-CULVERT

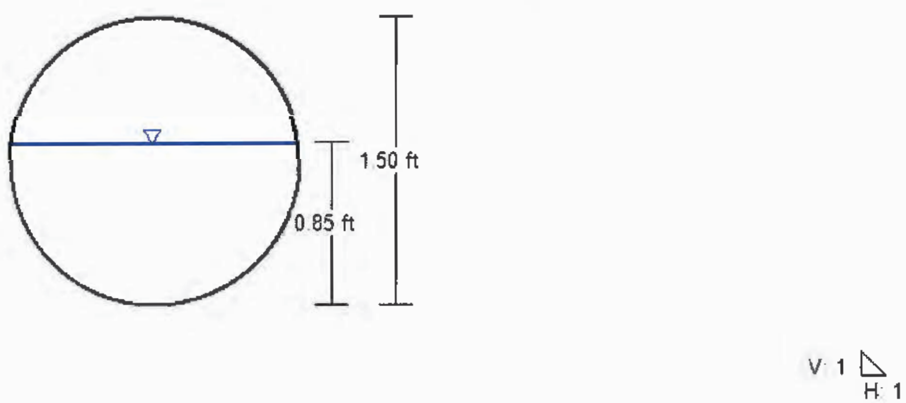
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.07800 | ft/ft |
| Normal Depth | 0.85 | ft |
| Diameter | 1.50 | ft |
| Discharge | 9.70 | $ft^3/s$ |

## Cross Section Image



# Worksheet for CPA6*-CULVERT

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.07800 | ft/ft |
| Diameter | 1.50 | ft |
| Discharge | 9.70 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.85 | ft |
| Flow Area | 1.03 | ft² |
| Wetted Perimeter | 2.55 | ft |
| Hydraulic Radius | 0.40 | ft |
| Top Width | 1.49 | ft |
| Critical Depth | 1.20 | ft |
| Percent Full | 56.4 | % |
| Critical Slope | 0.03031 | ft/ft |
| Velocity | 9.44 | ft/s |
| Velocity Head | 1.38 | ft |
| Specific Energy | 2.23 | ft |
| Froude Number | 2.00 | |
| Maximum Discharge | 17.09 | ft³/s |
| Discharge Full | 15.89 | ft³/s |
| Slope Full | 0.02907 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 56.43 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPA6*-CULVERT

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.85 | ft |
| Critical Depth | 1.20 | ft |
| Channel Slope | 0.07800 | ft/ft |
| Critical Slope | 0.03031 | ft/ft |

# Cross Section for CPC1-CULVERT

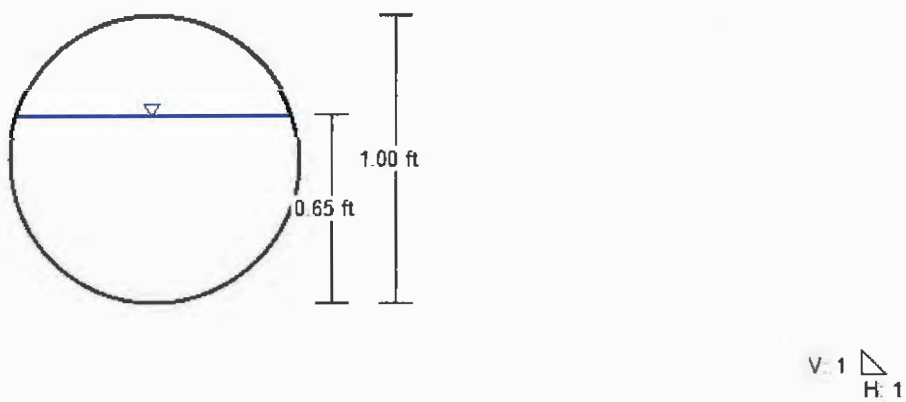
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.04200 | ft/ft |
| Normal Depth | 0.65 | ft |
| Diameter | 1.00 | ft |
| Discharge | 3.00 | ft³/s |

## Cross Section Image



# Worksheet for CPC1-CULVERT

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.04200 | ft/ft |
| Diameter | 1.00 | ft |
| Discharge | 3.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.65 | ft |
| Flow Area | 0.54 | ft² |
| Wetted Perimeter | 1.88 | ft |
| Hydraulic Radius | 0.29 | ft |
| Top Width | 0.95 | ft |
| Critical Depth | 0.74 | ft |
| Percent Full | 65.1 | % |
| Critical Slope | 0.02975 | ft/ft |
| Velocity | 5.54 | ft/s |
| Velocity Head | 0.48 | ft |
| Specific Energy | 1.13 | ft |
| Froude Number | 1.29 | |
| Maximum Discharge | 4.25 | ft³/s |
| Discharge Full | 3.95 | ft³/s |
| Slope Full | 0.02417 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 65.14 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPC1-CULVERT

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.65 | ft |
| Critical Depth | 0.74 | ft |
| Channel Slope | 0.04200 | ft/ft |
| Critical Slope | 0.02975 | ft/ft |

# Cross Section for CPD2*-CULVERT

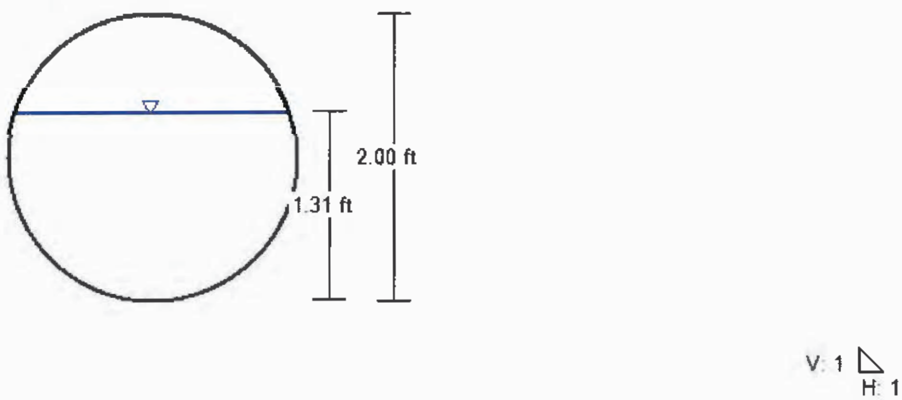
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.04100 | ft/ft |
| Normal Depth | 1.31 | ft |
| Diameter | 2.00 | ft |
| Discharge | 19.00 | ft³/s |

## Cross Section Image



# Worksheet for CPD2*-CULVERT

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.04100 | ft/ft |
| Diameter | 2.00 | ft |
| Discharge | 19.00 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.31 | ft |
| Flow Area | 2.18 | $ft^2$ |
| Wetted Perimeter | 3.77 | ft |
| Hydraulic Radius | 0.58 | ft |
| Top Width | 1.90 | ft |
| Critical Depth | 1.57 | ft |
| Percent Full | 65.6 | % |
| Critical Slope | 0.02620 | ft/ft |
| Velocity | 8.70 | ft/s |
| Velocity Head | 1.18 | ft |
| Specific Energy | 2.49 | ft |
| Froude Number | 1.43 | |
| Maximum Discharge | 26.69 | $ft^3/s$ |
| Discharge Full | 24.81 | $ft^3/s$ |
| Slope Full | 0.02404 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 65.57 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPD2*-CULVERT

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.31 | ft |
| Critical Depth | 1.57 | ft |
| Channel Slope | 0.04100 | ft/ft |
| Critical Slope | 0.02620 | ft/ft |

# Cross Section for CPD3*-CULVERT

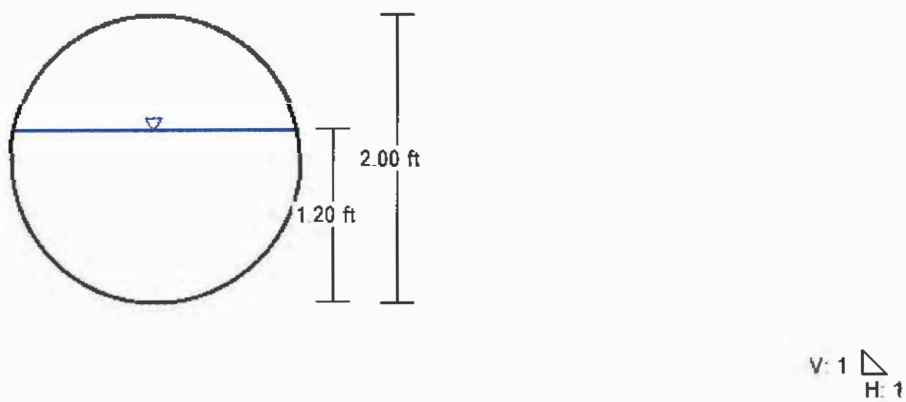
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.06500 | ft/ft |
| Normal Depth | 1.20 | ft |
| Diameter | 2.00 | ft |
| Discharge | 21.00 | $ft^3/s$ |

## Cross Section Image



# Worksheet for CPD3*-CULVERT

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.06500 | ft/ft |
| Diameter | 2.00 | ft |
| Discharge | 21.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.20 | ft |
| Flow Area | 1.97 | ft² |
| Wetted Perimeter | 3.55 | ft |
| Hydraulic Radius | 0.56 | ft |
| Top Width | 1.96 | ft |
| Critical Depth | 1.64 | ft |
| Percent Full | 60.0 | % |
| Critical Slope | 0.02928 | ft/ft |
| Velocity | 10.66 | ft/s |
| Velocity Head | 1.77 | ft |
| Specific Energy | 2.97 | ft |
| Froude Number | 1.88 | |
| Maximum Discharge | 33.60 | ft³/s |
| Discharge Full | 31.24 | ft³/s |
| Slope Full | 0.02937 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 60.03 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPD3*-CULVERT

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.20 | ft |
| Critical Depth | 1.64 | ft |
| Channel Slope | 0.06500 | ft/ft |
| Critical Slope | 0.02928 | ft/ft |

# Cross Section for CPD4-CULVERT

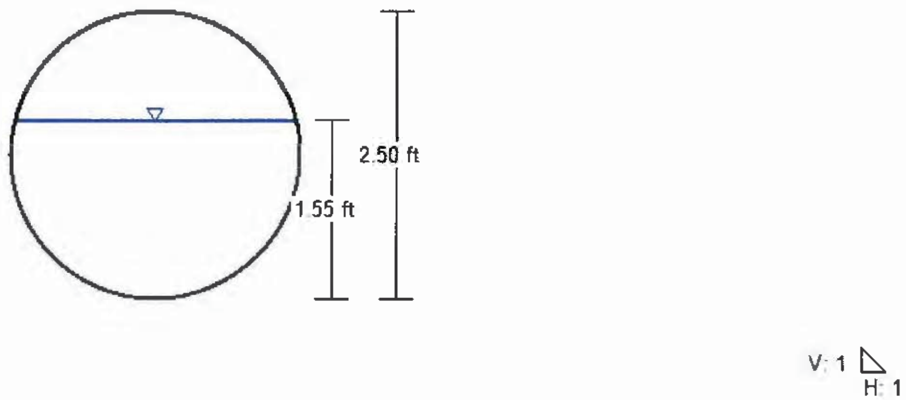
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.00800 | ft/ft |
| Normal Depth | 1.55 | ft |
| Diameter | 2.50 | ft |
| Discharge | 14.00 | ft³/s |

## Cross Section Image



# Worksheet for CPD4-CULVERT

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.00800 | ft/ft |
| Diameter | 2.50 | ft |
| Discharge | 14.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.55 | ft |
| Flow Area | 3.19 | ft² |
| Wetted Perimeter | 4.53 | ft |
| Hydraulic Radius | 0.70 | ft |
| Top Width | 2.43 | ft |
| Critical Depth | 1.26 | ft |
| Percent Full | 61.9 | % |
| Critical Slope | 0.01547 | ft/ft |
| Velocity | 4.39 | ft/s |
| Velocity Head | 0.30 | ft |
| Specific Energy | 1.85 | ft |
| Froude Number | 0.67 | |
| Maximum Discharge | 21.38 | ft³/s |
| Discharge Full | 19.87 | ft³/s |
| Slope Full | 0.00397 | ft/ft |
| Flow Type | SubCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 61.91 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPD4-CULVERT

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.55 | ft |
| Critical Depth | 1.26 | ft |
| Channel Slope | 0.00800 | ft/ft |
| Critical Slope | 0.01547 | ft/ft |

# Cross Section for CPD6*-CULVERT

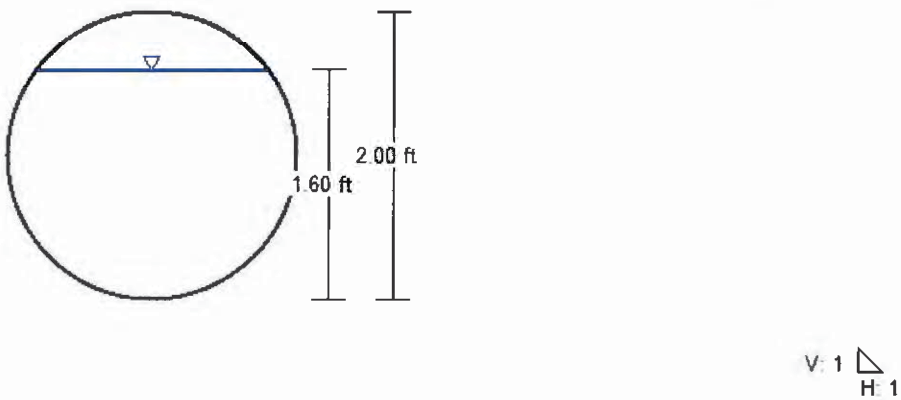
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.06700 | ft/ft |
| Normal Depth | 1.60 | ft |
| Diameter | 2.00 | ft |
| Discharge | 31.00 | ft³/s |

## Cross Section Image



# Worksheet for CPD6*-CULVERT

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.06700 | ft/ft |
| Diameter | 2.00 | ft |
| Discharge | 31.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.60 | ft |
| Flow Area | 2.69 | ft² |
| Wetted Perimeter | 4.43 | ft |
| Hydraulic Radius | 0.61 | ft |
| Top Width | 1.60 | ft |
| Critical Depth | 1.88 | ft |
| Percent Full | 80.0 | % |
| Critical Slope | 0.05531 | ft/ft |
| Velocity | 11.51 | ft/s |
| Velocity Head | 2.06 | ft |
| Specific Energy | 3.66 | ft |
| Froude Number | 1.56 | |
| Maximum Discharge | 34.12 | ft³/s |
| Discharge Full | 31.72 | ft³/s |
| Slope Full | 0.06401 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 80.00 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPD6*-CULVERT

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.60 | ft |
| Critical Depth | 1.88 | ft |
| Channel Slope | 0.06700 | ft/ft |
| Critical Slope | 0.05531 | ft/ft |

# Cross Section for CPD7-CULVERT

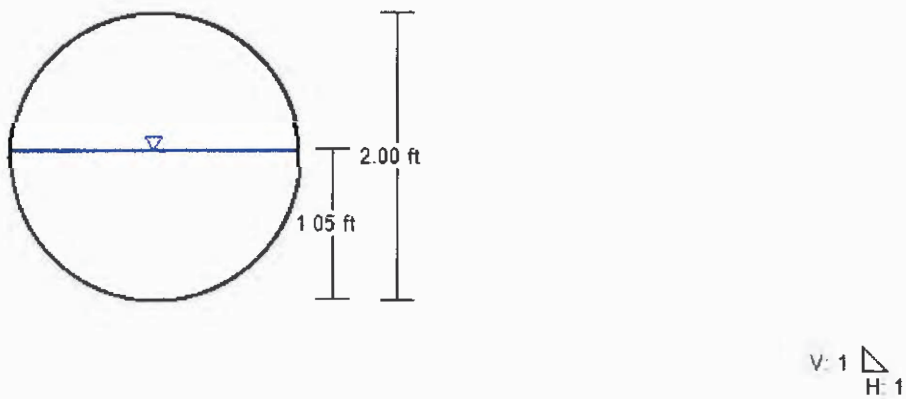
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.01100 | ft/ft |
| Normal Depth | 1.05 | ft |
| Diameter | 2.00 | ft |
| Discharge | 7.00 | $ft^3/s$ |

## Cross Section Image



# Worksheet for CPD7-CULVERT

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.01100 | ft/ft |
| Diameter | 2.00 | ft |
| Discharge | 7.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.05 | ft |
| Flow Area | 1.68 | ft² |
| Wetted Perimeter | 3.25 | ft |
| Hydraulic Radius | 0.52 | ft |
| Top Width | 2.00 | ft |
| Critical Depth | 0.94 | ft |
| Percent Full | 52.6 | % |
| Critical Slope | 0.01622 | ft/ft |
| Velocity | 4.18 | ft/s |
| Velocity Head | 0.27 | ft |
| Specific Energy | 1.32 | ft |
| Froude Number | 0.80 | |
| Maximum Discharge | 13.82 | ft³/s |
| Discharge Full | 12.85 | ft³/s |
| Slope Full | 0.00326 | ft/ft |
| Flow Type | SubCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 52.61 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPD7-CULVERT

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.05 | ft |
| Critical Depth | 0.94 | ft |
| Channel Slope | 0.01100 | ft/ft |
| Critical Slope | 0.01622 | ft/ft |

# Cross Section for CPD8*-CULVERT

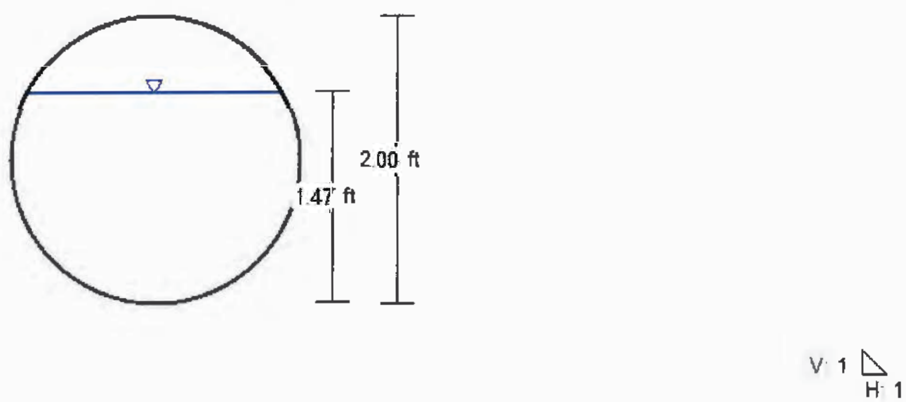
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.01900 | ft/ft |
| Normal Depth | 1.47 | ft |
| Diameter | 2.00 | ft |
| Discharge | 15.00 | ft³/s |

## Cross Section Image



# Worksheet for CPD8*-CULVERT

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.01900 | ft/ft |
| Diameter | 2.00 | ft |
| Discharge | 15.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.47 | ft |
| Flow Area | 2.47 | ft² |
| Wetted Perimeter | 4.11 | ft |
| Hydraulic Radius | 0.60 | ft |
| Top Width | 1.77 | ft |
| Critical Depth | 1.40 | ft |
| Percent Full | 73.4 | % |
| Critical Slope | 0.02154 | ft/ft |
| Velocity | 6.07 | ft/s |
| Velocity Head | 0.57 | ft |
| Specific Energy | 2.04 | ft |
| Froude Number | 0.91 | |
| Maximum Discharge | 18.17 | ft³/s |
| Discharge Full | 16.89 | ft³/s |
| Slope Full | 0.01499 | ft/ft |
| Flow Type | SubCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 73.35 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPD8*-CULVERT

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.47 | ft |
| Critical Depth | 1.40 | ft |
| Channel Slope | 0.01900 | ft/ft |
| Critical Slope | 0.02154 | ft/ft |

# Cross Section for CPD9*-CULVERT

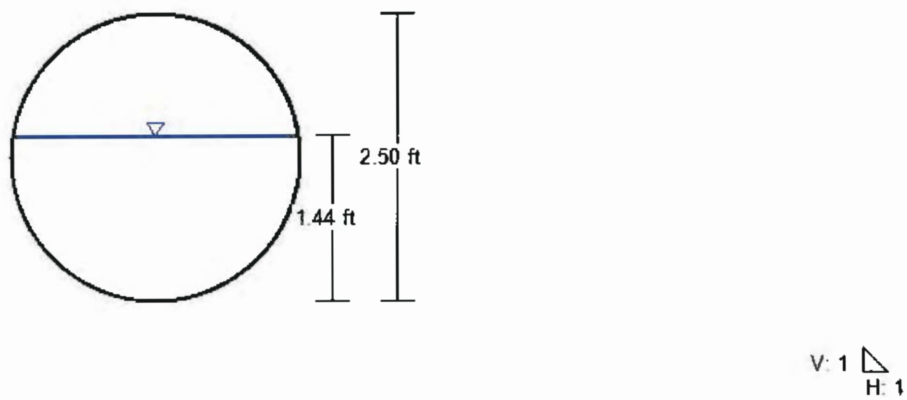
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.05900 | ft/ft |
| Normal Depth | 1.44 | ft |
| Diameter | 2.50 | ft |
| Discharge | 34.00 | $ft^3/s$ |

## Cross Section Image



# Worksheet for CPD9*-CULVERT

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.05900 | ft/ft |
| Diameter | 2.50 | ft |
| Discharge | 34.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.44 | ft |
| Flow Area | 2.93 | ft² |
| Wetted Perimeter | 4.31 | ft |
| Hydraulic Radius | 0.68 | ft |
| Top Width | 2.47 | ft |
| Critical Depth | 1.98 | ft |
| Percent Full | 57.6 | % |
| Critical Slope | 0.02494 | ft/ft |
| Velocity | 11.62 | ft/s |
| Velocity Head | 2.10 | ft |
| Specific Energy | 3.54 | ft |
| Froude Number | 1.88 | |
| Maximum Discharge | 58.05 | ft³/s |
| Discharge Full | 53.96 | ft³/s |
| Slope Full | 0.02343 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 57.58 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPD9*-CULVERT

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.44 | ft |
| Critical Depth | 1.98 | ft |
| Channel Slope | 0.05900 | ft/ft |
| Critical Slope | 0.02494 | ft/ft |

# Cross Section for CPD11*-CULVERT

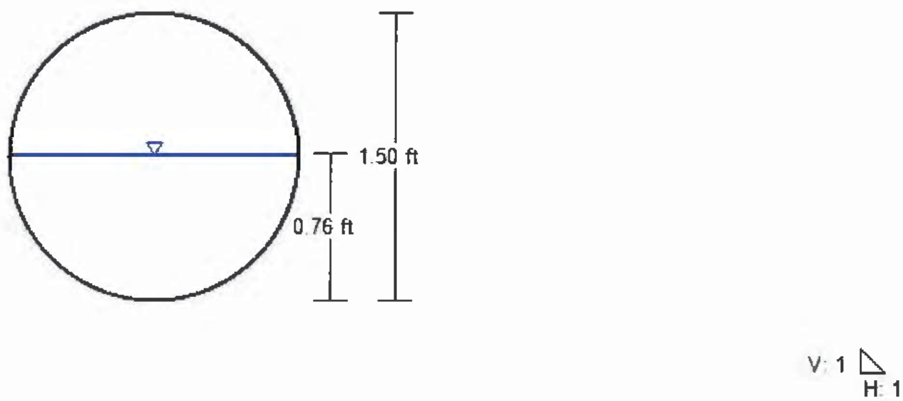
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.10900 | ft/ft |
| Normal Depth | 0.76 | ft |
| Diameter | 1.50 | ft |
| Discharge | 9.60 | ft³/s |

## Cross Section Image



# Worksheet for CPD11*-CULVERT

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.10900 | ft/ft |
| Diameter | 1.50 | ft |
| Discharge | 9.60 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.76 | ft |
| Flow Area | 0.90 | ft² |
| Wetted Perimeter | 2.38 | ft |
| Hydraulic Radius | 0.38 | ft |
| Top Width | 1.50 | ft |
| Critical Depth | 1.20 | ft |
| Percent Full | 50.6 | % |
| Critical Slope | 0.02996 | ft/ft |
| Velocity | 10.69 | ft/s |
| Velocity Head | 1.78 | ft |
| Specific Energy | 2.54 | ft |
| Froude Number | 2.44 | |
| Maximum Discharge | 20.21 | ft³/s |
| Discharge Full | 18.78 | ft³/s |
| Slope Full | 0.02847 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 50.64 | % |
| Downstream Velocity | Infinity | ft/s |

## Worksheet for CPD11*-CULVERT

### GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.76 | ft |
| Critical Depth | 1.20 | ft |
| Channel Slope | 0.10900 | ft/ft |
| Critical Slope | 0.02996 | ft/ft |

# Cross Section for CPD12*-CULVERT

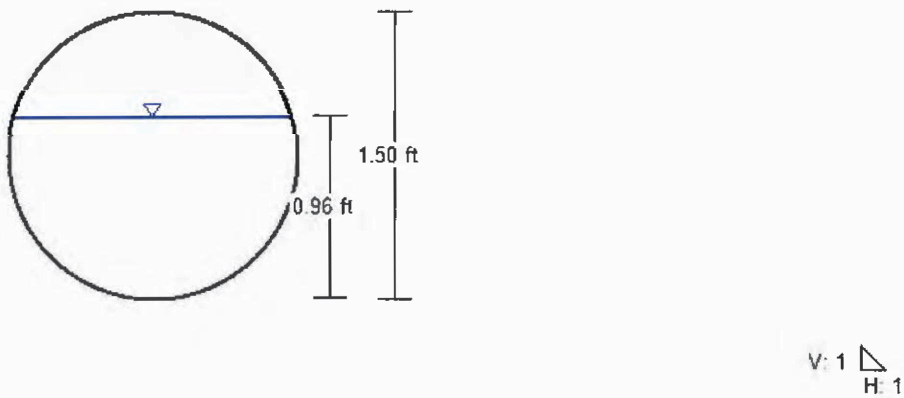
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.07800 | ft/ft |
| Normal Depth | 0.96 | ft |
| Diameter | 1.50 | ft |
| Discharge | 11.70 | $ft^3/s$ |

## Cross Section Image



# Worksheet for CPD12*-CULVERT

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.07800 | ft/ft |
| Diameter | 1.50 | ft |
| Discharge | 11.70 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.96 | ft |
| Flow Area | 1.19 | ft² |
| Wetted Perimeter | 2.78 | ft |
| Hydraulic Radius | 0.43 | ft |
| Top Width | 1.44 | ft |
| Critical Depth | 1.30 | ft |
| Percent Full | 63.8 | % |
| Critical Slope | 0.03869 | ft/ft |
| Velocity | 9.83 | ft/s |
| Velocity Head | 1.50 | ft |
| Specific Energy | 2.46 | ft |
| Froude Number | 1.91 | |
| Maximum Discharge | 17.09 | ft³/s |
| Discharge Full | 15.89 | ft³/s |
| Slope Full | 0.04229 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 63.78 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPD12*-CULVERT

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.96 | ft |
| Critical Depth | 1.30 | ft |
| Channel Slope | 0.07800 | ft/ft |
| Critical Slope | 0.03869 | ft/ft |

# Cross Section for CPD13-CULVERT

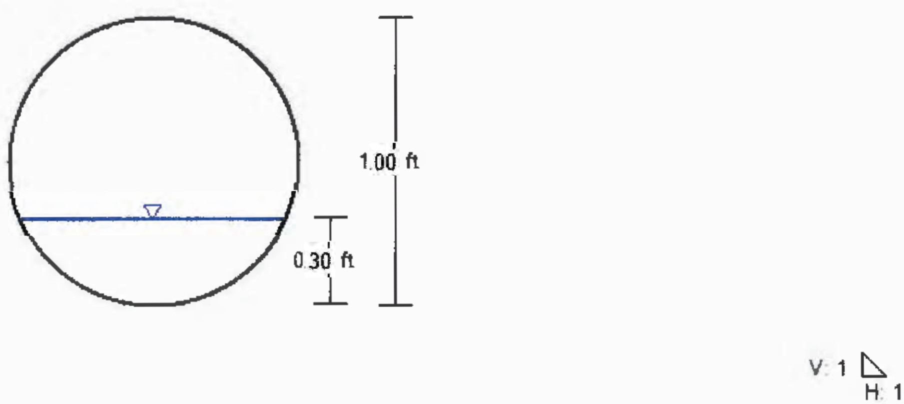
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.06700 | ft/ft |
| Normal Depth | 0.30 | ft |
| Diameter | 1.00 | ft |
| Discharge | 1.00 | ft³/s |

## Cross Section Image



# Worksheet for CPD13-CULVERT

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.06700 | ft/ft |
| Diameter | 1.00 | ft |
| Discharge | 1.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.30 | ft |
| Flow Area | 0.20 | ft² |
| Wetted Perimeter | 1.17 | ft |
| Hydraulic Radius | 0.17 | ft |
| Top Width | 0.92 | ft |
| Critical Depth | 0.42 | ft |
| Percent Full | 30.3 | % |
| Critical Slope | 0.01979 | ft/ft |
| Velocity | 4.97 | ft/s |
| Velocity Head | 0.38 | ft |
| Specific Energy | 0.69 | ft |
| Froude Number | 1.87 | |
| Maximum Discharge | 5.37 | ft³/s |
| Discharge Full | 5.00 | ft³/s |
| Slope Full | 0.00269 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 30.34 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPD13-CULVERT

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.30 | ft |
| Critical Depth | 0.42 | ft |
| Channel Slope | 0.06700 | ft/ft |
| Critical Slope | 0.01979 | ft/ft |

# Cross Section for CPD14*-CULVERT

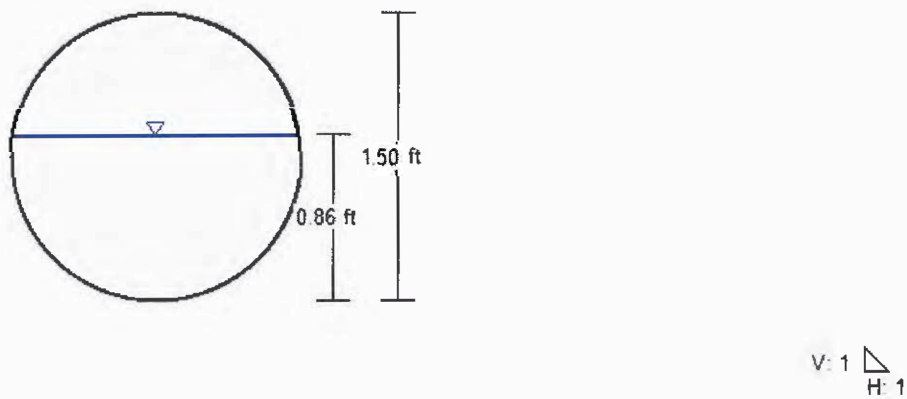
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.12500 | ft/ft |
| Normal Depth | 0.86 | ft |
| Diameter | 1.50 | ft |
| Discharge | 12.70 | ft³/s |

## Cross Section Image



# Worksheet for CPD14*-CULVERT

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.12500 | ft/ft |
| Diameter | 1.50 | ft |
| Discharge | 12.70 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.86 | ft |
| Flow Area | 1.06 | ft² |
| Wetted Perimeter | 2.59 | ft |
| Hydraulic Radius | 0.41 | ft |
| Top Width | 1.48 | ft |
| Critical Depth | 1.34 | ft |
| Percent Full | 57.7 | % |
| Critical Slope | 0.04412 | ft/ft |
| Velocity | 12.04 | ft/s |
| Velocity Head | 2.25 | ft |
| Specific Energy | 3.12 | ft |
| Froude Number | 2.52 | |
| Maximum Discharge | 21.64 | ft³/s |
| Discharge Full | 20.12 | ft³/s |
| Slope Full | 0.04983 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 57.65 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPD14*-CULVERT

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.86 | ft |
| Critical Depth | 1.34 | ft |
| Channel Slope | 0.12500 | ft/ft |
| Critical Slope | 0.04412 | ft/ft |

# Cross Section for CPD15-CULVERT

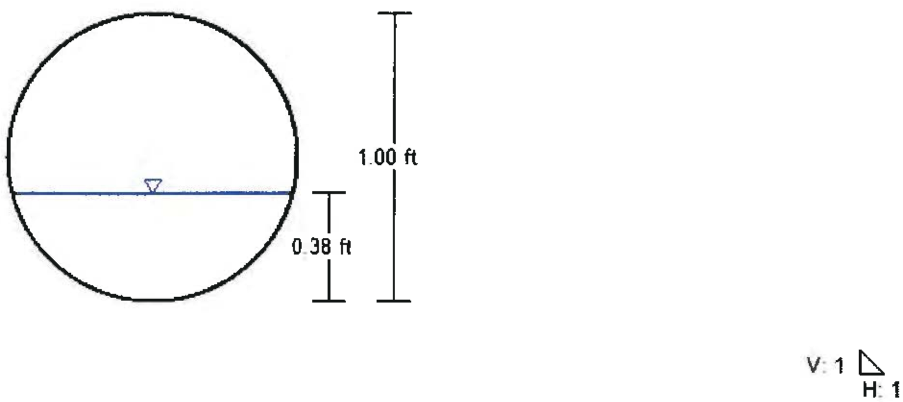
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.11900 | ft/ft |
| Normal Depth | 0.38 | ft |
| Diameter | 1.00 | ft |
| Discharge | 2.00 | ft³/s |

## Cross Section Image



# Worksheet for CPD15-CULVERT

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.11900 | ft/ft |
| Diameter | 1.00 | ft |
| Discharge | 2.00 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.38 | ft |
| Flow Area | 0.27 | $ft^2$ |
| Wetted Perimeter | 1.32 | ft |
| Hydraulic Radius | 0.20 | ft |
| Top Width | 0.97 | ft |
| Critical Depth | 0.60 | ft |
| Percent Full | 37.6 | % |
| Critical Slope | 0.02341 | ft/ft |
| Velocity | 7.41 | ft/s |
| Velocity Head | 0.85 | ft |
| Specific Energy | 1.23 | ft |
| Froude Number | 2.48 | |
| Maximum Discharge | 7.16 | $ft^3/s$ |
| Discharge Full | 6.66 | $ft^3/s$ |
| Slope Full | 0.01074 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 37.58 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPD15-CULVERT

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.38 | ft |
| Critical Depth | 0.60 | ft |
| Channel Slope | 0.11900 | ft/ft |
| Critical Slope | 0.02341 | ft/ft |

# Cross Section for CPD17*-CULVERT

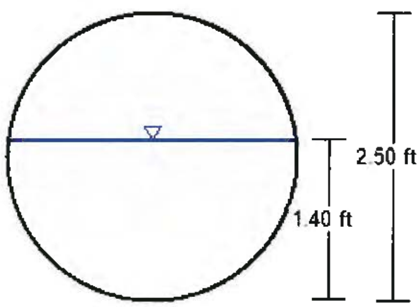
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.06800 | ft/ft |
| Normal Depth | 1.40 | ft |
| Diameter | 2.50 | ft |
| Discharge | 35.00 | ft³/s |

## Cross Section Image




V: 1
H: 1

# Worksheet for CPD17*-CULVERT

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.06800 | ft/ft |
| Diameter | 2.50 | ft |
| Discharge | 35.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.40 | ft |
| Flow Area | 2.83 | ft² |
| Wetted Perimeter | 4.23 | ft |
| Hydraulic Radius | 0.67 | ft |
| Top Width | 2.48 | ft |
| Critical Depth | 2.01 | ft |
| Percent Full | 56.1 | % |
| Critical Slope | 0.02574 | ft/ft |
| Velocity | 12.36 | ft/s |
| Velocity Head | 2.37 | ft |
| Specific Energy | 3.77 | ft |
| Froude Number | 2.04 | |
| Maximum Discharge | 62.32 | ft³/s |
| Discharge Full | 57.93 | ft³/s |
| Slope Full | 0.02482 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 56.07 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPD17*-CULVERT

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.40 | ft |
| Critical Depth | 2.01 | ft |
| Channel Slope | 0.06800 | ft/ft |
| Critical Slope | 0.02574 | ft/ft |

# Cross Section for CPD19*-CULVERT

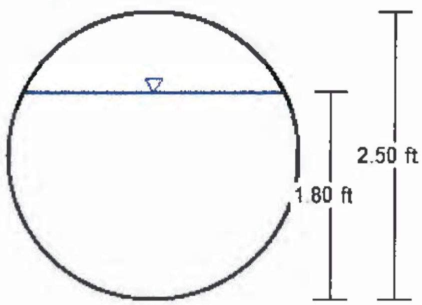
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.04300 | ft/ft |
| Normal Depth | 1.80 | ft |
| Diameter | 2.50 | ft |
| Discharge | 40.00 | ft³/s |

## Cross Section Image




V: 1
H: 1

# Worksheet for CPD19*-CULVERT

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.04300 | ft/ft |
| Diameter | 2.50 | ft |
| Discharge | 40.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.80 | ft |
| Flow Area | 3.78 | ft² |
| Wetted Perimeter | 5.07 | ft |
| Hydraulic Radius | 0.75 | ft |
| Top Width | 2.24 | ft |
| Critical Depth | 2.13 | ft |
| Percent Full | 72.0 | % |
| Critical Slope | 0.03044 | ft/ft |
| Velocity | 10.57 | ft/s |
| Velocity Head | 1.74 | ft |
| Specific Energy | 3.54 | ft |
| Froude Number | 1.43 | |
| Maximum Discharge | 49.56 | ft³/s |
| Discharge Full | 46.07 | ft³/s |
| Slope Full | 0.03242 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 72.02 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPD19*-CULVERT

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.80 | ft |
| Critical Depth | 2.13 | ft |
| Channel Slope | 0.04300 | ft/ft |
| Critical Slope | 0.03044 | ft/ft |

# Cross Section for CPD20-CULVERT

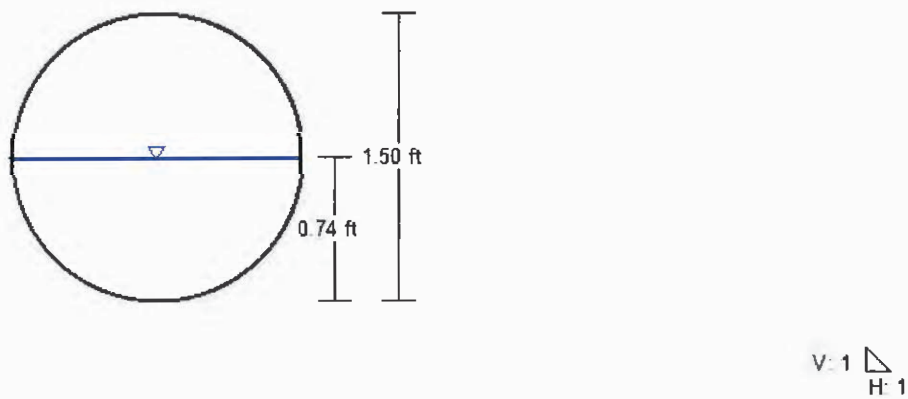
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.03200 | ft/ft |
| Normal Depth | 0.74 | ft |
| Diameter | 1.50 | ft |
| Discharge | 5.00 | ft³/s |

## Cross Section Image



# Worksheet for CPD20-CULVERT

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.03200 | ft/ft |
| Diameter | 1.50 | ft |
| Discharge | 5.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.74 | ft |
| Flow Area | 0.87 | ft² |
| Wetted Perimeter | 2.34 | ft |
| Hydraulic Radius | 0.37 | ft |
| Top Width | 1.50 | ft |
| Critical Depth | 0.86 | ft |
| Percent Full | 49.5 | % |
| Critical Slope | 0.01968 | ft/ft |
| Velocity | 5.74 | ft/s |
| Velocity Head | 0.51 | ft |
| Specific Energy | 1.25 | ft |
| Froude Number | 1.33 | |
| Maximum Discharge | 10.95 | ft³/s |
| Discharge Full | 10.18 | ft³/s |
| Slope Full | 0.00772 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 49.47 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPD20-CULVERT

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.74 | ft |
| Critical Depth | 0.86 | ft |
| Channel Slope | 0.03200 | ft/ft |
| Critical Slope | 0.01968 | ft/ft |

# Cross Section for CPA1-CHANNEL-HALF-CMP

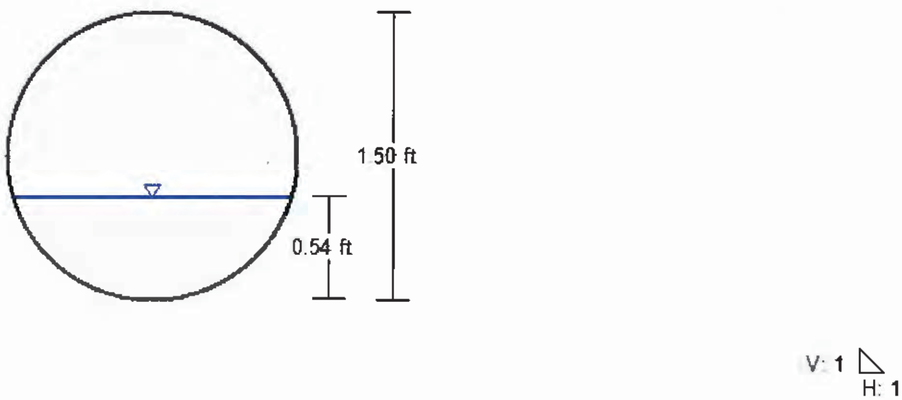
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.06600 | ft/ft |
| Normal Depth | 0.54 | ft |
| Diameter | 1.50 | ft |
| Discharge | 4.00 | $ft^3/s$ |

## Cross Section Image



# Worksheet for CPA1-CHANNEL-HALF-CMP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.06600 | ft/ft |
| Diameter | 1.50 | ft |
| Discharge | 4.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.54 | ft |
| Flow Area | 0.57 | ft² |
| Wetted Perimeter | 1.92 | ft |
| Hydraulic Radius | 0.30 | ft |
| Top Width | 1.44 | ft |
| Critical Depth | 0.77 | ft |
| Percent Full | 35.8 | % |
| Critical Slope | 0.01844 | ft/ft |
| Velocity | 7.05 | ft/s |
| Velocity Head | 0.77 | ft |
| Specific Energy | 1.31 | ft |
| Froude Number | 1.98 | |
| Maximum Discharge | 15.72 | ft³/s |
| Discharge Full | 14.62 | ft³/s |
| Slope Full | 0.00494 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 35.75 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPA1-CHANNEL-HALF-CMP

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.54 | ft |
| Critical Depth | 0.77 | ft |
| Channel Slope | 0.06600 | ft/ft |
| Critical Slope | 0.01844 | ft/ft |

# Cross Section for CPA1-CHANNEL-V-DITCH-6"-RIPRAP

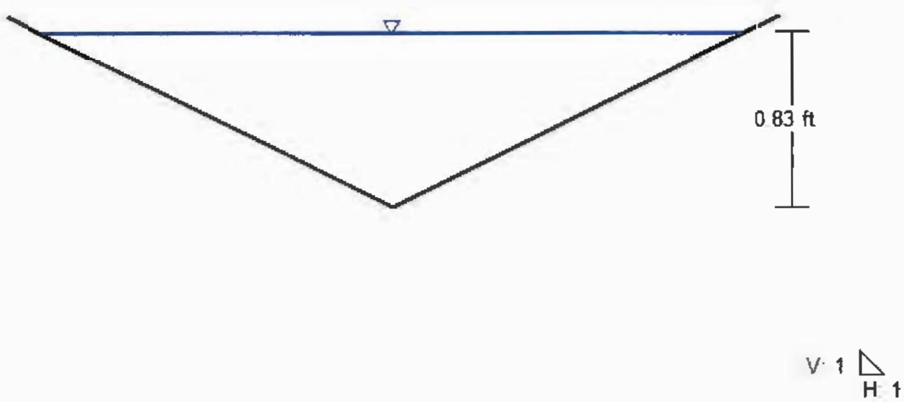
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.06600 | ft/ft |
| Normal Depth | 0.83 | ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 4.00 | $ft^3/s$ |

## Cross Section Image



# Worksheet for CPA1-CHANNEL-V-DITCH-6"-RIPRAP

## Project Description

| | | | |
|---|---|---|---|
| Friction Method | Manning Formula | | |
| Solve For | Normal Depth | | |

## Input Data

| | | | |
|---|---|---|---|
| Roughness Coefficient | | 0.069 | |
| Channel Slope | | 0.06600 | ft/ft |
| Left Side Slope | | 2.00 | ft/ft (H:V) |
| Right Side Slope | | 2.00 | ft/ft (H:V) |
| Discharge | | 4.00 | ft³/s |

## Results

| | | | |
|---|---|---|---|
| Normal Depth | | 0.83 | ft |
| Flow Area | | 1.39 | ft² |
| Wetted Perimeter | | 3.73 | ft |
| Hydraulic Radius | | 0.37 | ft |
| Top Width | | 3.34 | ft |
| Critical Depth | | 0.76 | ft |
| Critical Slope | | 0.11129 | ft/ft |
| Velocity | | 2.87 | ft/s |
| Velocity Head | | 0.13 | ft |
| Specific Energy | | 0.96 | ft |
| Froude Number | | 0.78 | |
| Flow Type | Subcritical | | |

## GVF Input Data

| | | | |
|---|---|---|---|
| Downstream Depth | | 0.00 | ft |
| Length | | 0.00 | ft |
| Number Of Steps | | 0 | |

## GVF Output Data

| | | | |
|---|---|---|---|
| Upstream Depth | | 0.00 | ft |
| Profile Description | | | |
| Profile Headloss | | 0.00 | ft |
| Downstream Velocity | | Infinity | ft/s |
| Upstream Velocity | | Infinity | ft/s |
| Normal Depth | | 0.83 | ft |
| Critical Depth | | 0.76 | ft |
| Channel Slope | | 0.06600 | ft/ft |
| Critical Slope | | 0.11129 | ft/ft |

## Cross Section for CPA2*-CHANNEL-HALF-CMP

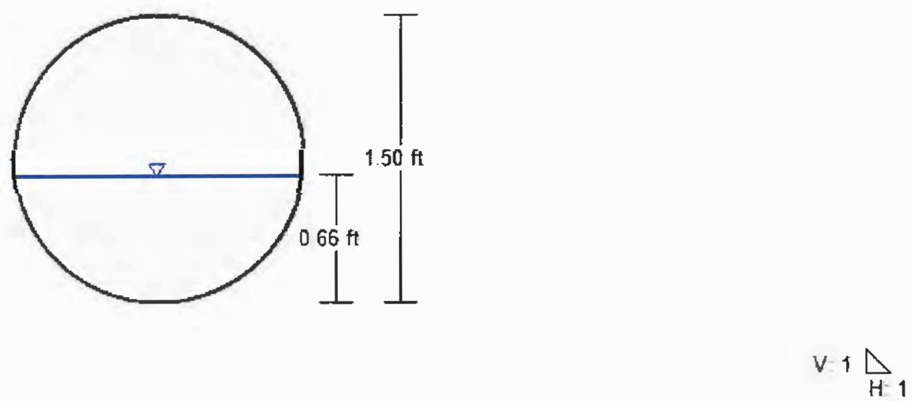
### Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

### Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.04800 | ft/ft |
| Normal Depth | 0.66 | ft |
| Diameter | 1.50 | ft |
| Discharge | 5.00 | ft³/s |

### Cross Section Image



# Worksheet for CPA2*-CHANNEL-HALF-CMP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.04800 | ft/ft |
| Diameter | 1.50 | ft |
| Discharge | 5.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.66 | ft |
| Flow Area | 0.75 | ft² |
| Wetted Perimeter | 2.18 | ft |
| Hydraulic Radius | 0.34 | ft |
| Top Width | 1.49 | ft |
| Critical Depth | 0.86 | ft |
| Percent Full | 44.1 | % |
| Critical Slope | 0.01967 | ft/ft |
| Velocity | 6.66 | ft/s |
| Velocity Head | 0.69 | ft |
| Specific Energy | 1.35 | ft |
| Froude Number | 1.66 | |
| Maximum Discharge | 13.41 | ft³/s |
| Discharge Full | 12.47 | ft³/s |
| Slope Full | 0.00772 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 44.06 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPA2*-CHANNEL-HALF-CMP

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.66 | ft |
| Critical Depth | 0.86 | ft |
| Channel Slope | 0.04800 | ft/ft |
| Critical Slope | 0.01967 | ft/ft |

# Cross Section for CPA2*-CHANNEL-V-DITCH-6"-RIPRAP

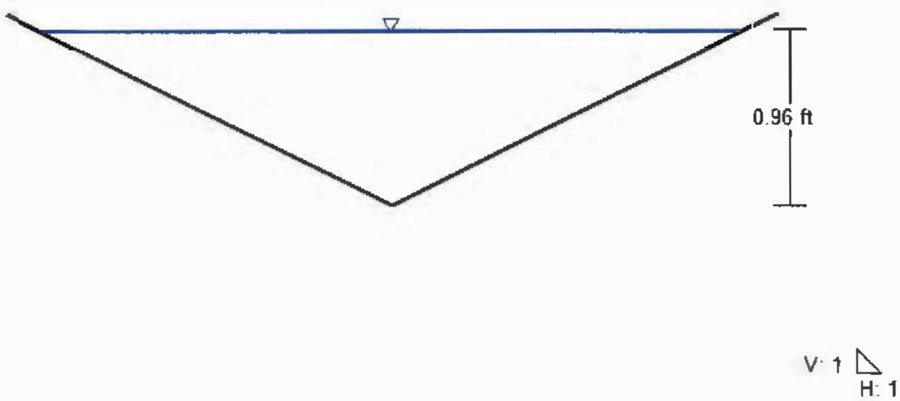
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.04800 | ft/ft |
| Normal Depth | 0.96 | ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 5.00 | ft³/s |

## Cross Section Image



# Worksheet for CPA2*-CHANNEL-V-DITCH-6"-RIPRAP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.04800 | ft/ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 5.00 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.96 | ft |
| Flow Area | 1.86 | $ft^2$ |
| Wetted Perimeter | 4.31 | ft |
| Hydraulic Radius | 0.43 | ft |
| Top Width | 3.86 | ft |
| Critical Depth | 0.83 | ft |
| Critical Slope | 0.10803 | ft/ft |
| Velocity | 2.69 | ft/s |
| Velocity Head | 0.11 | ft |
| Specific Energy | 1.08 | ft |
| Froude Number | 0.68 | |
| Flow Type | Subcritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.96 | ft |
| Critical Depth | 0.83 | ft |
| Channel Slope | 0.04800 | ft/ft |
| Critical Slope | 0.10803 | ft/ft |

# Cross Section for CPA3-CHANNEL-HALF-CMP

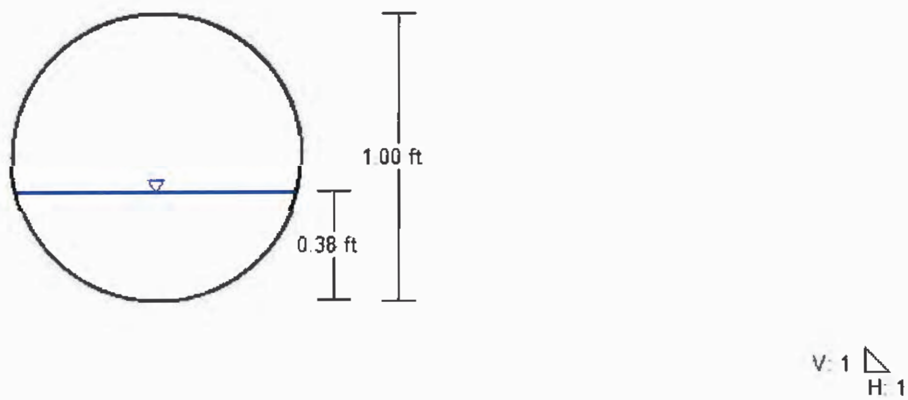
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.02900 | ft/ft |
| Normal Depth | 0.38 | ft |
| Diameter | 1.00 | ft |
| Discharge | 1.00 | ft³/s |

## Cross Section Image



# Worksheet for CPA3-CHANNEL-HALF-CMP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.02900 | ft/ft |
| Diameter | 1.00 | ft |
| Discharge | 1.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.38 | ft |
| Flow Area | 0.27 | ft² |
| Wetted Perimeter | 1.32 | ft |
| Hydraulic Radius | 0.21 | ft |
| Top Width | 0.97 | ft |
| Critical Depth | 0.42 | ft |
| Percent Full | 37.8 | % |
| Critical Slope | 0.01980 | ft/ft |
| Velocity | 3.67 | ft/s |
| Velocity Head | 0.21 | ft |
| Specific Energy | 0.59 | ft |
| Froude Number | 1.22 | |
| Maximum Discharge | 3.54 | ft³/s |
| Discharge Full | 3.29 | ft³/s |
| Slope Full | 0.00269 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 37.83 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPA3-CHANNEL-HALF-CMP

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.38 | ft |
| Critical Depth | 0.42 | ft |
| Channel Slope | 0.02900 | ft/ft |
| Critical Slope | 0.01980 | ft/ft |

# Cross Section for CPA3-CHANNEL-V-DITCH-EARTHEN

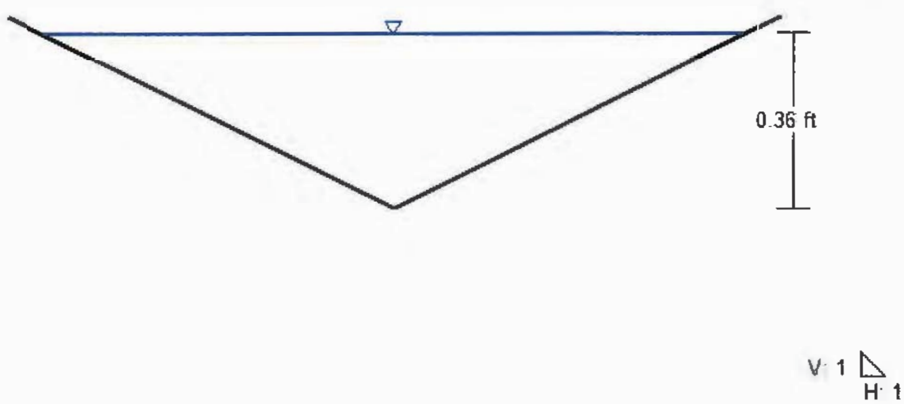
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.020 | |
| Channel Slope | 0.02900 | ft/ft |
| Normal Depth | 0.36 | ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 1.00 | $ft^3/s$ |

## Cross Section Image



# Worksheet for CPA3-CHANNEL-V-DITCH-EARTHEN

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.020 | |
| Channel Slope | 0.02900 | ft/ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 1.00 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.36 | ft |
| Flow Area | 0.27 | $ft^2$ |
| Wetted Perimeter | 1.63 | ft |
| Hydraulic Radius | 0.16 | ft |
| Top Width | 1.46 | ft |
| Critical Depth | 0.43 | ft |
| Critical Slope | 0.01125 | ft/ft |
| Velocity | 3.77 | ft/s |
| Velocity Head | 0.22 | ft |
| Specific Energy | 0.59 | ft |
| Froude Number | 1.56 | |
| Flow Type | Supercritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.36 | ft |
| Critical Depth | 0.43 | ft |
| Channel Slope | 0.02900 | ft/ft |
| Critical Slope | 0.01125 | ft/ft |

# Cross Section for CPA4*-CHANNEL-HALF-CMP

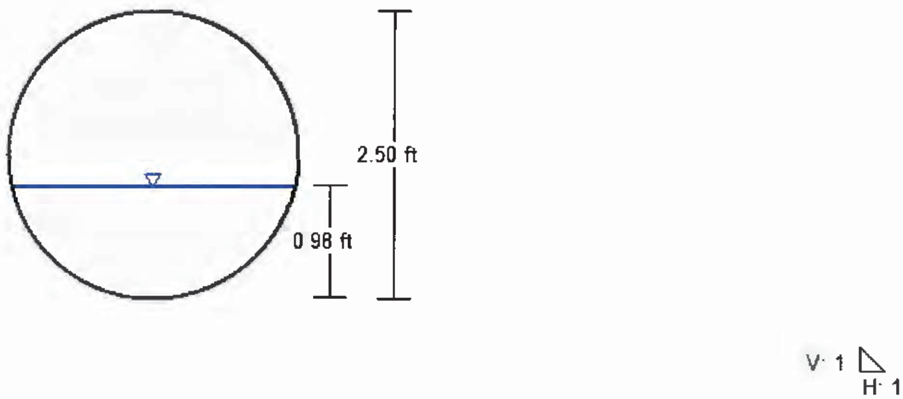
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.00800 | ft/ft |
| Normal Depth | 0.98 | ft |
| Diameter | 2.50 | ft |
| Discharge | 6.40 | $ft^3/s$ |

## Cross Section Image



# Worksheet for CPA4*-CHANNEL-HALF-CMP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.00800 | ft/ft |
| Diameter | 2.50 | ft |
| Discharge | 6.40 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.98 | ft |
| Flow Area | 1.77 | ft² |
| Wetted Perimeter | 3.37 | ft |
| Hydraulic Radius | 0.53 | ft |
| Top Width | 2.44 | ft |
| Critical Depth | 0.84 | ft |
| Percent Full | 39.0 | % |
| Critical Slope | 0.01413 | ft/ft |
| Velocity | 3.61 | ft/s |
| Velocity Head | 0.20 | ft |
| Specific Energy | 1.18 | ft |
| Froude Number | 0.75 | |
| Maximum Discharge | 21.38 | ft³/s |
| Discharge Full | 19.87 | ft³/s |
| Slope Full | 0.00083 | ft/ft |
| Flow Type | SubCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 39.03 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPA4*-CHANNEL-HALF-CMP

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.98 | ft |
| Critical Depth | 0.84 | ft |
| Channel Slope | 0.00800 | ft/ft |
| Critical Slope | 0.01413 | ft/ft |

# Cross Section for CPA4*-CHANNEL-V-DITCH-EARTHEN

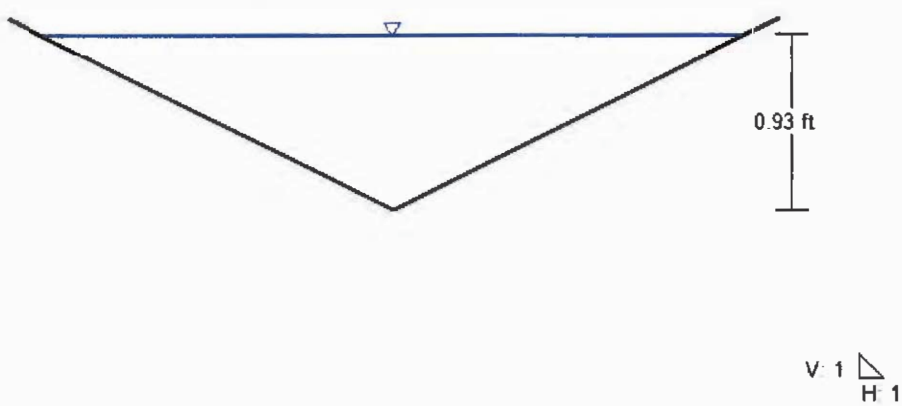
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.020 | |
| Channel Slope | 0.00800 | ft/ft |
| Normal Depth | 0.93 | ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 6.40 | ft³/s |

## Cross Section Image



# Worksheet for CPA4*-CHANNEL-V-DITCH-EARTHEN

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.020 | |
| Channel Slope | 0.00800 | ft/ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 6.40 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.93 | ft |
| Flow Area | 1.73 | $ft^2$ |
| Wetted Perimeter | 4.16 | ft |
| Hydraulic Radius | 0.42 | ft |
| Top Width | 3.72 | ft |
| Critical Depth | 0.91 | ft |
| Critical Slope | 0.00878 | ft/ft |
| Velocity | 3.70 | ft/s |
| Velocity Head | 0.21 | ft |
| Specific Energy | 1.14 | ft |
| Froude Number | 0.96 | |
| Flow Type | Subcritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.93 | ft |
| Critical Depth | 0.91 | ft |
| Channel Slope | 0.00800 | ft/ft |
| Critical Slope | 0.00878 | ft/ft |

# Cross Section for CPA5*-CHANNEL-HALF-CMP

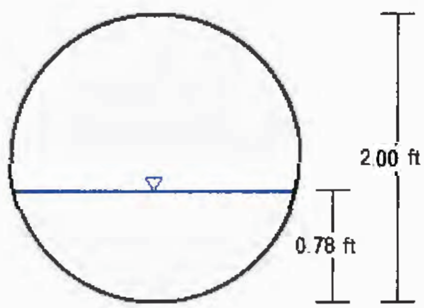
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.03600 | ft/ft |
| Normal Depth | 0.78 | ft |
| Diameter | 2.00 | ft |
| Discharge | 7.40 | ft³/s |

## Cross Section Image




V: 1 H: 1

# Worksheet for CPA5*-CHANNEL-HALF-CMP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.03600 | ft/ft |
| Diameter | 2.00 | ft |
| Discharge | 7.40 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.78 | ft |
| Flow Area | 1.13 | ft² |
| Wetted Perimeter | 2.69 | ft |
| Hydraulic Radius | 0.42 | ft |
| Top Width | 1.95 | ft |
| Critical Depth | 0.97 | ft |
| Percent Full | 38.8 | % |
| Critical Slope | 0.01638 | ft/ft |
| Velocity | 6.57 | ft/s |
| Velocity Head | 0.67 | ft |
| Specific Energy | 1.45 | ft |
| Froude Number | 1.53 | |
| Maximum Discharge | 25.01 | ft³/s |
| Discharge Full | 23.25 | ft³/s |
| Slope Full | 0.00365 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 38.78 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPA5*-CHANNEL-HALF-CMP

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.78 | ft |
| Critical Depth | 0.97 | ft |
| Channel Slope | 0.03600 | ft/ft |
| Critical Slope | 0.01638 | ft/ft |

# Cross Section for CPA5*-CHANNEL-V-DITCH-6"-RIPRAP

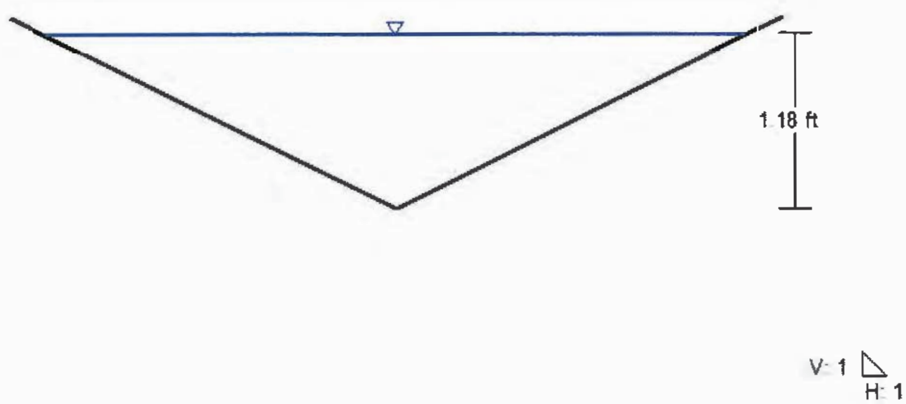
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.03600 | ft/ft |
| Normal Depth | 1.18 | ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 7.40 | ft³/s |

## Cross Section Image



# Worksheet for CPA5*-CHANNEL-V-DITCH-6"-RIPRAP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.03600 | ft/ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 7.40 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.18 | ft |
| Flow Area | 2.78 | $ft^2$ |
| Wetted Perimeter | 5.27 | ft |
| Hydraulic Radius | 0.53 | ft |
| Top Width | 4.71 | ft |
| Critical Depth | 0.97 | ft |
| Critical Slope | 0.10252 | ft/ft |
| Velocity | 2.67 | ft/s |
| Velocity Head | 0.11 | ft |
| Specific Energy | 1.29 | ft |
| Froude Number | 0.61 | |
| Flow Type | Subcritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.18 | ft |
| Critical Depth | 0.97 | ft |
| Channel Slope | 0.03600 | ft/ft |
| Critical Slope | 0.10252 | ft/ft |

# Cross Section for CPA6*-CHANNEL-HALF-CMP

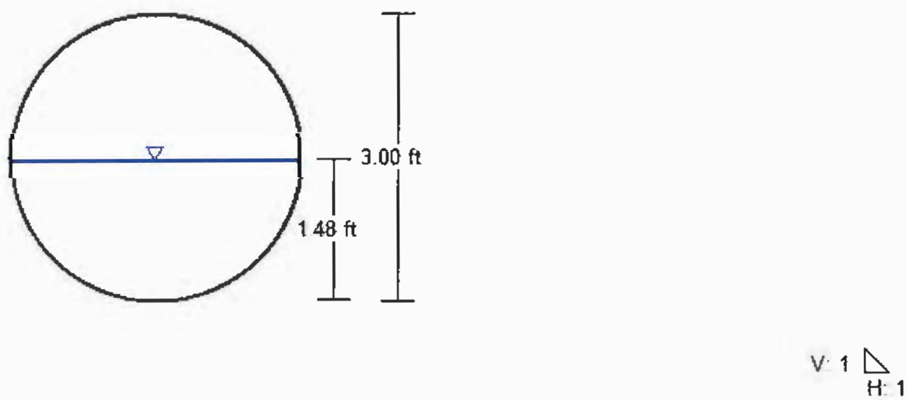
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.00300 | ft/ft |
| Normal Depth | 1.48 | ft |
| Diameter | 3.00 | ft |
| Discharge | 9.70 | $ft^3/s$ |

## Cross Section Image



# Worksheet for CPA6*-CHANNEL-HALF-CMP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.00300 | ft/ft |
| Diameter | 3.00 | ft |
| Discharge | 9.70 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.48 | ft |
| Flow Area | 3.48 | ft² |
| Wetted Perimeter | 4.68 | ft |
| Hydraulic Radius | 0.74 | ft |
| Top Width | 3.00 | ft |
| Critical Depth | 0.98 | ft |
| Percent Full | 49.4 | % |
| Critical Slope | 0.01329 | ft/ft |
| Velocity | 2.79 | ft/s |
| Velocity Head | 0.12 | ft |
| Specific Energy | 1.60 | ft |
| Froude Number | 0.46 | |
| Maximum Discharge | 21.29 | ft³/s |
| Discharge Full | 19.79 | ft³/s |
| Slope Full | 0.00072 | ft/ft |
| Flow Type | SubCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 49.42 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPA6*-CHANNEL-HALF-CMP

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.48 | ft |
| Critical Depth | 0.98 | ft |
| Channel Slope | 0.00300 | ft/ft |
| Critical Slope | 0.01329 | ft/ft |

# Cross Section for CPA6*-CHANNEL-V-DITCH-EARTHEN

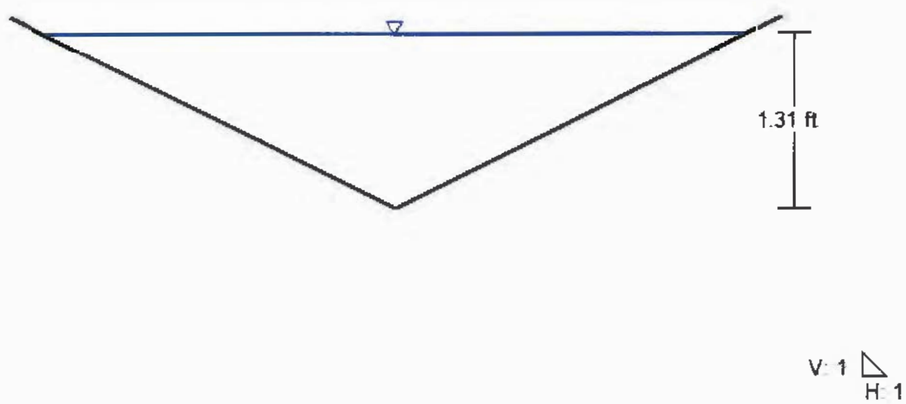
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.020 | |
| Channel Slope | 0.00300 | ft/ft |
| Normal Depth | 1.31 | ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 9.70 | $ft^3/s$ |

## Cross Section Image



# Worksheet for CPA6*-CHANNEL-V-DITCH-EARTHEN

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.020 | |
| Channel Slope | 0.00300 | ft/ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 9.70 | $ft^3/s$ |

## Results

| | | | |
|---|---|---|---|
| Normal Depth | | 1.31 | ft |
| Flow Area | | 3.41 | $ft^2$ |
| Wetted Perimeter | | 5.84 | ft |
| Hydraulic Radius | | 0.58 | ft |
| Top Width | | 5.22 | ft |
| Critical Depth | | 1.08 | ft |
| Critical Slope | | 0.00831 | ft/ft |
| Velocity | | 2.84 | ft/s |
| Velocity Head | | 0.13 | ft |
| Specific Energy | | 1.43 | ft |
| Froude Number | | 0.62 | |
| Flow Type | Subcritical | | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.31 | ft |
| Critical Depth | 1.08 | ft |
| Channel Slope | 0.00300 | ft/ft |
| Critical Slope | 0.00831 | ft/ft |

## Cross Section for CPD2*-CHANNEL-V-DITCH-EARTHEN

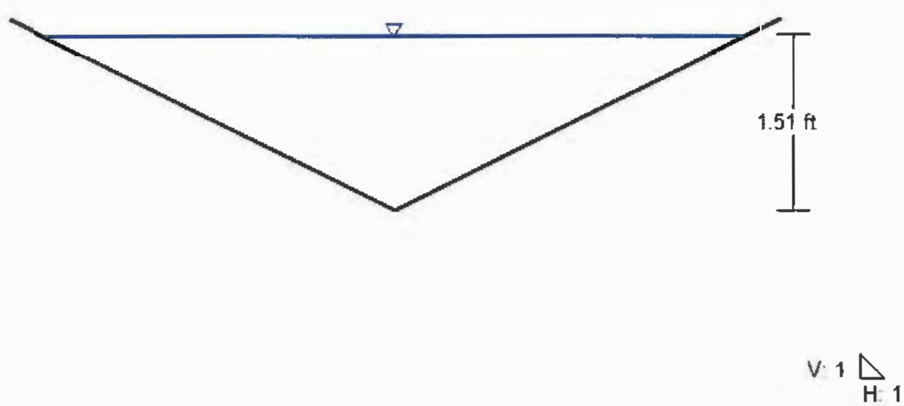
### Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

### Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.020 | |
| Channel Slope | 0.02000 | ft/ft |
| Normal Depth | 1.51 | ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 37.10 | ft³/s |

### Cross Section Image



# Worksheet for CPD2*-CHANNEL-V-DITCH-EARTHEN

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.020 | |
| Channel Slope | 0.02000 | ft/ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 37.10 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.51 | ft |
| Flow Area | 4.58 | ft² |
| Wetted Perimeter | 6.77 | ft |
| Hydraulic Radius | 0.68 | ft |
| Top Width | 6.05 | ft |
| Critical Depth | 1.85 | ft |
| Critical Slope | 0.00695 | ft/ft |
| Velocity | 8.10 | ft/s |
| Velocity Head | 1.02 | ft |
| Specific Energy | 2.53 | ft |
| Froude Number | 1.64 | |
| Flow Type | Supercritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.51 | ft |
| Critical Depth | 1.85 | ft |
| Channel Slope | 0.02000 | ft/ft |
| Critical Slope | 0.00695 | ft/ft |

# Cross Section for CPD3*-CHANNEL-V-DITCH-EARTHEN

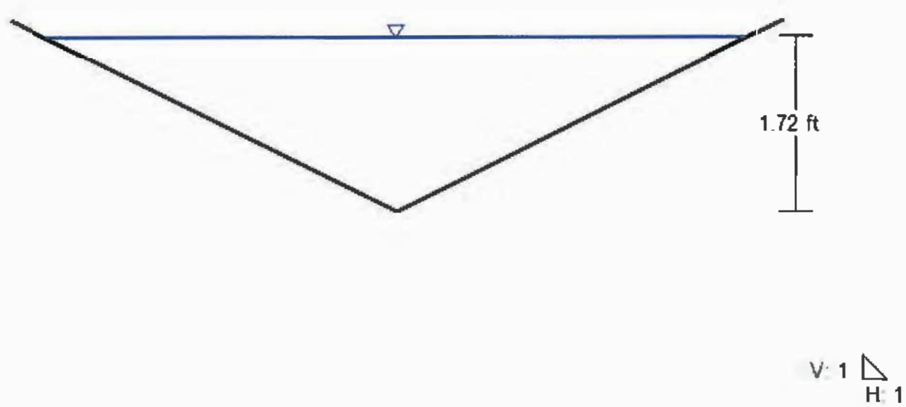
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.020 | |
| Channel Slope | 0.01300 | ft/ft |
| Normal Depth | 1.72 | ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 41.90 | ft³/s |

## Cross Section Image



# Worksheet for CPD3*-CHANNEL-V-DITCH-EARTHEN

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.020 | |
| Channel Slope | 0.01300 | ft/ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 41.90 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.72 | ft |
| Flow Area | 5.90 | ft² |
| Wetted Perimeter | 7.68 | ft |
| Hydraulic Radius | 0.77 | ft |
| Top Width | 6.87 | ft |
| Critical Depth | 1.94 | ft |
| Critical Slope | 0.00684 | ft/ft |
| Velocity | 7.10 | ft/s |
| Velocity Head | 0.78 | ft |
| Specific Energy | 2.50 | ft |
| Froude Number | 1.35 | |
| Flow Type | Supercritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.72 | ft |
| Critical Depth | 1.94 | ft |
| Channel Slope | 0.01300 | ft/ft |
| Critical Slope | 0.00684 | ft/ft |

# Cross Section for CPD4-CHANNEL-V-DITCH-EARTHEN

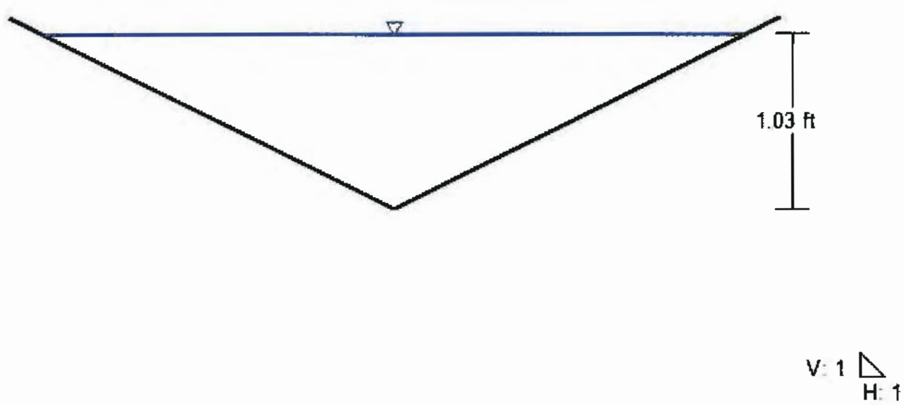
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.020 | |
| Channel Slope | 0.02200 | ft/ft |
| Normal Depth | 1.03 | ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 14.00 | $ft^3/s$ |

## Cross Section Image



# Worksheet for CPD4-CHANNEL-V-DITCH-EARTHEN

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.020 | |
| Channel Slope | 0.02200 | ft/ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 14.00 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.03 | ft |
| Flow Area | 2.13 | $ft^2$ |
| Wetted Perimeter | 4.61 | ft |
| Hydraulic Radius | 0.46 | ft |
| Top Width | 4.13 | ft |
| Critical Depth | 1.25 | ft |
| Critical Slope | 0.00791 | ft/ft |
| Velocity | 6.58 | ft/s |
| Velocity Head | 0.67 | ft |
| Specific Energy | 1.70 | ft |
| Froude Number | 1.62 | |
| Flow Type | Supercritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.03 | ft |
| Critical Depth | 1.25 | ft |
| Channel Slope | 0.02200 | ft/ft |
| Critical Slope | 0.00791 | ft/ft |

# Cross Section for CPD6*-CHANNEL-V-DITCH-6"-RIPRAP

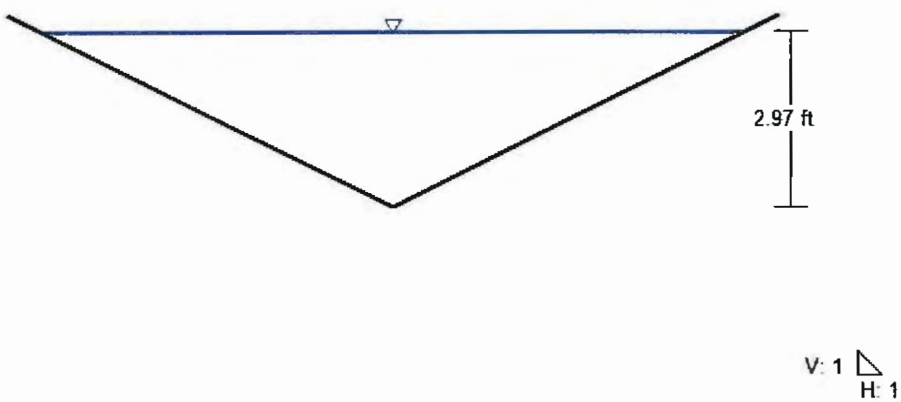
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.01800 | ft/ft |
| Normal Depth | 2.97 | ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 61.50 | ft³/s |

## Cross Section Image



# Worksheet for CPD6*-CHANNEL-V-DITCH-6"-RIPRAP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.01800 | ft/ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 61.50 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 2.97 | ft |
| Flow Area | 17.62 | $ft^2$ |
| Wetted Perimeter | 13.27 | ft |
| Hydraulic Radius | 1.33 | ft |
| Top Width | 11.87 | ft |
| Critical Depth | 2.26 | ft |
| Critical Slope | 0.07731 | ft/ft |
| Velocity | 3.49 | ft/s |
| Velocity Head | 0.19 | ft |
| Specific Energy | 3.16 | ft |
| Froude Number | 0.51 | |
| Flow Type | Subcritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 2.97 | ft |
| Critical Depth | 2.26 | ft |
| Channel Slope | 0.01800 | ft/ft |
| Critical Slope | 0.07731 | ft/ft |

# Cross Section for CPD7-CHANNEL-V-DITCH-6"-RIPRAP

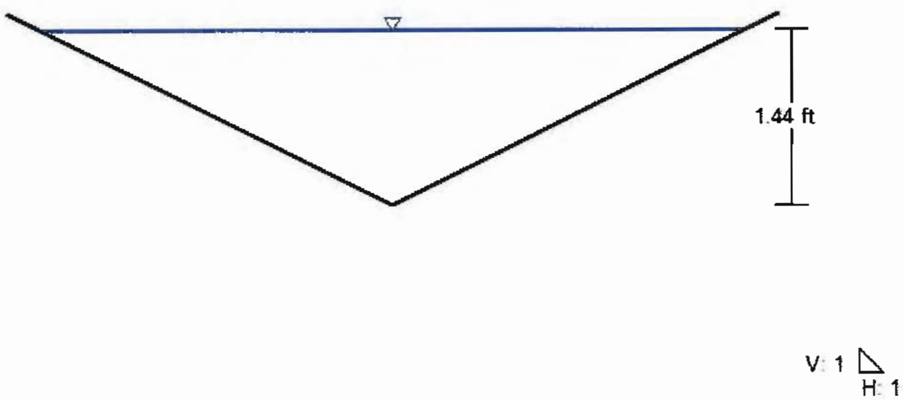
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.04400 | ft/ft |
| Normal Depth | 1.44 | ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 14.00 | ft³/s |

## Cross Section Image



# Worksheet for CPD7-CHANNEL-V-DITCH-6"-RIPRAP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.04400 | ft/ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 14.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.44 | ft |
| Flow Area | 4.15 | ft² |
| Wetted Perimeter | 6.44 | ft |
| Hydraulic Radius | 0.64 | ft |
| Top Width | 5.76 | ft |
| Critical Depth | 1.25 | ft |
| Critical Slope | 0.09417 | ft/ft |
| Velocity | 3.37 | ft/s |
| Velocity Head | 0.18 | ft |
| Specific Energy | 1.62 | ft |
| Froude Number | 0.70 | |
| Flow Type | Subcritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.44 | ft |
| Critical Depth | 1.25 | ft |
| Channel Slope | 0.04400 | ft/ft |
| Critical Slope | 0.09417 | ft/ft |

# Cross Section for CPD8*-CHANNEL-V-DITCH-6"-RIPRAP

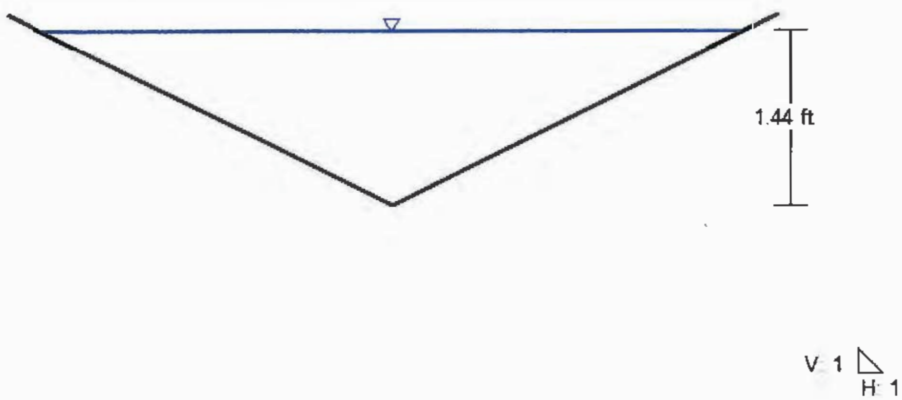
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.05100 | ft/ft |
| Normal Depth | 1.44 | ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 15.00 | ft³/s |

## Cross Section Image



# Worksheet for CPD8*-CHANNEL-V-DITCH-6"-RIPRAP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.05100 | ft/ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 15.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.44 | ft |
| Flow Area | 4.14 | ft² |
| Wetted Perimeter | 6.43 | ft |
| Hydraulic Radius | 0.64 | ft |
| Top Width | 5.75 | ft |
| Critical Depth | 1.28 | ft |
| Critical Slope | 0.09331 | ft/ft |
| Velocity | 3.62 | ft/s |
| Velocity Head | 0.20 | ft |
| Specific Energy | 1.64 | ft |
| Froude Number | 0.75 | |
| Flow Type | Subcritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.44 | ft |
| Critical Depth | 1.28 | ft |
| Channel Slope | 0.05100 | ft/ft |
| Critical Slope | 0.09331 | ft/ft |

# Cross Section for CPD9*-CHANNEL-HALF-CMP

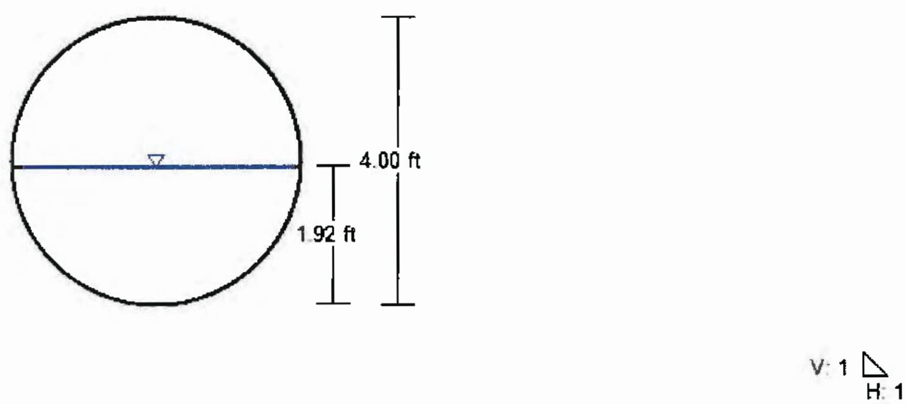
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.03400 | ft/ft |
| Normal Depth | 1.92 | ft |
| Diameter | 4.00 | ft |
| Discharge | 66.80 | ft³/s |

## Cross Section Image



# Worksheet for CPD9*-CHANNEL-HALF-CMP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.03400 | ft/ft |
| Diameter | 4.00 | ft |
| Discharge | 66.80 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.92 | ft |
| Flow Area | 5.96 | $ft^2$ |
| Wetted Perimeter | 6.12 | ft |
| Hydraulic Radius | 0.97 | ft |
| Top Width | 4.00 | ft |
| Critical Depth | 2.47 | ft |
| Percent Full | 48.0 | % |
| Critical Slope | 0.01500 | ft/ft |
| Velocity | 11.21 | ft/s |
| Velocity Head | 1.95 | ft |
| Specific Energy | 3.87 | ft |
| Froude Number | 1.62 | |
| Maximum Discharge | 154.32 | $ft^3/s$ |
| Discharge Full | 143.46 | $ft^3/s$ |
| Slope Full | 0.00737 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 47.96 | % |
| Downstream Velocity | Infinity | ft/s |

## Worksheet for CPD9*-CHANNEL-HALF-CMP

### GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.92 | ft |
| Critical Depth | 2.47 | ft |
| Channel Slope | 0.03400 | ft/ft |
| Critical Slope | 0.01500 | ft/ft |

# Cross Section for CPD9*-CHANNEL-V-DITCH-6"-RIPRAP

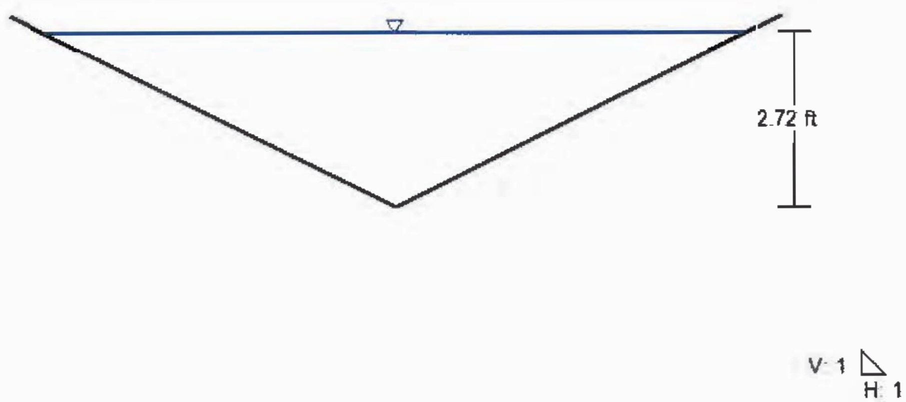
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.03400 | ft/ft |
| Normal Depth | 2.72 | ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 66.80 | ft³/s |

## Cross Section Image



# Worksheet for CPD9*-CHANNEL-V-DITCH-6"-RIPRAP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.03400 | ft/ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 66.80 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 2.72 | ft |
| Flow Area | 14.77 | $ft^2$ |
| Wetted Perimeter | 12.15 | ft |
| Hydraulic Radius | 1.22 | ft |
| Top Width | 10.87 | ft |
| Critical Depth | 2.33 | ft |
| Critical Slope | 0.07646 | ft/ft |
| Velocity | 4.52 | ft/s |
| Velocity Head | 0.32 | ft |
| Specific Energy | 3.04 | ft |
| Froude Number | 0.68 | |
| Flow Type | Subcritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 2.72 | ft |
| Critical Depth | 2.33 | ft |
| Channel Slope | 0.03400 | ft/ft |
| Critical Slope | 0.07646 | ft/ft |

# Cross Section for CPD11*-CHANNEL-HALF-CMP

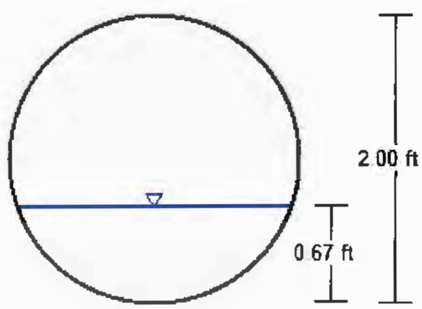
## Project Description

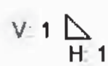
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.10600 | ft/ft |
| Normal Depth | 0.67 | ft |
| Diameter | 2.00 | ft |
| Discharge | 9.60 | ft³/s |

## Cross Section Image



# Worksheet for CPD11*-CHANNEL-HALF-CMP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.10600 | ft/ft |
| Diameter | 2.00 | ft |
| Discharge | 9.60 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.67 | ft |
| Flow Area | 0.92 | ft² |
| Wetted Perimeter | 2.46 | ft |
| Hydraulic Radius | 0.37 | ft |
| Top Width | 1.89 | ft |
| Critical Depth | 1.11 | ft |
| Percent Full | 33.4 | % |
| Critical Slope | 0.01749 | ft/ft |
| Velocity | 10.44 | ft/s |
| Velocity Head | 1.69 | ft |
| Specific Energy | 2.36 | ft |
| Froude Number | 2.64 | |
| Maximum Discharge | 42.91 | ft³/s |
| Discharge Full | 39.89 | ft³/s |
| Slope Full | 0.00614 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 33.40 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPD11*-CHANNEL-HALF-CMP

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.67 | ft |
| Critical Depth | 1.11 | ft |
| Channel Slope | 0.10600 | ft/ft |
| Critical Slope | 0.01749 | ft/ft |

# Cross Section for CPD11*-CHANNEL-V-DITCH-6"-RIPRAP

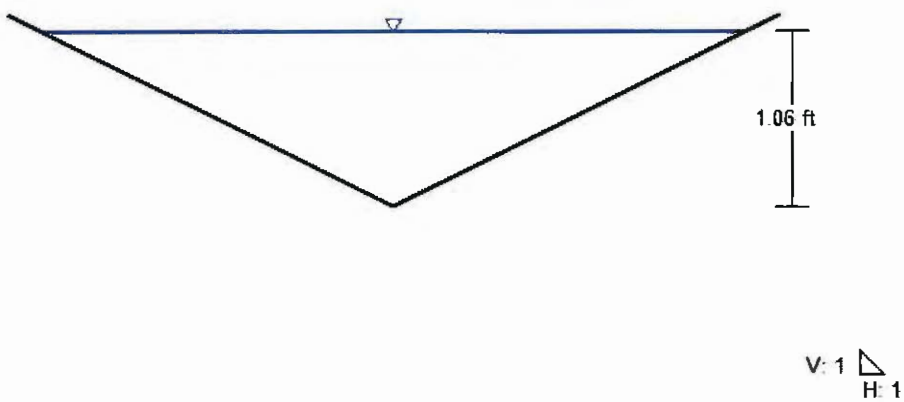
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.10600 | ft/ft |
| Normal Depth | 1.06 | ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 9.60 | $ft^3/s$ |

## Cross Section Image



# Worksheet for CPD11*-CHANNEL-V-DITCH-6"-RIPRAP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.10600 | ft/ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 9.60 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.06 | ft |
| Flow Area | 2.25 | ft² |
| Wetted Perimeter | 4.74 | ft |
| Hydraulic Radius | 0.47 | ft |
| Top Width | 4.24 | ft |
| Critical Depth | 1.07 | ft |
| Critical Slope | 0.09903 | ft/ft |
| Velocity | 4.27 | ft/s |
| Velocity Head | 0.28 | ft |
| Specific Energy | 1.34 | ft |
| Froude Number | 1.03 | |
| Flow Type | Supercritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.06 | ft |
| Critical Depth | 1.07 | ft |
| Channel Slope | 0.10600 | ft/ft |
| Critical Slope | 0.09903 | ft/ft |

# Cross Section for CPD12*-CHANNEL-HALF-CMP

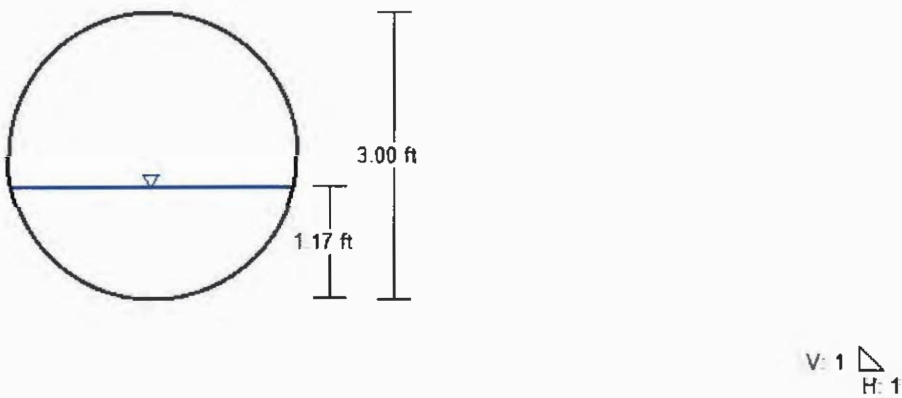
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.01000 | ft/ft |
| Normal Depth | 1.17 | ft |
| Diameter | 3.00 | ft |
| Discharge | 11.70 | ft³/s |

## Cross Section Image



# Worksheet for CPD12*-CHANNEL-HALF-CMP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.01000 | ft/ft |
| Diameter | 3.00 | ft |
| Discharge | 11.70 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.17 | ft |
| Flow Area | 2.56 | ft² |
| Wetted Perimeter | 4.06 | ft |
| Hydraulic Radius | 0.63 | ft |
| Top Width | 2.93 | ft |
| Critical Depth | 1.09 | ft |
| Percent Full | 39.1 | % |
| Critical Slope | 0.01340 | ft/ft |
| Velocity | 4.56 | ft/s |
| Velocity Head | 0.32 | ft |
| Specific Energy | 1.50 | ft |
| Froude Number | 0.86 | |
| Maximum Discharge | 38.86 | ft³/s |
| Discharge Full | 36.13 | ft³/s |
| Slope Full | 0.00105 | ft/ft |
| Flow Type | SubCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 39.14 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPD12*-CHANNEL-HALF-CMP

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.17 | ft |
| Critical Depth | 1.09 | ft |
| Channel Slope | 0.01000 | ft/ft |
| Critical Slope | 0.01340 | ft/ft |

# Cross Section for CPD12*-CHANNEL-V-DITCH-6"-RIPRAP

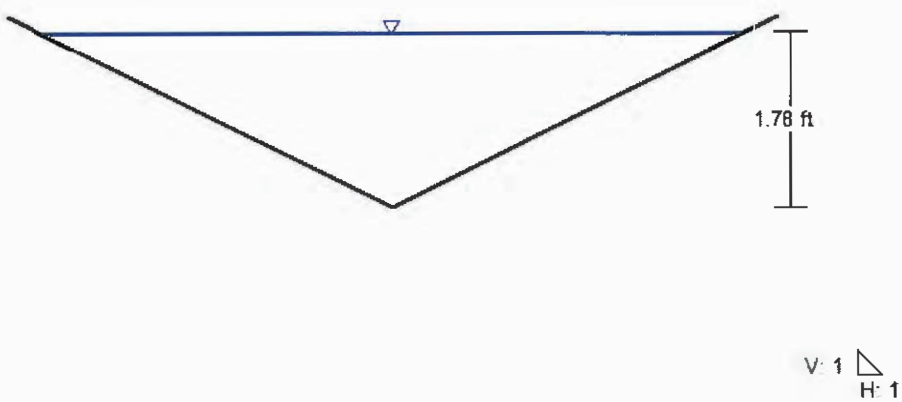
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.01000 | ft/ft |
| Normal Depth | 1.78 | ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 11.70 | ft³/s |

## Cross Section Image



# Worksheet for CPD12*-CHANNEL-V-DITCH-6"-RIPRAP

## Project Description

| | | |
|---|---|---|
| Friction Method | Manning Formula | |
| Solve For | Normal Depth | |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.01000 | ft/ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 11.70 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.78 | ft |
| Flow Area | 6.33 | ft² |
| Wetted Perimeter | 7.95 | ft |
| Hydraulic Radius | 0.80 | ft |
| Top Width | 7.12 | ft |
| Critical Depth | 1.16 | ft |
| Critical Slope | 0.09645 | ft/ft |
| Velocity | 1.85 | ft/s |
| Velocity Head | 0.05 | ft |
| Specific Energy | 1.83 | ft |
| Froude Number | 0.35 | |
| Flow Type | Subcritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.78 | ft |
| Critical Depth | 1.16 | ft |
| Channel Slope | 0.01000 | ft/ft |
| Critical Slope | 0.09645 | ft/ft |

# Cross Section for CPD13-CHANNEL-HALF-CMP

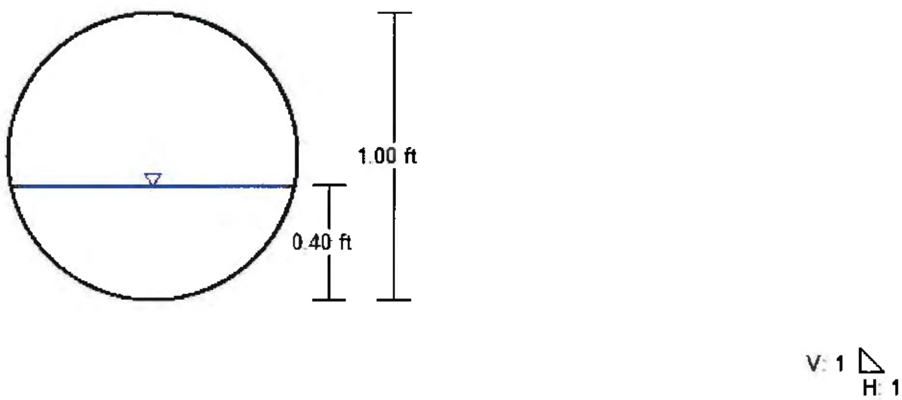
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.08800 | ft/ft |
| Normal Depth | 0.40 | ft |
| Diameter | 1.00 | ft |
| Discharge | 1.90 | ft³/s |

## Cross Section Image



# Worksheet for CPD13-CHANNEL-HALF-CMP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.08800 | ft/ft |
| Diameter | 1.00 | ft |
| Discharge | 1.90 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.40 | ft |
| Flow Area | 0.29 | ft² |
| Wetted Perimeter | 1.36 | ft |
| Hydraulic Radius | 0.21 | ft |
| Top Width | 0.98 | ft |
| Critical Depth | 0.59 | ft |
| Percent Full | 39.7 | % |
| Critical Slope | 0.02293 | ft/ft |
| Velocity | 6.55 | ft/s |
| Velocity Head | 0.67 | ft |
| Specific Energy | 1.06 | ft |
| Froude Number | 2.12 | |
| Maximum Discharge | 6.16 | ft³/s |
| Discharge Full | 5.72 | ft³/s |
| Slope Full | 0.00969 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 39.68 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPD13-CHANNEL-HALF-CMP

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.40 | ft |
| Critical Depth | 0.59 | ft |
| Channel Slope | 0.08800 | ft/ft |
| Critical Slope | 0.02293 | ft/ft |

# Cross Section for CPD13-CHANNEL-V-DITCH-6"-RIPRAP

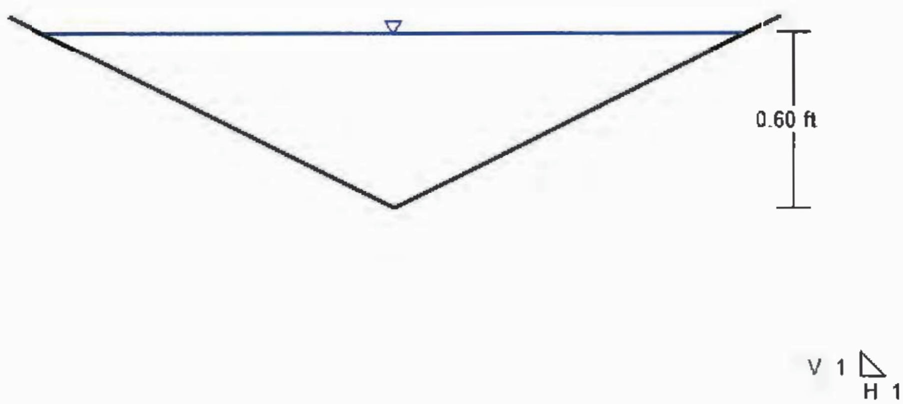
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.08800 | ft/ft |
| Normal Depth | 0.60 | ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 1.90 | $ft^3/s$ |

## Cross Section Image



# Worksheet for CPD13-CHANNEL-V-DITCH-6"-RIPRAP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.08800 | ft/ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 1.90 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.60 | ft |
| Flow Area | 0.72 | $ft^2$ |
| Wetted Perimeter | 2.68 | ft |
| Hydraulic Radius | 0.27 | ft |
| Top Width | 2.39 | ft |
| Critical Depth | 0.56 | ft |
| Critical Slope | 0.12290 | ft/ft |
| Velocity | 2.65 | ft/s |
| Velocity Head | 0.11 | ft |
| Specific Energy | 0.71 | ft |
| Froude Number | 0.86 | |
| Flow Type | Subcritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.60 | ft |
| Critical Depth | 0.56 | ft |
| Channel Slope | 0.08800 | ft/ft |
| Critical Slope | 0.12290 | ft/ft |

# Cross Section for CPD14*-CHANNEL-HALF-CMP

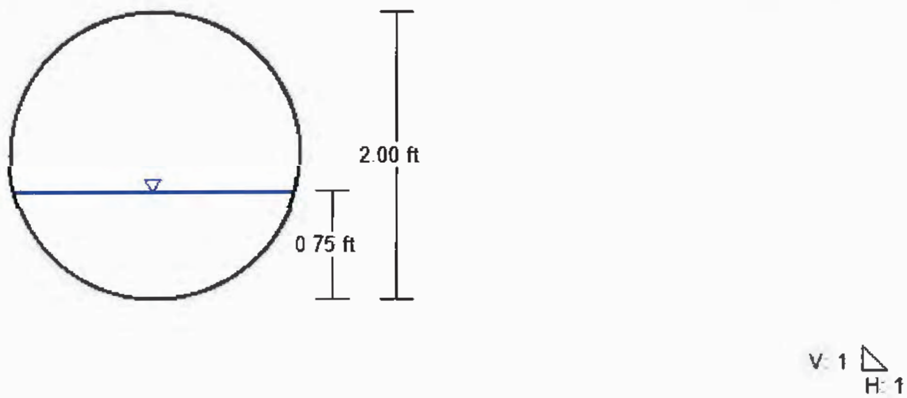
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.12000 | ft/ft |
| Normal Depth | 0.75 | ft |
| Diameter | 2.00 | ft |
| Discharge | 12.70 | ft³/s |

## Cross Section Image



# Worksheet for CPD14*-CHANNEL-HALF-CMP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.12000 | ft/ft |
| Diameter | 2.00 | ft |
| Discharge | 12.70 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.75 | ft |
| Flow Area | 1.08 | $ft^2$ |
| Wetted Perimeter | 2.64 | ft |
| Hydraulic Radius | 0.41 | ft |
| Top Width | 1.94 | ft |
| Critical Depth | 1.28 | ft |
| Percent Full | 37.5 | % |
| Critical Slope | 0.01955 | ft/ft |
| Velocity | 11.80 | ft/s |
| Velocity Head | 2.17 | ft |
| Specific Energy | 2.92 | ft |
| Froude Number | 2.79 | |
| Maximum Discharge | 45.66 | $ft^3/s$ |
| Discharge Full | 42.45 | $ft^3/s$ |
| Slope Full | 0.01074 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 37.50 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPD14*-CHANNEL-HALF-CMP

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.75 | ft |
| Critical Depth | 1.28 | ft |
| Channel Slope | 0.12000 | ft/ft |
| Critical Slope | 0.01955 | ft/ft |

# Cross Section for CPD14*-CHANNEL-V-DITCH-6"-RIPRAP

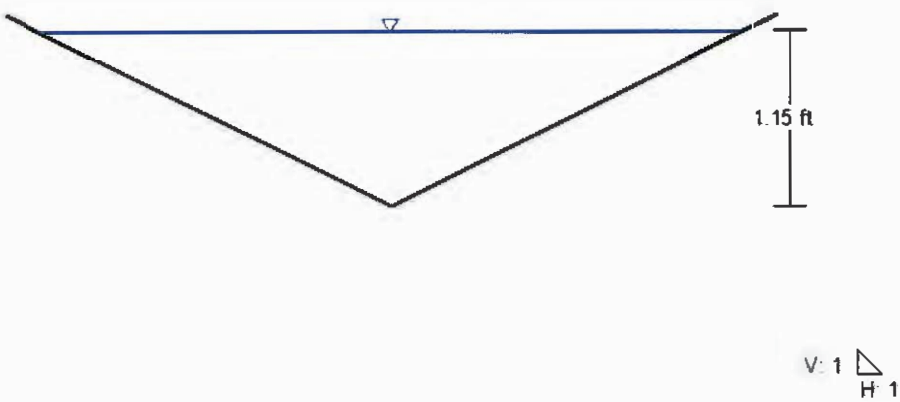
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.12000 | ft/ft |
| Normal Depth | 1.15 | ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 12.70 | $ft^3/s$ |

## Cross Section Image



# Worksheet for CPD14*-CHANNEL-V-DITCH-6"-RIPRAP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.12000 | ft/ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 12.70 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.15 | ft |
| Flow Area | 2.65 | $ft^2$ |
| Wetted Perimeter | 5.15 | ft |
| Hydraulic Radius | 0.51 | ft |
| Top Width | 4.60 | ft |
| Critical Depth | 1.20 | ft |
| Critical Slope | 0.09540 | ft/ft |
| Velocity | 4.79 | ft/s |
| Velocity Head | 0.36 | ft |
| Specific Energy | 1.51 | ft |
| Froude Number | 1.11 | |
| Flow Type | Supercritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.15 | ft |
| Critical Depth | 1.20 | ft |
| Channel Slope | 0.12000 | ft/ft |
| Critical Slope | 0.09540 | ft/ft |

# Cross Section for CPD15-CHANNEL-HALF-CMP

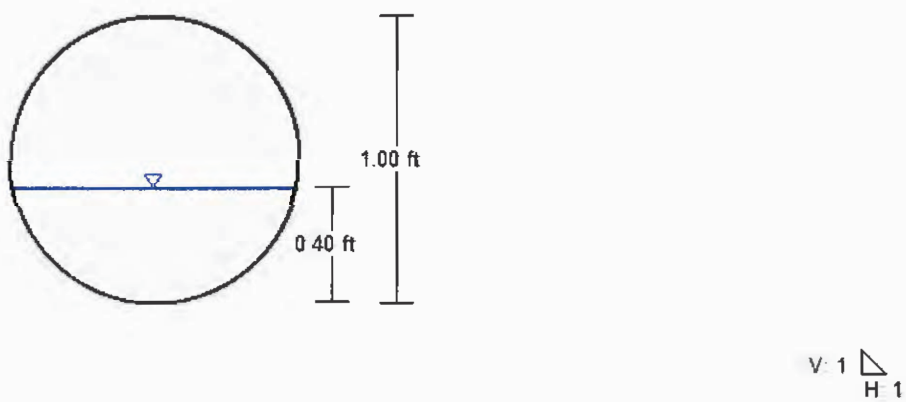
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.09100 | ft/ft |
| Normal Depth | 0.40 | ft |
| Diameter | 1.00 | ft |
| Discharge | 2.00 | $ft^3/s$ |

## Cross Section Image



# Worksheet for CPD15-CHANNEL-HALF-CMP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.09100 | ft/ft |
| Diameter | 1.00 | ft |
| Discharge | 2.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.40 | ft |
| Flow Area | 0.30 | ft² |
| Wetted Perimeter | 1.38 | ft |
| Hydraulic Radius | 0.22 | ft |
| Top Width | 0.98 | ft |
| Critical Depth | 0.60 | ft |
| Percent Full | 40.4 | % |
| Critical Slope | 0.02337 | ft/ft |
| Velocity | 6.72 | ft/s |
| Velocity Head | 0.70 | ft |
| Specific Energy | 1.11 | ft |
| Froude Number | 2.15 | |
| Maximum Discharge | 6.26 | ft³/s |
| Discharge Full | 5.82 | ft³/s |
| Slope Full | 0.01074 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 40.44 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPD15-CHANNEL-HALF-CMP

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.40 | ft |
| Critical Depth | 0.60 | ft |
| Channel Slope | 0.09100 | ft/ft |
| Critical Slope | 0.02337 | ft/ft |

# Cross Section for CPD15-CHANNEL-V-DITCH-6"-RIPRAP

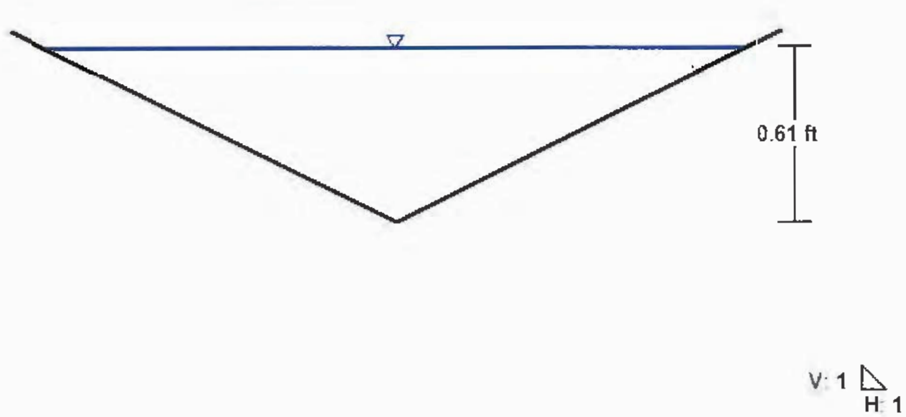
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.09100 | ft/ft |
| Normal Depth | 0.61 | ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 2.00 | $ft^3/s$ |

## Cross Section Image



# Worksheet for CPD15-CHANNEL-V-DITCH-6"-RIPRAP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.09100 | ft/ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 2.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.61 | ft |
| Flow Area | 0.74 | ft² |
| Wetted Perimeter | 2.71 | ft |
| Hydraulic Radius | 0.27 | ft |
| Top Width | 2.43 | ft |
| Critical Depth | 0.57 | ft |
| Critical Slope | 0.12208 | ft/ft |
| Velocity | 2.72 | ft/s |
| Velocity Head | 0.11 | ft |
| Specific Energy | 0.72 | ft |
| Froude Number | 0.87 | |
| Flow Type | Subcritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.61 | ft |
| Critical Depth | 0.57 | ft |
| Channel Slope | 0.09100 | ft/ft |
| Critical Slope | 0.12208 | ft/ft |

# Cross Section for CPD16-CHANNEL-HALF-CMP

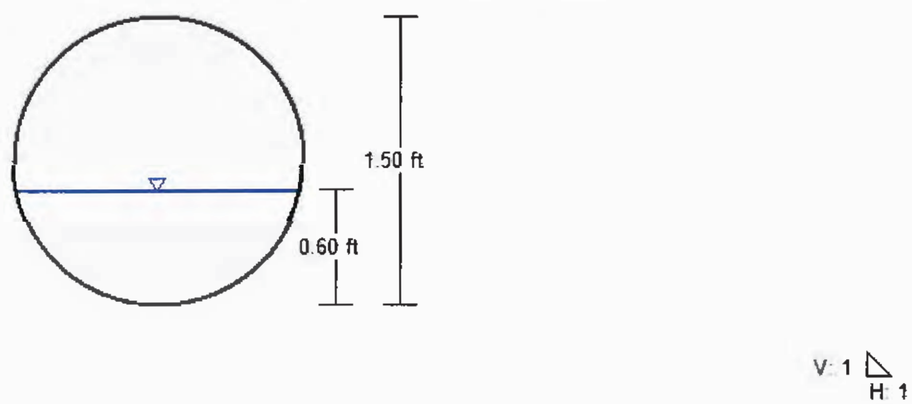
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.07000 | ft/ft |
| Normal Depth | 0.60 | ft |
| Diameter | 1.50 | ft |
| Discharge | 5.00 | $ft^3/s$ |

## Cross Section Image



# Worksheet for CPD16-CHANNEL-HALF-CMP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.07000 | ft/ft |
| Diameter | 1.50 | ft |
| Discharge | 5.00 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.60 | ft |
| Flow Area | 0.65 | $ft^2$ |
| Wetted Perimeter | 2.04 | ft |
| Hydraulic Radius | 0.32 | ft |
| Top Width | 1.47 | ft |
| Critical Depth | 0.86 | ft |
| Percent Full | 39.7 | % |
| Critical Slope | 0.01968 | ft/ft |
| Velocity | 7.66 | ft/s |
| Velocity Head | 0.91 | ft |
| Specific Energy | 1.51 | ft |
| Froude Number | 2.02 | |
| Maximum Discharge | 16.19 | $ft^3/s$ |
| Discharge Full | 15.05 | $ft^3/s$ |
| Slope Full | 0.00772 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 39.69 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPD16-CHANNEL-HALF-CMP

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.60 | ft |
| Critical Depth | 0.86 | ft |
| Channel Slope | 0.07000 | ft/ft |
| Critical Slope | 0.01968 | ft/ft |

# Cross Section for CPD16-CHANNEL-V-DITCH-6"-RIPRAP

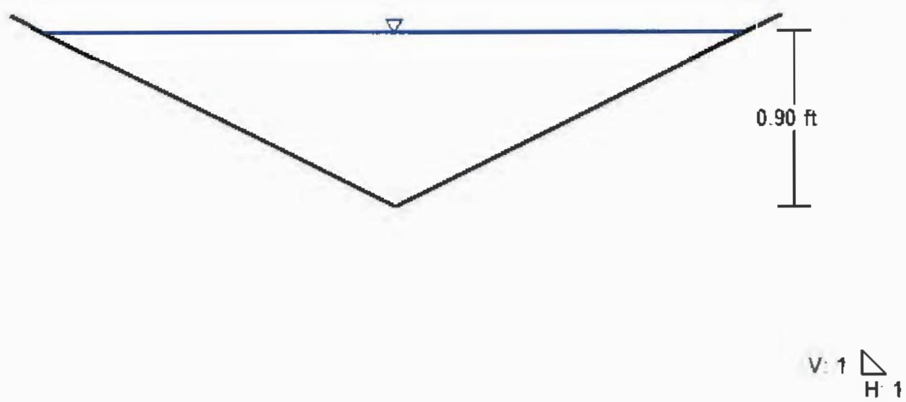
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.07000 | ft/ft |
| Normal Depth | 0.90 | ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 5.00 | ft³/s |

## Cross Section Image



# Worksheet for CPD16-CHANNEL-V-DITCH-6"-RIPRAP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.07000 | ft/ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 5.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.90 | ft |
| Flow Area | 1.61 | ft² |
| Wetted Perimeter | 4.01 | ft |
| Hydraulic Radius | 0.40 | ft |
| Top Width | 3.59 | ft |
| Critical Depth | 0.83 | ft |
| Critical Slope | 0.10802 | ft/ft |
| Velocity | 3.10 | ft/s |
| Velocity Head | 0.15 | ft |
| Specific Energy | 1.05 | ft |
| Froude Number | 0.82 | |
| Flow Type | Subcritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.90 | ft |
| Critical Depth | 0.83 | ft |
| Channel Slope | 0.07000 | ft/ft |
| Critical Slope | 0.10802 | ft/ft |

# Cross Section for CPD17*-CHANNEL-HALF-CMP

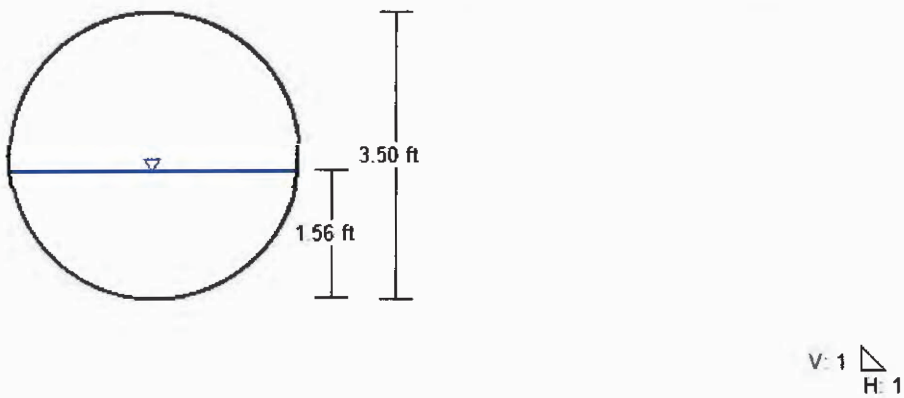
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.09300 | ft/ft |
| Normal Depth | 1.56 | ft |
| Diameter | 3.50 | ft |
| Discharge | 68.30 | ft³/s |

## Cross Section Image



# Worksheet for CPD17*-CHANNEL-HALF-CMP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.09300 | ft/ft |
| Diameter | 3.50 | ft |
| Discharge | 68.30 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.56 | ft |
| Flow Area | 4.16 | $ft^2$ |
| Wetted Perimeter | 5.12 | ft |
| Hydraulic Radius | 0.81 | ft |
| Top Width | 3.48 | ft |
| Critical Depth | 2.59 | ft |
| Percent Full | 44.7 | % |
| Critical Slope | 0.01949 | ft/ft |
| Velocity | 16.43 | ft/s |
| Velocity Head | 4.19 | ft |
| Specific Energy | 5.76 | ft |
| Froude Number | 2.65 | |
| Maximum Discharge | 178.77 | $ft^3/s$ |
| Discharge Full | 166.18 | $ft^3/s$ |
| Slope Full | 0.01571 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 44.66 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPD17*-CHANNEL-HALF-CMP

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.56 | ft |
| Critical Depth | 2.59 | ft |
| Channel Slope | 0.09300 | ft/ft |
| Critical Slope | 0.01949 | ft/ft |

# Cross Section for CPD17*-CHANNEL-V-DITCH-6"-RIPRAP

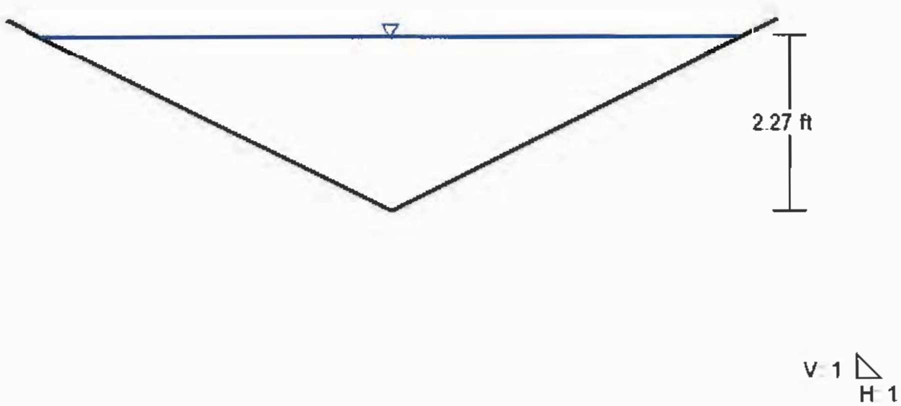
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.09300 | ft/ft |
| Normal Depth | 2.27 | ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 68.30 | ft³/s |

## Cross Section Image



# Worksheet for CPD17*-CHANNEL-V-DITCH-6"-RIPRAP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.09300 | ft/ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 68.30 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 2.27 | ft |
| Flow Area | 10.30 | ft² |
| Wetted Perimeter | 10.15 | ft |
| Hydraulic Radius | 1.01 | ft |
| Top Width | 9.08 | ft |
| Critical Depth | 2.36 | ft |
| Critical Slope | 0.07623 | ft/ft |
| Velocity | 6.63 | ft/s |
| Velocity Head | 0.68 | ft |
| Specific Energy | 2.95 | ft |
| Froude Number | 1.10 | |
| Flow Type | Supercritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 2.27 | ft |
| Critical Depth | 2.36 | ft |
| Channel Slope | 0.09300 | ft/ft |
| Critical Slope | 0.07623 | ft/ft |

# Cross Section for CPD18*-CHANNEL-HALF-CMP

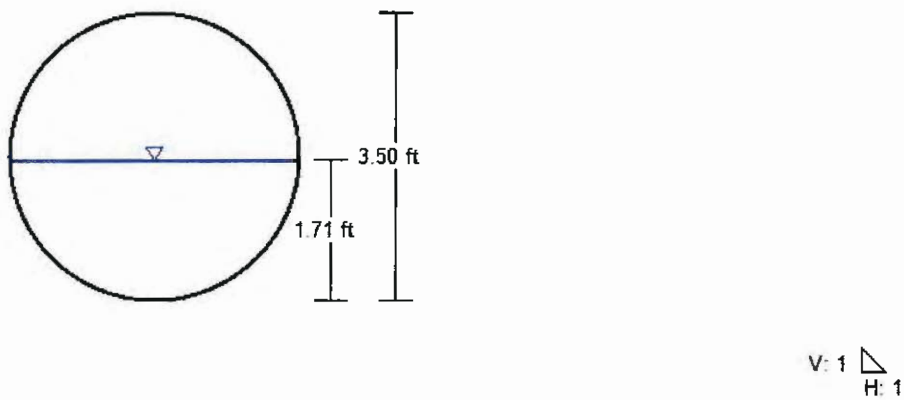
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.09100 | ft/ft |
| Normal Depth | 1.71 | ft |
| Diameter | 3.50 | ft |
| Discharge | 79.00 | ft³/s |

## Cross Section Image



# Worksheet for CPD18*-CHANNEL-HALF-CMP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.09100 | ft/ft |
| Diameter | 3.50 | ft |
| Discharge | 79.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.71 | ft |
| Flow Area | 4.67 | ft² |
| Wetted Perimeter | 5.42 | ft |
| Hydraulic Radius | 0.86 | ft |
| Top Width | 3.50 | ft |
| Critical Depth | 2.78 | ft |
| Percent Full | 48.9 | % |
| Critical Slope | 0.02234 | ft/ft |
| Velocity | 16.92 | ft/s |
| Velocity Head | 4.45 | ft |
| Specific Energy | 6.16 | ft |
| Froude Number | 2.58 | |
| Maximum Discharge | 176.83 | ft³/s |
| Discharge Full | 164.39 | ft³/s |
| Slope Full | 0.02102 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 48.85 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPD18*-CHANNEL-HALF-CMP

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.71 | ft |
| Critical Depth | 2.78 | ft |
| Channel Slope | 0.09100 | ft/ft |
| Critical Slope | 0.02234 | ft/ft |

# Cross Section for CPD18*-CHANNEL-V-DITCH-6"-RIPRAP

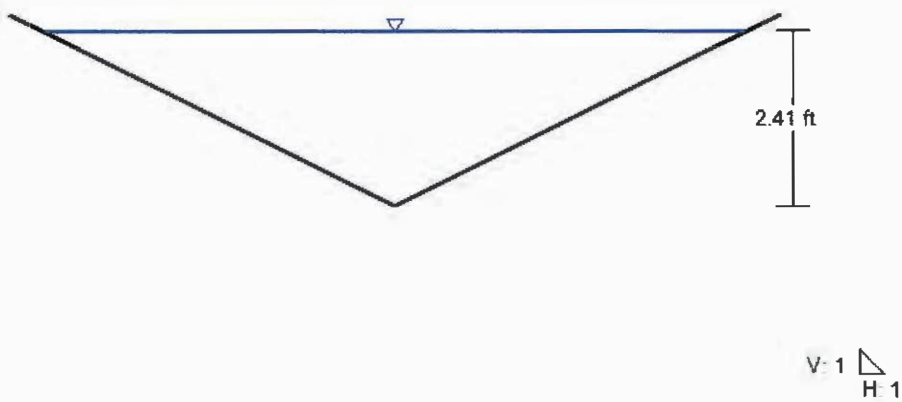
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.09100 | ft/ft |
| Normal Depth | 2.41 | ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 79.00 | ft³/s |

## Cross Section Image



# Worksheet for CPD18*-CHANNEL-V-DITCH-6"-RIPRAP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.09100 | ft/ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 79.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 2.41 | ft |
| Flow Area | 11.58 | ft² |
| Wetted Perimeter | 10.76 | ft |
| Hydraulic Radius | 1.08 | ft |
| Top Width | 9.63 | ft |
| Critical Depth | 2.50 | ft |
| Critical Slope | 0.07477 | ft/ft |
| Velocity | 6.82 | ft/s |
| Velocity Head | 0.72 | ft |
| Specific Energy | 3.13 | ft |
| Froude Number | 1.10 | |
| Flow Type | Supercritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 2.41 | ft |
| Critical Depth | 2.50 | ft |
| Channel Slope | 0.09100 | ft/ft |
| Critical Slope | 0.07477 | ft/ft |

# Cross Section for CPD19*-CHANNEL-HALF-CMP

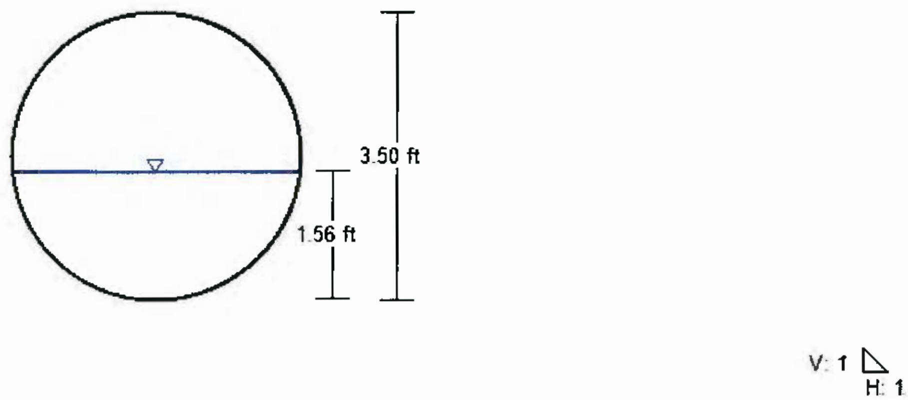
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.12600 | ft/ft |
| Normal Depth | 1.56 | ft |
| Diameter | 3.50 | ft |
| Discharge | 79.20 | ft³/s |

## Cross Section Image



# Worksheet for CPD19*-CHANNEL-HALF-CMP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.12600 | ft/ft |
| Diameter | 3.50 | ft |
| Discharge | 79.20 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.56 | ft |
| Flow Area | 4.15 | ft² |
| Wetted Perimeter | 5.12 | ft |
| Hydraulic Radius | 0.81 | ft |
| Top Width | 3.48 | ft |
| Critical Depth | 2.78 | ft |
| Percent Full | 44.6 | % |
| Critical Slope | 0.02240 | ft/ft |
| Velocity | 19.10 | ft/s |
| Velocity Head | 5.67 | ft |
| Specific Energy | 7.23 | ft |
| Froude Number | 3.08 | |
| Maximum Discharge | 208.08 | ft³/s |
| Discharge Full | 193.43 | ft³/s |
| Slope Full | 0.02112 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 44.57 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPD19*-CHANNEL-HALF-CMP

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.56 | ft |
| Critical Depth | 2.78 | ft |
| Channel Slope | 0.12600 | ft/ft |
| Critical Slope | 0.02240 | ft/ft |

# Cross Section for CPD19*-CHANNEL-V-DITCH-6"-RIPRAP

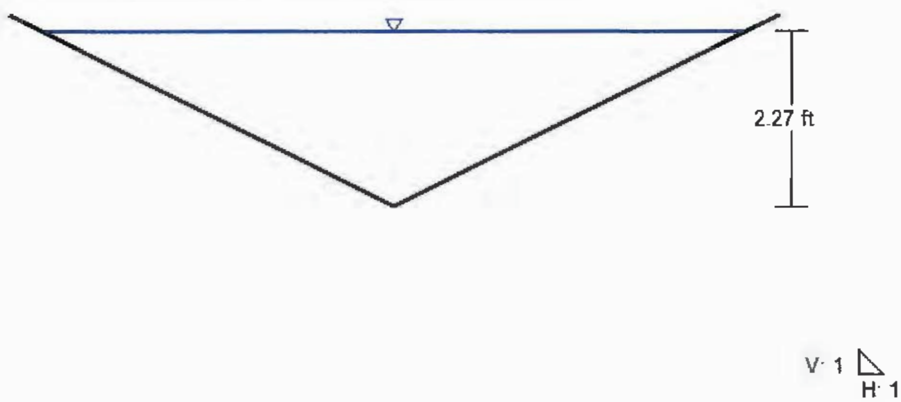
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.12600 | ft/ft |
| Normal Depth | 2.27 | ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 79.20 | $ft^3/s$ |

## Cross Section Image



# Worksheet for CPD19*-CHANNEL-V-DITCH-6"-RIPRAP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.12600 | ft/ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 79.20 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 2.27 | ft |
| Flow Area | 10.27 | ft² |
| Wetted Perimeter | 10.13 | ft |
| Hydraulic Radius | 1.01 | ft |
| Top Width | 9.06 | ft |
| Critical Depth | 2.50 | ft |
| Critical Slope | 0.07474 | ft/ft |
| Velocity | 7.71 | ft/s |
| Velocity Head | 0.92 | ft |
| Specific Energy | 3.19 | ft |
| Froude Number | 1.28 | |
| Flow Type | Supercritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 2.27 | ft |
| Critical Depth | 2.50 | ft |
| Channel Slope | 0.12600 | ft/ft |
| Critical Slope | 0.07474 | ft/ft |

# Cross Section for CPD20-CHANNEL-HALF-CMP

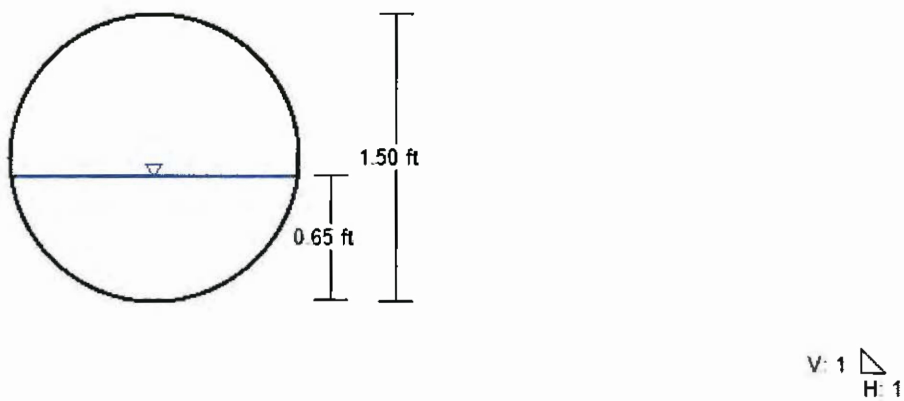
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.06600 | ft/ft |
| Normal Depth | 0.65 | ft |
| Diameter | 1.50 | ft |
| Discharge | 5.70 | $ft^3/s$ |

## Cross Section Image



# Worksheet for CPD20-CHANNEL-HALF-CMP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.06600 | ft/ft |
| Diameter | 1.50 | ft |
| Discharge | 5.70 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.65 | ft |
| Flow Area | 0.73 | $ft^2$ |
| Wetted Perimeter | 2.16 | ft |
| Hydraulic Radius | 0.34 | ft |
| Top Width | 1.49 | ft |
| Critical Depth | 0.92 | ft |
| Percent Full | 43.4 | % |
| Critical Slope | 0.02071 | ft/ft |
| Velocity | 7.76 | ft/s |
| Velocity Head | 0.93 | ft |
| Specific Energy | 1.59 | ft |
| Froude Number | 1.94 | |
| Maximum Discharge | 15.72 | $ft^3/s$ |
| Discharge Full | 14.62 | $ft^3/s$ |
| Slope Full | 0.01004 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 43.37 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for CPD20-CHANNEL-HALF-CMP

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.65 | ft |
| Critical Depth | 0.92 | ft |
| Channel Slope | 0.06600 | ft/ft |
| Critical Slope | 0.02071 | ft/ft |

# Cross Section for CPD20-CHANNEL-V-DITCH-6"-RIPRAP

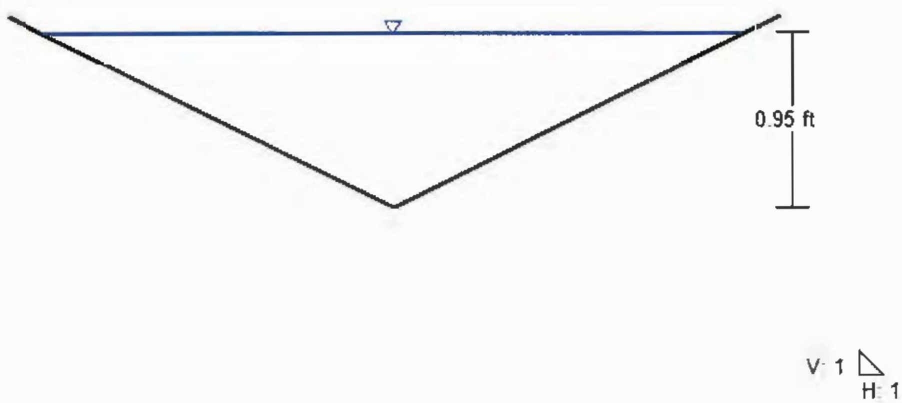
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.06600 | ft/ft |
| Normal Depth | 0.95 | ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 5.70 | ft³/s |

## Cross Section Image



# Worksheet for CPD20-CHANNEL-V-DITCH-6"-RIPRAP

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.069 | |
| Channel Slope | 0.06600 | ft/ft |
| Left Side Slope | 2.00 | ft/ft (H:V) |
| Right Side Slope | 2.00 | ft/ft (H:V) |
| Discharge | 5.70 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.95 | ft |
| Flow Area | 1.82 | ft² |
| Wetted Perimeter | 4.26 | ft |
| Hydraulic Radius | 0.43 | ft |
| Top Width | 3.81 | ft |
| Critical Depth | 0.87 | ft |
| Critical Slope | 0.10615 | ft/ft |
| Velocity | 3.14 | ft/s |
| Velocity Head | 0.15 | ft |
| Specific Energy | 1.11 | ft |
| Froude Number | 0.80 | |
| Flow Type | Subcritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.95 | ft |
| Critical Depth | 0.87 | ft |
| Channel Slope | 0.06600 | ft/ft |
| Critical Slope | 0.10615 | ft/ft |

# APPENDIX 7-D
# RETENTION BASIN CALCULATIONS

**PICKLES BUTTE LANDFILL**
**STORMWATER RETENTION ANALYSIS**

**Contributing Drainage Areas:** BASIN A (CPA7*) - 25-YEAR, 24-HOUR STORM EVENT
**Retention Basin(s):** BASIN A

**VOLUME REQUIRED CALCULATIONS**

| Type | Area ($ft^2$) | Area (Ac) | 'C' Coefficient C | Precipitation (Inches) | Retention Required ($ft^3$) | Retention Required (Ac-ft) |
|---|---|---|---|---|---|---|
| Landscaped | 905,233 | 20.78 | 0.70 | 1.80 | 95,049 | 2.18 |
| Total | 905,233 | 20.78 | | | **95,049** | **2.18** |

**RETENTION BASIN CALCULATIONS**

| Elevation | Delta Depth (ft) | Surface Area ($ft^2$) | | Volume Provided ($ft^3$) | Σ ($ft^3$) | (Ac-ft) | Σ (Ac-ft) |
|---|---|---|---|---|---|---|---|
| 2904.0 | 4.0 | 30,814 | | 102,082 | 102,082 | 2.34 | 2.34 |
| 2900.0 | | 20,571 | | | *102,082* | | *2.34* |
| | | | *Provided* | | 102,082 | | 2.34 |
| | | | *Required* | | 95,049 | | 2.18 |
| *Basin HWE* | *Basin Depth* | | *Balance* | | **7,033** | | **0.16** |
| 2903.72 | 3.72 | | | | | | |

**Contributing Drainage Areas:** BASIN B (CPB1) - 25-YEAR, 24-HOUR STORM EVENT
**Retention Basin(s):** BASIN B

**VOLUME REQUIRED CALCULATIONS**

| Type | Area ($ft^2$) | Area (Ac) | 'C' Coefficient C | Precipitation (Inches) | Retention Required ($ft^3$) | Retention Required (Ac-ft) |
|---|---|---|---|---|---|---|
| Landscaped | 258,732 | 5.94 | 0.70 | 1.80 | 27,167 | 0.62 |
| Total | 258,732 | 5.94 | | | **27,167** | **0.62** |

**RETENTION BASIN CALCULATIONS**

| Elevation | Delta Depth (ft) | Surface Area ($ft^2$) | | Volume Provided ($ft^3$) | Σ ($ft^3$) | (Ac-ft) | Σ (Ac-ft) |
|---|---|---|---|---|---|---|---|
| 2912.0 | 2.0 | 21,119 | | 37,745 | 37,745 | 0.87 | 0.87 |
| 2910.0 | | 16,712 | | | *37,745* | | *0.87* |
| | | | *Provided* | | 37,745 | | 0.87 |
| | | | *Required* | | 27,167 | | 0.62 |
| *Basin HWE* | *Basin Depth* | | *Balance* | | **10,578** | | **0.25** |
| 2911.44 | 1.44 | | | | | | |

## PICKLES BUTTE LANDFILL
## STORMWATER RETENTION ANALYSIS

**Contributing Drainage Areas:** BASIN C (CPC1) - 25-YEAR, 24-HOUR STORM EVENT
**Retention Basin(s):** BASIN C

**VOLUME REQUIRED CALCULATIONS**

| Type | Area ($ft^2$) | Area (Ac) | 'C' Coefficient C | Precipitation (Inches) | Retention Required ($ft^3$) | Retention Required (Ac-ft) |
|---|---|---|---|---|---|---|
| Landscaped | 81,064 | 1.86 | 0.70 | 1.80 | 8,512 | 0.20 |
| Total | 81,064 | 1.86 | | | **8,512** | **0.20** |

**RETENTION BASIN CALCULATIONS**

| Elevation | Delta Depth (ft) | Surface Area ($ft^2$) | | Volume Provided ($ft^3$) | Σ ($ft^3$) | (Ac-ft) | Σ (Ac-ft) |
|---|---|---|---|---|---|---|---|
| 2922.0 | 2.0 | 5,692 | | 8,681 | 8,681 | 0.20 | 0.20 |
| 2920.0 | | 3,117 | | | *8,681* | | *0.20* |
| | | | *Provided* | | 8,681 | | 0.20 |
| | | | *Required* | | 8,512 | | 0.20 |
| *Basin HWE* | *Basin Depth* | | *Balance* | | **169** | | **0.00** |
| 2921.96 | 1.96 | | | | | | |

**Contributing Drainage Areas:** BASIN D (CPD21*) - 25-YEAR, 24-HOUR STORM EVENT
**Retention Basin(s):** BASIN D

**VOLUME REQUIRED CALCULATIONS**

| Type | Area ($ft^2$) | Area (Ac) | 'C' Coefficient C | Precipitation (Inches) | Retention Required ($ft^3$) | Retention Required (Ac-ft) |
|---|---|---|---|---|---|---|
| Landscaped | 4,990,573 | 114.57 | 0.70 | 1.80 | 524,010 | 12.03 |
| Total | 4,990,573 | 114.57 | | | **524,010** | **12.03** |

**RETENTION BASIN CALCULATIONS**

| Elevation | Delta Depth (ft) | Surface Area ($ft^2$) | | Volume Provided ($ft^3$) | Σ ($ft^3$) | (Ac-ft) | Σ (Ac-ft) |
|---|---|---|---|---|---|---|---|
| 2690.0 | 16.0 | 65,448 | | 574,884 | 574,884 | 13.20 | 13.20 |
| 2674.0 | | 13,082 | | | *574,884* | | *13.20* |
| | | | *Provided* | | 574,884 | | 13.20 |
| | | | *Required* | | 524,010 | | 12.03 |
| *Basin HWE* | *Basin Depth* | | *Balance* | | **50,874** | | **1.17** |
| 2688.58 | 14.58 | | | | | | |

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